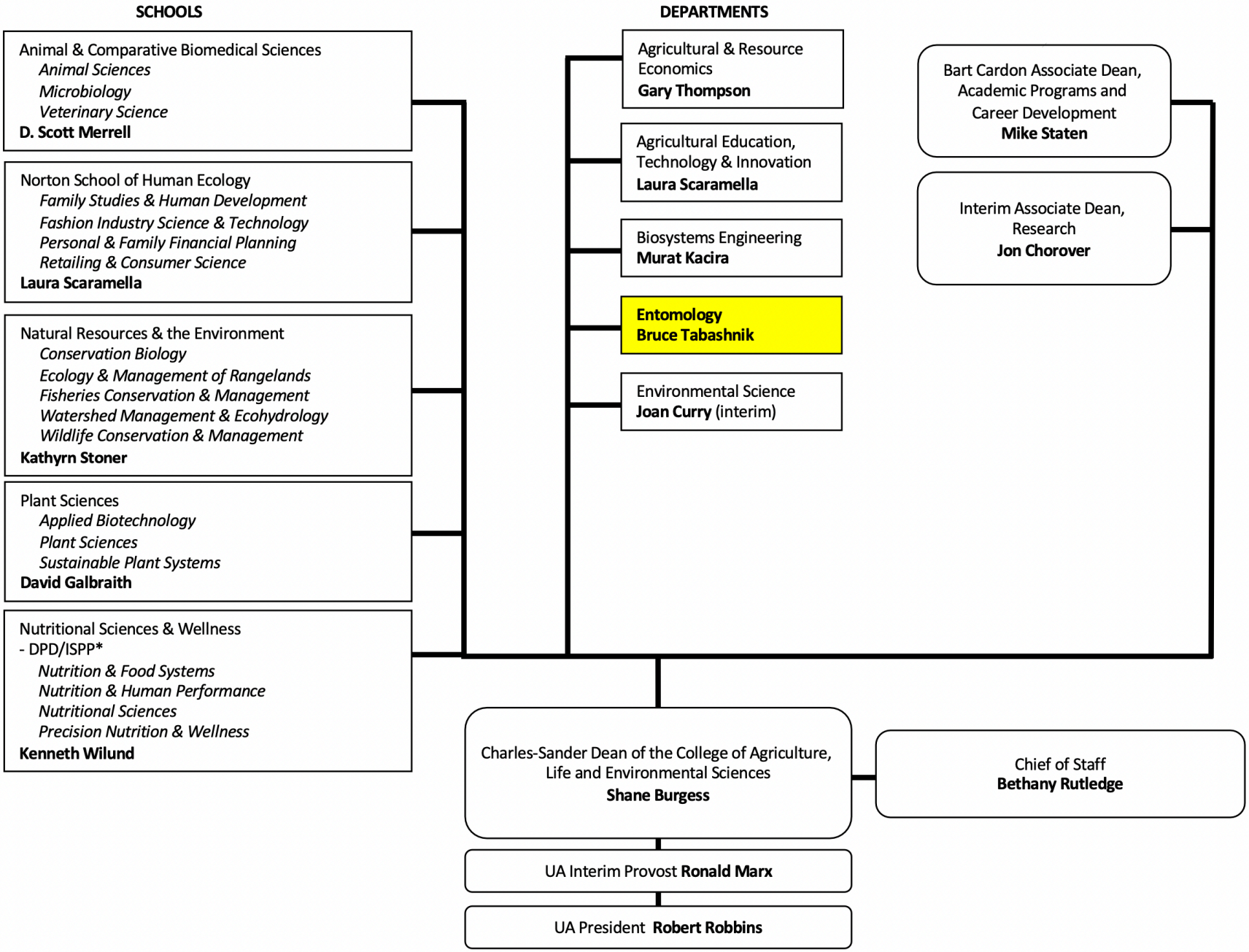
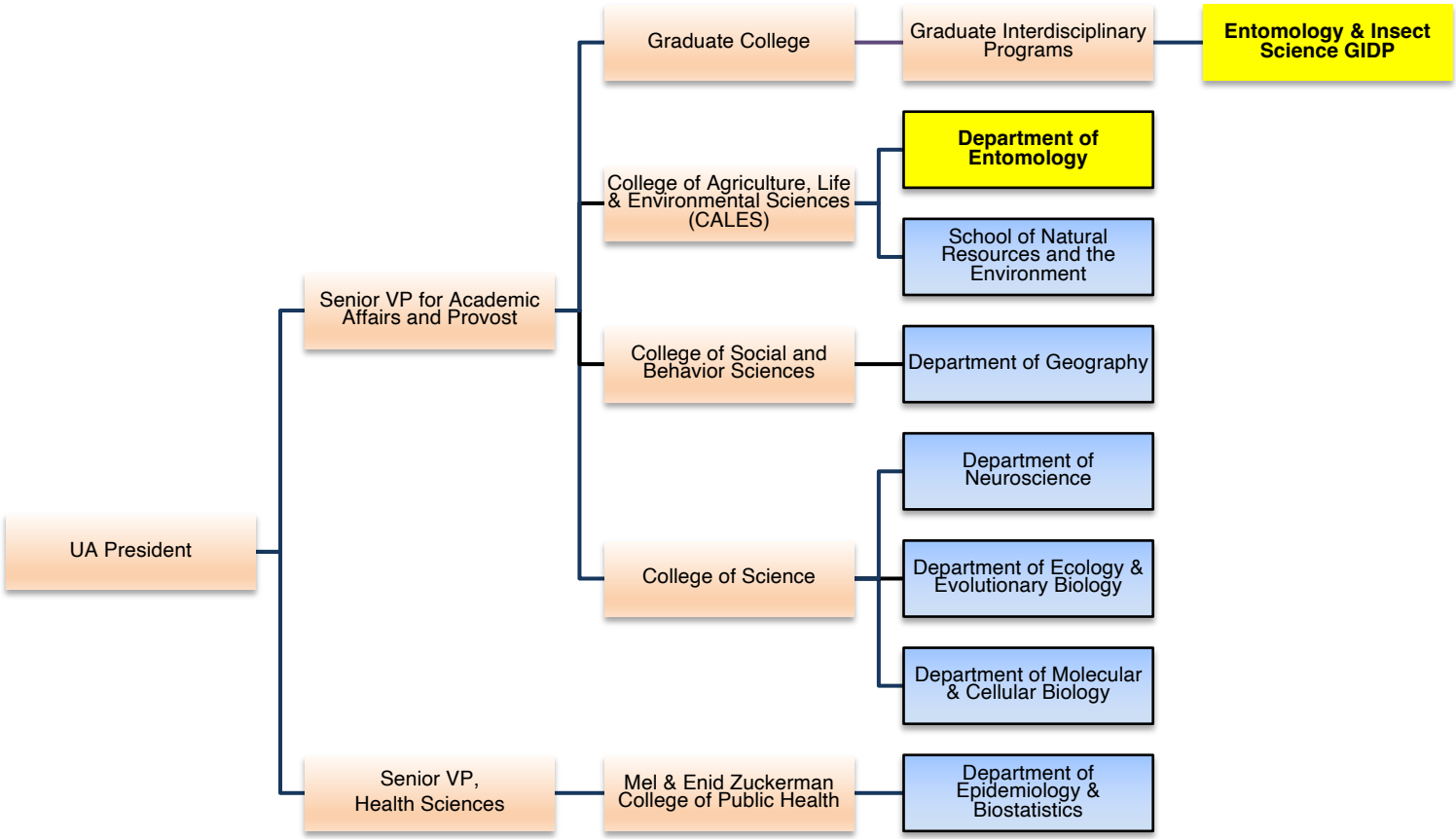
updated 8/9/2023

Appendix A1
The University of Arizona
COLLEGE OF AGRICULTURE, LIFE and ENVIRONMENTAL SCIENCES
(Morrill Act, 1862)





Appendix A2. University of Arizona Organization Chart Highlighting the Entomology & Insect Science GIDP and the Department of Entomology. The seven units with active EIS member faculty are outlined in black.

Appendix B1.

ENTOMOLOGY 2025 STRATEGIC PLAN

October 30, 2019

Purpose

Improve the quality of life of the people of Arizona and the world by generating, disseminating, and applying information about insects.

2025 Vision (each component below is reflected in a specific strategic goal)

1. The quality and impact of our research will be recognized in Arizona, nationally & globally.
2. Our IPM programs will be implemented in Arizona and other regions worldwide and will promote better health, protect the environment, and boost the economy.
3. We will engage undergraduate students with active-learning courses and mentoring to help them succeed in the fourth industrial revolution (4IR).
4. The graduate program in Entomology & Insect Science (EIS) will attract the best students; students completing EIS degrees will be in high demand by employers.
5. Our outreach programs will educate, delight, and connect community members with Entomology, CALS, and the University of Arizona.
6. The UA Insect Collection will be the best source of specimens from the Sonoran Desert Region and a global center for specimen-based insect research.
7. Our programs will be well supported by private donors, as well as by governmental agencies.

Mission

- Conduct outstanding research to better understand insects and their impact on humanity
- Provide distinguished education in insect biology
- Provide innovative solutions to address critical issues such as food security and vector-borne diseases
- Develop and deploy the most advanced technologies and progressive IPM programs in the world to minimize the negative impacts of insects and maximize their positive impacts
- Provide outstanding outreach programs about insects accessible to all community members

Shared Values

- Respect for all people
- Collaboration among department members
- Collaboration within & across disciplines with others in CALS, UA, and other institutions
- Put knowledge to work to improve lives
- Serve our profession and the people of Arizona and the world
- Excellence in all pursuits
- Passion for achieving positive outcomes
- Work hard and have fun doing what we love to do
- Provide value for resources invested in Entomology
- Develop programs with local and global relevance
- Take advantage of our desert environment & position in the front line of climate change

1. RESEARCH STRATEGIC GOAL: Increase Entomology research productivity 30% by 2025.

A. Current situation and gap between current and desired situation

Outstanding, cutting-edge research is our hallmark and the core strength that underlies excellence in our instruction, Extension and outreach. We aim to capitalize on this core strength to increase Entomology research productivity 30% by 2025. Our internationally recognized research must rise to meet the challenges of climate change and a rapidly increasing human population. These challenges demand innovative interdisciplinary research to lead the way in combating crop pests, biomedical pests, invasive species, and the decline in biodiversity.

B. Strategies to achieve goal

1. Target critical global issues with research led by our faculty and their collaborators
2. Retain current faculty who have outstanding research productivity
3. Recruit new faculty with outstanding research productivity
4. Increase research productivity of current faculty
5. Enhance collaborations in the Dept. and with others (UA, national, and international)
6. Strengthen research infrastructure including support staff and facilities

C. Actions **Time Period (Fiscal Years)**

- Continue building interdisciplinary teams to address global challenges 2020-25
- Reward faculty achievement with merit raises and promotions..... 2020-25
- Nominate faculty for awards to recognize their outstanding achievements 2020-25
- Enhance mentoring of faculty by head and outstanding peers..... 2020-25
- Encourage and reward productive team efforts 2020-25
- Recruit faculty in areas with strong extramural funding prospects: mitigating .. 2020-25
  effects of climate change on biodiversity, pollinators, and food security;
  invasive species; insect genomics and bioinformatics;
  and insects of biomedical importance.
- Obtain more funding from international sources 2020-25

D. Inputs needed to achieve the goal

- 6 tenure-track faculty lines (0.80 FTE research, 0.20 teaching): $510K salary per year + ERE; startup of $1.8M
- Research support staff: 12 FTE, $480K salary per year + ERE
- Repair or replace shared research equipment: $20K per year

E. Objective metrics that will be used to track progress towards attaining goal

- Extramural research funding per faculty research FTE per year
- Publications listed in Web of Science per faculty research FTE per year
- Citations per departmental publication in Web of Science
- Faculty honors and awards

Note: We expect 4-5 current tenure-track faculty will leave the department by 2024. Thus, filling the 6 requested faculty lines would slightly increase the number of tenure-track faculty.

2. IPM STRATEGIC GOAL: By FY25, greatly enhance effectiveness of Integrated Pest Management (IPM) research, education, and Extension programs in Arizona for teaching students and stakeholders, and for addressing health, environmental, and economic problems caused by pests.

A. Current situation:

- Cooperative Extension and research programs in IPM have garnered national and international recognition for their development and deployment of new strategies with large impacts on the economy, environmental protection, & society (e.g., > $500 million saved since 1996 in Arizona alone).
- Key IPM faculty have left in the past decade (Dennehy, Byrne, Baker) and 2-4 of the remaining five Extension faculty are likely to leave by 2025.
- An internationally recognized graduate IDP in Entomology & Insect Science, with undergrads and graduate students actively engaged in fully integrated research/Extension programs giving them practical experience addressing real-world challenges.
- Capacity to create a premier U.S. center for IPM research, education, and Extension is incomplete, but would attract major funding, the best scientists, science, and students of IPM, and would generate solutions to society's pressing needs for safe and secure food, fiber, and healthy environments.

Desired situation:

- A world-class student-centered graduate and undergraduate IPM educational program (IDP) that capitalizes on the high profile research and Extension programs currently in place.
- Stable funding for students engaged in interdisciplinary problem-solving programs.
- An interdisciplinary synergistic approach that enables a fully collaborative environment across unit boundaries and enhances our effectiveness at winning major grants and having major impacts.
- Establish the UA as a premier center for IPM research, education, and Extension that impacts the future of the science and its application and implementation, and supplies the workforce needed to educate a generation of students that will face daunting food security, safety, and environmental challenges posed by pests and pest-related risks.

Gaps:

- New IPM teaching personnel are needed to develop the interdisciplinary curriculum that provides the third leg of our integrated research, education, and Extension IPM center.
- Investments have been made to establish cooperative teams including numerous units from within and external to CALS that work collaboratively with broad national networks, but the human assets employed to coordinate and link multiple groups across the state are funded solely by grants and contracts, thus program stability is constantly under threat.
- New IPM research and Extension personnel to fuel innovation in science and implementation.

B. Strategies to achieve goal

1. Recruit and retain outstanding faculty, other appointed personnel & classified staff in IPM.
2. Create a fertile environment for the development of translational sciences needed to support IPM.
3. Leverage resources from gifts/grants/contracts to support staffing needs (50% share of each).
4. Partner with allied colleges (e.g., Public Health, Pharmacy, Medicine, etc.), departments and units with similar interests to develop an IPM curriculum and to forge strong interdisciplinary relationships in research and Extension (Entomology (lead), Biosystems Engineering, Agricultural & Resource Economics, School of Natural Resources & the Environment, Plant Sciences,

Environmental Science, Experiment Station (MAC, YAC, SAC, CAC), County, and statewide Tribal Cooperative Extension Offices).

5. Develop courses (Gen Ed IPM, Advanced Topics in IPM, structural IPM, Medical & Veterinary IPM).
6. Establish new Extension IPM programs to meet stakeholder needs (e.g., Greenhouse, Small Farms, Commercial Horticultural IPM).
7. Establish stable funding for graduate student Extension assistantships & undergraduate research & Extension internships.

C. Actions **Time Period (Fiscal Years)**

Secure 50% CALS/State funding of salary + ERE for highly productive appointed personnel who are now 100% grant funded ……2021-25
Hire IPM faculty (80% research:20% teaching) & 1 research specialist..... 2021
Offer 100 level IPM Gen Ed course 2021
Offer specialized 400/500 level IPM courses (e.g., Biocontrol, Urban IPM)……2022
Hire IPM faculty (80% Extension:20% teaching) & 1 research specialist..... 2022
Establish three IPM RA/TAships..... 2022
Hire IPM faculty (80% Extension:20% research) & 0.5 Extension educator 2023
Establish two IPM Extension Assistantships 2021
Hire IPM faculty (80% Extension:20% research) & 0.5 Assistant in Extension 2024

D. Inputs needed to achieve the goal

- Research/teaching faculty in IPM (2; $170K salary per year + ERE)
- Classified staff (2 @ 3 years each; $390K total)
- Graduate assistantships (2 RA/TAs; $50K/yr)
- Cross unit agreements to mentor students
- Extension/research faculty in IPM (2; $170K salary per year + ERE)
- Assistant/Associate in Extension (appointed, 4 @ 0.5 FTE; $130K salary per yr + ERE)
- Extension assistantships (2 Ext. Asst.; $50K/yr)
- Undergrad summer internships (2@ 0.5; $4K/yr)
- One-time startup cost for 4 IPM faculty $800K

E. Objective metrics that will be used to track progress towards attaining goal

- Number of IPM undergraduate and graduate students recruited to & graduated from IDP programs
- Number and amounts of grants awarded to IPM faculty
- Number and % of IPM graduates placed in career-track positions (near 100%)
- Number of professional continuing education units offered (CEUs) and delivered (No. of participants)
- Economic and social impacts of our IPM programs ($ saved, pesticide use reductions)
- Increased security and safety of food and fiber supply produced in Arizona
- Number of peer-reviewed publications created each year
- Number of awards and honors received by IPM faculty
- Successful and continuing leverage of staff resources (classified staff > 3yrs; 2@0.5 Extension educators)
- Interest in and extramural support for fellowships, internships, assistantships, and endowments

Notes

The investment in human capital is a ca. $500K per year with one time costs of another $390K in staff support. Leveraged returns on this investment will easily be 3-fold & costs mostly offset by IDC returns to University [average annual grants (realistic, initially): $250K/yr/faculty or $1M/yr; average IDC rate %30 or $300K/yr; (ideally and over time) $3M/yr total with ca. $1M/yr in IDC].

- Federal re-organization of IPM funding under a consolidated "Crop Protection" line of the USDA will increase visibility and funding for this vital program, and increase and standardize IDC to 30% equivalent to an effective rate of 42.65% of TDC (from previous 0–22% depending on sub-program).
- USDA's National Institute for Food and Agriculture (NIFA) has created the Agriculture and Food Research Initiative (AFRI) competitive grants program that now rewards large, collaborative, team-based, and integrated (research, education, Extension) projects. Many awards are in the millions of dollars and at least 30% of funds from this program will be allocated to the Extension components. IPM, as a practical science that can fully articulate with Extension implementation programs, will have many new opportunities for funding through this program. A premiere IPM center for research, education, and Extension at UA would be ideally positioned to capture major resources from this program. Current IDC cap at 30% for this program, but many believe that future authorizations of this program will increase this cap in the future. http://www.csrees.usda.gov/business/awards/indirect_cost.html

3. UNDERGRADUATE ENGAGEMENT STRATEGIC GOAL: Increase the yearly undergraduate student credit hours taught 30% by FY2025.

A. Current situation and gap between current situation and desired situation

The Department of Entomology more than doubled the yearly undergraduate student credit hours (SCH) it teaches during the past decade, but would like to do more to provide students with a common foundation of competencies and skills to help them succeed in the 4IR. Accordingly, we aim to increase SCH taught 25% by FY2022. We have increased the number of undergraduate students mentored by faculty in our research labs, which strengthens the students' critical thinking skills, engages them in cutting edge research, and makes them more employable. Because of the exceptional benefits of this mentoring, we also seek to expand our impact in this area.

B. Strategies to achieve goal

1. Increase the percentage of undergraduate courses taught through active learning to 60% by FY2021 and 75% by FY2022.
2. Increase faculty mentoring of undergraduate students in Entomology laboratories
3. Implement a certificate program in Entomology
4. Develop a minor in Entomology

C. Actions **Time Period (Fiscal Years)**

- Support faculty to incorporate active learning in their courses..... 2020-25
- Appoint a departmental coordinator for undergraduate research…… 2020-21
- Revise certificate program proposal (if needed) after receiving UA feedback….2020-21
- Produce and submit proposal for minor in Entomology……..2020-21
- Reward faculty for undergraduate teaching and mentoring……..2020-25

D. Inputs needed to achieve the goal

- Faculty effort in incorporating active learning in their courses
- Faculty effort in mentoring students in their laboratories
- Approval by UA of the certificate proposal we submitted in 2016, with potential revisions by faculty to meet new guidelines, if needed

E. Objective metrics that will be used to track progress towards attaining goal

- Undergraduate SCH taught per academic year
- Percentage of undergraduate courses taught through active learning
- Number of undergraduate students mentored by faculty per year in Entomology laboratories
- Presentations by undergraduate students at scientific meetings
- Awards won by undergraduate students
- Journal articles coauthored by undergraduate students

4. GRADUATE PROGRAM STRATEGIC GOAL: Double the stable funding for Entomology & Insect Science (EIS) graduate students by FY25.

A. Current situation and gap between current situation and desired situation

The Graduate Interdisciplinary Program in Entomology & Insect Science (EIS) is nationally recognized as excellent and attracts outstanding students. In the past 15 years, 94% of students completing MS or PhD degrees in our graduate programs (EIS and its previously separate parent programs Entomology and Insect Science) obtained positions related to their graduate training. Enrollment in EIS has remained stable at ~30 students, with the largest single year intake (10) in AY19-20. Yet, funding for students is unpredictable, which threatens future recruiting and the long-term success of the program. Although faculty grants support some students, the largest single funding source now is via TAs for undergrad courses that we do not control (i.e., Introductory Biology courses in the College of Science). We are grateful for CALS support for GAs, but this has declined in the past few years from about 3 to 1 GA per year. In recent years, larger enrollment classes taught by our faculty have modestly increased our CALS funded TAs. To attain the desired situation of a standing enrollment of 30 or more fully funded EIS students, we aim to double funding from stable sources.

B. Strategies to achieve goal

1. Increase support of RAs via increased faculty research grants (see Research Goal)
2. Improve online interface with potential students and the general public
3. Build enrollment in frequently taught general education courses to earn TA support according to the CALS formula (each 60 students = 0.25 TA).
4. Solicit donors for endowments for student-invited speakership (Hagedorn) and student cash award to honor Genevieve Comeau (in progress)
5. Build support for first and second year students to apply for outside graduate fellowships (NSF, NIH, USDA)
6. Shift recruiting strategy to prioritize PhD over MS students to align with the new CALS first year funding formula providing 0.5 GA per 3-year rolling average number of first year PhD students (and none for MS students).

C. Actions **Time Period (Fiscal Years)**

- Increase donor base and obtain donations for supporting students 2020-25
- Develop the spring EIS seminar as a short research proposal writing seminar 2020-21
- Increase enrollment in frequently taught general education courses to earn TA support according to the CALS formula (each 60 students = 0.25 TA)……2020-25

D. Inputs needed to achieve the goal

- Faculty effort in increasing extramural grant funding with support for RAs
- Faculty effort in recruiting and mentoring EIS PhD students
- Efforts of department members and Advisory Board to develop donor base for student endowments: Attractive brochures, displays for Insect Festival, and websites
- Faculty teaching effort in large undergraduate courses
- CALS/UA increase in funding per year for GAs from current $27K to $66K
- CALS/UA support of TAs for 4 large undergrad courses, $60K per year

E. Objective metrics that will be used to track progress towards attaining goal

- Funding of EIS students from faculty research grants, CALS RA and TA support and endowments
- Fully funded EIS students (total number and %)
- EIS degrees granted per year
- Increased proportion of EIS PhD students enrolled per year
- Papers published by EIS students
- Presentations by EIS students at scientific meetings
- Awards won by EIS students
- Job placement of EIS graduates

- **Note:** Core and joint Entomology faculty are the major advisors for nearly all EIS students.

5. OUTREACH STRATEGIC GOAL: Double the number of people served each year by FY25 through sustainable outreach programs to meet public demand for insect information, to support K-12 science education, and to connect underserved communities to UA Entomology and CALS.

A. Current situation and gap between current situation and desired situation

We deliver outreach via 3 main programs: Insect Discovery, the Arizona Insect Festival, and the UA Insect Collection (UAIC). Insect Discovery serves ca. 2,000 K-8 students yearly and teaches ca. 25 UA undergraduate and graduate students how to communicate science to the public. More than half of the students served are from low-income and minority communities. Since the first Arizona Insect Festival in 2011, this festival has grown to an annual event attracting over 3,000 visitors and involving more than 250 participants from within the university as well as the community. During the past year, associates of the UAIC delivered 25 presentations on insects to community groups and responded to 3,000 insect identification inquiries from the public. Despite the success of our current outreach programs, an enormous community demand remains for information about insects and for insect-related science enrichment for K-12 education. Moreover, these programs are supported largely by temporary extramural funding. To solve the problem of unstable funding and to capitalize on the opportunity to connect better with the community, we aim to obtain long-term funding and double the number of people served by Entomology outreach programs.

B. Strategies to achieve goal

1. Provide opportunities for graduate students to increase expertise in outreach through paid positions, courses, and seminars
2. Enhance communication statewide among all UA insect-related outreach activities
3. Increase awareness and participation in Entomology outreach activities in low income and minority communities.
4. Establish endowments for Insect Discovery and the Insect Festival
5. Train K-12 teachers how to use insects to teach science
6. Develop online insect outreach materials to reach beyond the local community

C. Actions **Time Period (Fiscal Years)**

- Contact UA faculty statewide to coordinate insect-related outreach programs 2020-21
- Catalog K-12 insect outreach resources online including links to programs 2020-21
- Recruit more undergraduate students to Insect Discovery preceptor course 2020-23
- Invite community organizations and businesses to sponsor the Insect Festival 2020-24
- Collaborate with TenWest and other organizations to publicize the Insect Festival, with special focus on Spanish-language media..... 2020-25
- Enhance UAIC and Insect Discovery websites..... 2020-21
- Provide teacher training in using insects and insect collecting methods 2020-25
- Develop a graduate course in communicating science and public outreach 2021-22

D. Inputs needed to achieve the goal

- Funding for 2 new semesters of Outreach TAships per year (0.5 FTE) - $32K per year
- Increased undergraduate volunteer involvement for course credit
- Faculty, student, and staff participation in annual Insect Festival
- Financial support for Insect Festival - $20K per year until endowment is established

E. Objective metrics that will be used to track progress towards attaining goals

- Number of people served by Insect Discovery, Insect Festival, and UAIC
- Number of children in Title 1 and high minority enrollment schools participating in Insect Discovery.
- Number of visitors to the Arizona Insect Festival from zip codes in low-income, high minority neighborhoods
- Number and amounts of funded grants supporting outreach
- Number and amounts of donations supporting insect outreach as well as years of support (develop long-term sponsors)
- Number of insect-related K-12 programs statewide included in online outreach catalog
- Number of new collaborations among insect outreach programs
- Impact of Insect Discovery and other insect outreach programs on K-12 student learning based on teacher questionnaires

6. INSECT COLLECTION STRATEGIC GOAL: Make the University of Arizona's Insect Collection the world's best source of arthropod data and specimens from the Sonoran Desert Region, and a global center for insect research

A. Current situation and gap to desired situation

The 2 million specimens in the University of Arizona Insect Collection (UAIC) are a unique treasure for research, extension, education, and outreach focusing on biodiversity of the Sonoran Desert Region. Over the past six years we have: (1) moved the entire pinned collection into modern facilities, (2) improved visiting researcher facilities, (3) initiated an endowed visiting researcher program, (4) established a specimen-level database, Symbiota Collections of Arthropod Network (SCAN), which provides specimen-level data online via a Virtual Network linked to other arthropod collections around the world, (5) established a new lab within the footprint of the UAIC dedicated to extracting DNA from museum specimens, and (6) established an endowment designated to cover non-salary operating expenses for the collection.

We are well positioned to develop large-scale specimen-based projects related to biodiversity, pest management, invasive species, and/or the effects of climate change. Such projects will use the specimens in the UAIC to develop species occurrence maps and identification tools, including high-resolution images and species-specific DNA sequence data. In doing so, we will ultimately generate a new collection of total genomic DNA extracted from specimens curated in the UAIC. We will focus our initial efforts on two projects.

Project 1. Insects of Agricultural Importance in Arizona. We will network with UA Extension faculty and the USDA identifiers in Phoenix, Nogales, and Yuma to help us determine which species are of greatest concern to agriculture in Arizona and for which molecular-based identification tools would be most useful. [estimated 50 species and 1,000 specimens]

Project 2. Native Bees of the Sonoran Desert Region. With over 700 species of native bees, the Sonoran Desert Region is home to one of the highest diversities of bee species *in the world*. We need these important pollinators, and in many cases we don't even know their names. The UAIC maintains thousands of native bee specimens, representing 5 families, 65 genera, and approximately 520 species, many of which have been specialist-identified. The UAIC collection and the associated identification tools we are building will help researchers and conservationists to track and monitor the health of native bees of the Sonoran Desert Region. [estimated 520 species and 6,000 specimens]

These projects, and others like them, will position the UAIC as a leader in museum sciences, the Department as a global center for specimen-based insect research, and the University as a lead collaborator with other local education and agricultural institutions (USDA, Pima Community College, Arizona-Sonora Desert Museum).

B. Strategies to achieve goal

1. We will expand the collection to include at least one specimen of every species in our two target groups (noted above).
2. We will enhance the UAIC by re-curating all specimens of the target species, following updated taxonomy. In the process, all specimen-level data, including georeferences, will be published in the SCAN database.
3. One specimen of every species in our target groups will be documented with high-resolution imagery. Total genomic DNA will be extracted from that specimen, archived in the collection, and aliquots of DNA will be made available to researchers upon request.
4. The barcode region of the mitochondrial gene COI will be PCR-amplified and sequenced for every target species. The DNA barcode will be published and made freely available to researchers, students, and the general public on the Barcode of Life Database (BOLD).
5. We will engage future scientists at the UA, Pima Community College, and Tucson Unified School District in the generation of DNA barcodes through course-based research experiences for undergraduates and high school students.
6. We will revive our established UAIC board of advisors to help guide transitions, connect with the larger community of systematists, and select annual Visiting Arthropod Systematists from applications.
7. Connect UA students, faculty, and staff with the local community of retired systematists and active amateur entomologists
8. Obtain funding from grants and donations to support needed personnel

C. Actions **Time Period (Fiscal Years)**

- Specimen-level work as described above 2020-21
- Update the UAIC website 2020-21
- Expand the UAIC website to include these project descriptions and outputs 2020-21
- Target systematists to apply for the Visiting Arthropod Systematist program 2020-25
- Work with programmers to link SCAN and BOLD 2020-21
- Enlist UAIC volunteers to help with UAIC projects 2020-25
- Apply for funding to cover needed personnel 2020-24

D. Inputs needed to achieve the goals

- Project Coordinator or postdoc ($50K per year), 1.0 FTE (via fundraising efforts, internal grants at UA, and external NSF-ADBC or NSF-CSBR grant ($300K, proposal in prep).
- Graduate Research Assistantship for collection support ($20K per year) 0.5 FTE. Hiring graduate students will allow us to attain our goals while simultaneously training the next generation of museum specialists.

E. Objective metrics that will be used to track progress towards attaining goal

- Number of specimens re-curated, databased, published online.
- Number of UAIC specimen-related barcodes published online.

- Size of the UAIC Genomic collection and the number of loan requests received.
- Use of collection for local entomology meetings, sorting events by students, and outreach
- Number of research articles published using the UAIC.
- Amount of extramural resources obtained for projects.
- Number and scope of inter-institutional, regional, national, and international requests of UAIC and collaborations formed.

7. DEVELOPMENT GOAL: Raise $2M from private donors to support our programs by FY25.

A. Current situation and gap between current situation and desired situation

The Department of Entomology fulfills UA's Land Grant mission by offering economically important research, extension and outreach to our state's stakeholders in agriculture, urban pest management, biodiversity conservation, and education. We are unique in UA and CALS because we focus on insects, which generate tremendous public interest. However, we receive little direct financial support from the public. We will connect with the community in new ways to increase stakeholders' financial support of Entomology & CALS.

B. Strategies to achieve goal

1. Increase visibility to stakeholders and all citizens of the state & region.
2. Connect with the community through events such as the Arizona Insect Festival, programs such as Insect Discovery, and resources such as the UA Insect Collection (UAIC).
3. Double the number of engaged alumni (e.g., service, advocacy, giving).
4. Increase alumni giving rate.
5. Maintain and enhance our high Department profile in local and national news.

C. Actions **Time Period (Fiscal Years)**

- Work with the CALS Development Office to seek funding for our programs (Insect Discovery, EIS grad program, UAIC, Insect Festival, etc.). 2020-25
- Invigorate the Department **Advisory Board** to connect with the community and be our advocates in diverse circles within the State (medicine, agriculture, pest management, etc.). ... 2020-25
- **Renovate** the Entomology classroom (Forbes 412) and main business office (Forbes 410) to project a more modern image to visitors. 2020-22
- Work with CALS to build **appealing exhibits** in the main lobby of Forbes, in the Student Union, and elsewhere on campus to highlight the accomplishments and activities of the Department and other CALS Departments. 2020-25
- Enhance the **department website** with development goals and ways for stakeholders to become involved with departmental activities. 2020-21
- Hold regularly scheduled support-raising events such as the Insect Festival, insect-themed social events, and high-end events with invited supporters and potential new supporters. 2020-25

D. Inputs needed to achieve the goal

- Effort by faculty and other Department members to support development
- Effort by Entomology Advisory Board
- Part-time Entomology Development Coordinator who will increase our profile, organize fund-raising events, and garner new resources: $30K per year
- Collaboration from CALS Development Office
- Funds for physical renovations, exhibit development, and IT support: $15K per year

E. Objective metrics that will be used to track progress towards attaining goal

- Funds raised per year

Appendix B2. Relationship of ENTO Strategic Priorities to the UA Strategic Plan
ENTO's strategies to achieve our goals are listed below each of ENTO's seven Strategic Goals. The following page shows these how these strategies (identified there as S1-S8) and the related ENTO goals align with the UA Strategic Plan.

GOAL 1: Research
Strategies

1. Target critical global issues with research led by our faculty & their collaborators
2. Retain current faculty who have outstanding research productivity
3. Recruit new faculty with outstanding research productivity
4. Increase research productivity of current faculty
5. Enhance collaborations in the Dept. and with others (UA, national & international)
6. Strengthen research infrastructure including support staff and facilities

GOAL 2: Integrated Pest Management (IPM)
Strategies

1. Recruit & retain outstanding IPM faculty, appointed personnel & classified staff
2. Create a fertile environment for translational sciences needed to support IPM
3. Leverage resources from gifts/grants/contracts to support staffing needs (50% share of each)

GOAL 3: Undergraduate Engagement
Strategies

1. Increase the percentage of undergraduate courses taught through active learning to 60% by FY2021 and 75% by FY2022
2. Increase faculty mentoring of undergraduate students in Entomology laboratories

GOAL 4: Entomology & Insect Science (EIS) Graduate Program
Strategies

1. Increase support of RAs via increased faculty research grants
4. Solicit donors for endowments for student-invited speakership (Hagedorn) and student cash award to honor Genevieve Comeau (in progress)
5. Build support for first and second year students to apply for outside graduate fellowships (NSF, NIH, USDA)

GOAL 5: Outreach
Strategy

1. Establish endowments for Insect Discovery and the Insect Festival

GOAL 6: University of Arizona Insect Collection
Strategy

8. Obtain funding from grants and donations to support needed personnel

GOAL 7: Development
Strategies

3. Double the number of engaged alumni (e.g., service, advocacy, giving).
4. Increase alumni giving rate.

THE UNIVERSITY OF ARIZONA

		Pillar 1					Pillar 2							Pillar 3				Pillar 4			Pillar 5			
		The Wildcat Journey Driving Student Success for a Rapidly Changing World					**Grand Challenges** Tackling Critical Problems at the Edges of Human Endeavor							**The Arizona Advantage** Advancing our Land Grant Mission to Drive Social, Cultural, and Economic Impact				**UA Global - Redefining International** The UA will set the standard for a global university in the digital age			**Institutional Excellence** Ensuring UA lives its values and innovative culture … for a high performing enterprise			
	Entomology	Student Body	Engagement	Persistence & Completion	Student-Centered Teaching & Learning	Post-Graduate Outcomes	Funding	Space University	Physical Sciences	Social Sciences	Capabilities	Talent	Impact	Communities	Destination Arizona	Arts & Culture	Innovation & Partnerships	Global Impact	Global Education	Global Engagement	Values-Driven University	Service Excellence	Streamlining Solutions	Leading Sustainability
	College Strategic Goals																							
1	Unit Goal 1: Increase Entomology research productivity 30% by 2025.						**S1-S6**					**S2-S3**	**S5**								**S2**			
2	Unit Goal 2: By FY25, greatly enhance effectiveness of Integrated Pest Management (IPM) research, education, and Extension programs for teaching students and stakeholders, and for solving health, environmental, and economic problems caused by pests.						**S1-S3**				**S1-S4**	**S1-S2**		**S1-S4**							**S1**			**S1-S4**
3	Unit Goal 3: Increase the yearly undergraduate student credit hours taught 30% by FY25.			**S2**	**S1**																			
4	Unit Goal 4: Double the stable funding for Entomology & Insect Science (EIS) graduate students by FY25.		**S4**				**S1, S5**																	
5	Unit Goal 5: Double the number of people served each year by FY25 through sustainable outreach programs to meet public demand for insect information, to support K-12 science education and to connect underserved communities to UA Entomology and CALS.		**S4**																					
6	Unit Goal 6: Make the University of Arizona's Insect Collection the world's best source of arthropod data and specimens from the Sonoran Desert Region and a global center for insect research		**S8**				**S8**																	
7	Unit Goal 7: Raise $2M from private donors to support our programs by FY25.		**S3-S4**																					

College of Agriculture & Life Sciences

Appendix C1. Courses for Entomology Minor & Certificate

Entomology Minor Checklist, 2022-2023

18 Total Units, 2.0 Minimum GPA
9 Upper-Division Units
6 Units Allowed of Transfer Units

Required Insect Biology (3 Units)
Required Prerequisites: MCB 181 & ECOL 182

___ **ENTO 415R:** Insect Biology

Research or Education (3 Units)

___ **ENTO 392, 492:** Directed Research
OR
___ **ENTO 299, 299H, 399, 499, 499H:** Independent Study
OR
___ **ENTO 498H, 498:** Honors Thesis, Senior Capstone
OR
___ **ENTO 393, 493:** Internship
OR
___ **ENTO 391, 391H, 491, 491H:** Preceptorship
OR
___ **ENTO 407:** Insect Discovery

Electives (12 Units)
All Courses 3 Units Unless Otherwise Noted

___ ****ENTO 160D1:** How Insects Shaped Human History
___ ****ENTO 170C2:** How Insects Conquered Earth
___ **ENTO 300:** Integrated Pest Management for Desert Cropping (Yuma Campus Only)
___ **ENTO 401:** Ecological Physiology
___ **ENTO 407:** Insect Discovery
___ ***ENTO 417:** Insect Systematics
___ **ENTO 432:** Comparative Immunology
___ **ENTO 436:** Agro Ecology
___ **ENTO 457:** Medical-Veterinary Entomology
___ **ENTO 468:** Integrated Pest Management
___ **ENTO 403R:** Biology Animal Parasites
___ **ENTO 497C:** Greenhouse Pest Management
___ ***ENTO 405:** Aquatic Entomology

*4 Units
** Can Double Dip with General Education Requirements
ENTO 407 can be used for Elective Credit OR Research/Education Credit, **NOT BOTH**

Entomology Certificate Checklist, 2022-2023

12 Total Units, 3.0 Minimum GPA
6 Upper-Division Units
6 Units Allowed of Transfer Credit

Required Insect Biology (3 Units)
Required Prerequisites: MCB 181 & ECOL 182

___ **ENTO 415R:** Insect Biology

Electives & Research (9 Units)
All Courses 3 Units Unless Otherwise Noted

___ **ENTO 160D1:** How Insects Shaped Human History
___ **ENTO 170C2:** How Insects Conquered Earth
___ **ENTO 300:** Integrated Pest Management for Desert Cropping (Yuma Campus Only)
___ **ENTO 401:** Ecological Physiology
___ **ENTO 407:** Insect Discovery
___ ***ENTO 417:** Insect Systematics
___ **ENTO 432:** Comparative Immunology
___ **ENTO 436:** Agro Ecology
___ **ENTO 457:** Medical-Veterinary Entomology
___ **ENTO 468:** Integrated Pest Management
___ **ENTO 403R:** Biology Animal Parasites
___ **ENTO 497C:** Greenhouse Pest Management
___ ***ENTO 405:** Aquatic Entomology
___ ****ENTO 392, 492:** Directed Research
___ ****ENTO 499, 499H:** Independent Study

*4 Units
**1-3 Units

ENTO 160D1 & ENTO 170C2 can only be used for certificate if they are not being used to fulfill General Education requirements
NO MORE THAN 4 UNITS of **ENTO 392, 492, 499, or 499H** may be used to fulfill certificate requirements

Appendix D1. 275 journal publications and 9 book chapters authored by members of the Department of Entomology and students in the Entomology & Insect Science Graduate Interdisciplinary Program at the University of Arizona (2016 - July 7, 2023; listed by Scopus July 7, 2023)

*At least one author was a student in the EIS GIDP

Journal Publications (275)

	Authors	Title	Year	Source title	Cited by
*	**Anderson K.E.; Rodrigues P.A.P.; Mott B.M.; Maes P.; Corby-Ha**	Ecological Succession in the Honey Bee Gut: Shift ir	**2016**	Microbial Ecology	44
*	**Asiimwe P.; Ellsworth P.C.; Naranjo S.E.**	Natural enemy impacts on Bemisia tabaci (MEAM1) c	**2016**	Ecological Entomology	11
	Carrière Y.; Fabrick J.A.; Tabashnik B.E.	Can Pyramids and Seed Mixtures Delay Resistance t	**2016**	Trends in Biotechnology	156
*	**Cass B.N.; Himler A.G.; Bondy E.C.; Bergen J.E.; Fung S.K.; Ke**	Conditional fitness benefits of the Rickettsia bacteria	**2016**	Oecologia	27
	Castagnola A.; Mulley G.; Davis N.; Waterfield N.; Stock S.P.	Transcript abundance of Photorhabdus insect-relate	**2016**	Toxins	3
	Cooney F.; Vitikainen E.I.K.; Marshall H.H.; van Rooyen W.; Sn	Lack of aggression and apparent altruism towards in	**2016**	Royal Society Open Science	3
*	**Corby-Harris V.; Meador C.A.D.; Snyder L.A.; Schwan M.R.; Ma**	Transcriptional, translational, and physiological signa	**2016**	J. Insect Physiology	30
	Corby-Harris V.; Snyder L.; Meador C.A.D.; Naldo R.; Mott B.; A	Parasaccharibacter apium, gen. Nov., sp. Nov., Impr	**2016**	J. Economic Entomology	61
	Corona M.; Libbrecht R.; Wheeler D.E.	Molecular mechanisms of phenotypic plasticity in soc	**2016**	Current Opinion in Insect Science	100
	Cui J.; Li S.; Spurgeon D.W.; Jia W.; Lu Y.; Gouge D.H.	Flight Capacity of *Sitophilus zeamais* Motschulsky in	**2016**	Southwestern Entomologist	0
	Davidowitz G.	Endocrine Proxies Can Simplify Endocrine Complexit	**2016**	Integrative & Comparative Biology	13
*	**Gebiola M.; Kelly S.E.; Hammerstein P.; Giorgini M.; Hunter M.**	"Darwin's corollary" and cytoplasmic incompatibility in	**2016**	Evolution	24
	Gómez R.A.; Reddell J.; Will K.; Moore W.	Up high and down low: Molecular systematics and in	**2016**	Molecular Phylogenetics & Evolutio	7
	Hood-Nowotny R.; Mayr L.; Saad N.; Seth R.K.; Davidowitz G.;	Towards Incorporating Insect Isotope Analysis Using	**2016**	Florida Entomologist	4
*	**Kusakabe A.; Contreras-Barragan B.A.; Simpson C.R.; Enciso J**	Application of partial rootzone drying to improve irrigat	**2016**	Agricultural Water Management	26
*	**Lanan M.C.; Rodrigues P.A.P.; Agellon A.; Jansma P.; Wheeler**	A bacterial filter protects and structures the gut micro	**2016**	ISME J.	85
	Larabee F.J.; Fisher B.K.; Schmidt C.A.; Matos-Maraví P.; Janc	Molecular phylogenetics and diversification of trap-ja	**2016**	Molecular Phylogenetics & Evolutio	27
	Levin E.; Mitra C.; Davidowitz G.	Fed males increase oviposition in female hawkmoths	**2016**	Animal Behaviour	19
	Lü S.; Jiang M.; Huo T.; Li X.; Zhang Y.	3-hydroxy-3-methyl glutaryl coenzyme A reductase: A	**2016**	Insect Molecular Biology	16
*	**Maes P.W.; Rodrigues P.A.P.; Oliver R.; Mott B.M.; Anderson K**	Diet-related gut bacterial dysbiosis correlates with imp	**2016**	Molecular Ecology	116
	Mitra C.; Reynoso E.; Davidowitz G.; Papaj D.	Effects of sodium puddling on male mating success,	**2016**	Animal Behaviour	17
*	**Orozco R.A.; Molnár I.; Bode H.; Stock S.P.**	Bioprospecting for secondary metabolites in the entc	**2016**	J. Invertebrate Pathology	14
	Palumbo J.C.; Perring T.M.; Millar J.G.; Reed D.A.	Biology, Ecology, and Management of an Invasive S	**2016**	Annual Review of Entomology	56
	Pape R.B.	The importance of ants in cave ecology, with new rec	**2016**	International J. Speleology	7
	Pietri J.E.; Pakpour N.; Napoli E.; Song G.; Pietri E.; Potts R.; C	Two insulin-like peptides differentially regulate malari	**2016**	Biochemical J.	17
	Resende L.P.A.; Zepon T.; Bichuette M.E.; Pape R.B.; Gil-Santa	Associations between Emesinae heteropterans and	**2016**	Neotropical Biology & Conservatio	6
*	**Russell A.L.; Leonard A.S.; Gillette H.D.; Papaj D.R.**	Concealed floral rewards and the role of experience	**2016**	Animal Behaviour	31

*	**Stanley D.A.; Russell A.L.; Morrison S.J.; Rogers C.; Raine N.E**	Investigating the impacts of field-realistic exposure to	**2016**	J. Applied Ecology	106
	Tabashnik B.E.	Tips for battling billion-dollar beetles	**2016**	Science	17
	Tassone E.E.; Zastrow-Hayes G.; Mathis J.; Nelson M.E.; Wu G	Sequencing, de novo assembly and annotation of a	**2016**	GigaScience	13
	Wang L.; Wan P.; Cong S.; Wang J.; Huang M.; Tabashnik B.E.;	Adult exposure to Bt toxin Cry1Ac reduces life span	**2016**	J. Economic Entomology	2
	Xiao Y.; Liu K.; Zhang D.; Gong L.; He F.; Soberón M.; Bravo A.	Resistance to Bacillus thuringiensis Mediated by an	**2016**	PLoS Pathogens	40
	Bear A.; Prudic K.L.; Monteiro A.	Steroid hormone signaling during development has a	**2017**	PLoS ONE	7
*	**Beck J.; McCain C.M.; Axmacher J.C.; Ashton L.A.; Bärtschi F.**	Elevational species richness gradients in a hyperdive	**2017**	Global Ecology & Biogeography	70
	Bockoven A.A.; Coates C.J.; Eubanks M.D.	Colony-level behavioural variation correlates with diff	**2017**	Molecular Ecology	14
	Carrière Y.; Antilla L.; Liesner L.; Tabashnik B.E.	Large-Scale Evaluation of Association between Phe	**2017**	J. Economic Entomology	5
	Carrière Y.; Degain B.; Liesner L.; Dutilleul P.; Palumbo J.C.	Validation of a Landscape-Based Model for Whitefly	**2017**	J. Economic Entomology	4
	Carroll M.J.; Brown N.; Goodall C.; Downs A.M.; Sheenan T.H.;	Honey bees preferentially consume freshlystored Pol	**2017**	PLoS ONE	47
	Castle S.; Palumbo J.; Merten P.; Cowden C.; Prabhaker N.	Effects of foliar and systemic insecticides on whitefly t	**2017**	Pest Management Science	19
*	**Charbonneau D.; Sasaki T.; Dornhaus A.**	Who needs 'lazy' workers? Inactive workers act as a	**2017**	PLoS ONE	39
	Ciezki K.; Murfin K.; Goodrich-Blair H.; Stock S.P.; Forst S.	R-type bacteriocins in related strains of Xenorhabdus	**2017**	FEMS Microbiology Letters	8
	Gebiola M.; Giorgini M.; Kelly S.E.; Doremus M.R.; Ferree P.M.	Cytological analysis of cytoplasmic incompatibility indu	**2017**	Proceedings of the Royal Society B	24
	Gebiola M.; Kelly S.E.; Velten L.; Zug R.; Hammerstein P.; Gior	Reproductive interference and fecundity affect comp	**2017**	Heredity	1
	Gebiola M.; Monti M.M.; Johnson R.C.; Woolley J.B.; Hunter M	A revision of the Encarsia pergandiella species complex	**2017**	Systematic Entomology	29
	Gibson C.M.	A big, bug science party	**2017**	Science	0
	Hatle J.D.; Awan A.; Nicholas J.; Koch R.; Vokrri J.R.; McCue M	Life-extending dietary restriction and ovariectomy ea	**2017**	Experimental Gerontology	5
	Hoekman D.; Levan K.E.; Ball G.E.; Browne R.A.; Davidson R.L	Design for ground beetle abundance and diversity sa	**2017**	Ecosphere	27
*	**Hunter M.S.; Asiimwe P.; Himler A.G.; Kelly S.E.**	Host nuclear genotype influences phenotype of a co	**2017**	J. Evolutionary Biology	16
*	**Leighton G.M.; Charbonneau D.; Dornhaus A.**	Task switching is associated with temporal delays in	**2017**	Behavioral Ecology	22
	Levin E.; Lopez-Martinez G.; Fane B.; Davidowitz G.	Hawkmoths use nectar sugar to reduce oxidative dar	**2017**	Science	52
	Levin E.; McCue M.D.; Davidowitz G.	More than just sugar: Allocation of nectar amino acid	**2017**	Proc. Royal Society B: Biological S	44
	Levin E.; McCue M.D.; Davidowitz G.	Sex differences in the utilization of essential & non-e	**2017**	J. Experimental Biology	15
*	**Lichtenstein J.L.L.; Chism G.T.; Kamath A.; Pruitt J.N.**	Intraindividual Behavioral Variability Predicts Foragin	**2017**	Scientific Reports	11
	Lingafelter S.W.; Tishechkin A.K.	Two new species of parandrinae (coleoptera: Ceraml	**2017**	Zootaxa	0
	Liu J.; Li Z.; Zhang H.; Du H.; Ding X.; Zhou Y.; Wu J.; Wong A.	Comparative study of the sublethal effects of indoxaca	**2017**	Journal of Asia-Pacific Entomology	2
	Liu L.; Gao M.; Yang S.; Liu S.; Wu Y.; Carrière Y.; Yang Y.	Resistance to Bacillus thuringiensis toxin Cry2Ab and	**2017**	Evolutionary Applications	27
	Lynch Z.R.; Schlenke T.A.; Morran L.T.; de Roode J.C.	Ethanol confers differential protection against genera	**2017**	PLoS ONE	13
*	**Mann E.; Stouthamer C.M.; Kelly S.E.; Dzieciol M.; Hunter M.S.;**	Transcriptome sequencing reveals novel candidate g	**2017**	mSystems	20
	McMullen J.G., II; McQuade R.; Ogier J.-C.; Pagès S.; Gaudriau	Variable virulence phenotype of Xenorhabdus bovie	**2017**	Microbiology (United Kingdom)	16
	McMullen J.G., II; Peterson B.F.; Forst S.; Blair H.G.; Stock S.P	Fitness costs of symbiont switching using entomopat	**2017**	BMC Evolutionary Biology	19

	Mehlferber E.C.; Benowitz K.M.; Roy-Zokan E.M.; McKinney E.C	Duplication and sub/neofunctionalization of Malvolio,	2017	G3: Genes, Genomes, Genetics	10
	Naranjo S.E.; Ellsworth P.C.	Methodology for developing life tables for sessile insec	2017	J. Visualized Experiments	15
	Ni M.; Ma W.; Wang X.; Gao M.; Dai Y.; Wei X.; Zhang L.; Peng Y	Next-generation transgenic cotton: pyramiding RNAi	2017	Plant Biotechnology J.	81
	Ocelotl J.; Sánchez J.; Gómez I.; Tabashnik B.E.; Bravo A.; So	ABCC2 is associated with Bacillus thuringiensis Cry1A	2017	Scientific Reports	46
*	Papaj D.R.; Buchmann S.L.; Russell A.L.	Division of labor of anthers in heterantherous plants:	2017	Arthropod-Plant Interactions	20
*	Patricia Stock S.; Kusakabe A.; Orozco R.A.	Secondary metabolites produced by heterorhabditis	2017	J. Nematology	22
	Ramírez D.M.; Vea L.; Field J.A.; Baker P.B.; Gandolfi A.J.; Mai	Transferable Training Modules: Building Environment	2017	Family & Community Health	2
	Reed D.A.; Ganjisaffar F.; Palumbo J.C.; Perring T.M.	Effects of Temperatures on Immature Development a	2017	J. Economic Entomology	17
	Robertson J.A.; Moore W.	Phylogeny of Paussus L. (Carabidae: Paussinae): ur	2017	Systematic Entomology	16
	Romero A.; Sutherland A.M.; Gouge D.H.; Spafford H.; Nair S.; I	Pest management strategies for bed bugs (Hemipter	2017	J. Integrated Pest Management	23
*	Russell A.L.; Buchmann S.L.; Papaj D.R.	How a generalist bee achieves high efficiency of poll	2017	Behavioral Ecology	36
*	Russell A.L.; Morrison S.J.; Moschonas E.H.; Papaj D.R.	Patterns of pollen and nectar foraging specialization	2017	Scientific Reports	41
	Tabashnik B.E.; Carrière Y.	Surge in insect resistance to transgenic crops and pr	2017	Nature Biotechnology	363
	Wan P.; Xu D.; Cong S.; Jiang Y.; Huang Y.; Wang J.; Wu H.; Wa	Hybridizing transgenic Bt cotton with non-Bt cotton c	2017	PNAS	73
	Benowitz K.M.; Sparks M.E.; McKinney E.C.; Moore P.J.; Moore	Variation in mandible development and its relationsh	2018	Ecology & Evolution	2
	Carrière Y.; Degain B.A.; Unnithan G.C.; Harpold V.S.; Heuberg	Effects of seasonal changes in cotton plants on the	2018	Pest Management Science	17
	Carrière Y.; Williams J.L.; Crowder D.W.; Tabashnik B.E.	Genotype-specific fitness cost of resistance to Bt tox	2018	Pest Management Science	11
	Coleman J.M.; Benowitz K.M.; Jost A.G.; Matzkin L.M.	Behavioral evolution accompanying host shifts in cac	2018	Ecology & Evolution	10
	Diaz F.; Allan C.W.; Matzkin L.M.	Positive selection at sites of chemosensory genes is	2018	BMC Evolutionary Biology	3
	Díaz F.; Lima A.L.A.; Nakamura A.M.; Fernandes F.; Sobrinho I	Evidence for introgression among three species of th	2018	Frontiers in Genetics	11
	Farrar J.J.; Ellsworth P.C.; Sisco R.; Baur M.E.; Crump A.; Four	Assessing compatibility of a pesticide in an IPM progra	2018	J. of Integrated Pest Management	8
	Gage S.L.; Kramer C.; Calle S.; Carroll M.; Heien M.; DeGrandi-	Nosema ceranae parasitism impacts olfactory learnin	2018	J. Experimental Biology	28
	Gao M.; Wang X.; Yang Y.; Tabashnik B.E.; Wu Y.	Epistasis confers resistance to Bt toxin Cry1Ac in the	2018	Evolutionary Applications	12
*	Hughes G.B.; Moore W.	Monophyly of the subfamily Neobisiinae (Pseudosco	2018	J. Arachnology	3
	Hust J.; Lavine M.D.; Worthington A.M.; Zinna R.; Gotoh H.; Niir	The Fat-Dachsous signaling pathway regulates grow	2018	J. Insect Physiology	9
	Jalali M.A.; Mehrnejad M.R.; Ellsworth P.C.; Ranjbar F.; Ziaadd	Predator performance: inferring predator switching be	2018	Pest Management Science	7
	Jin L.; Wang J.; Guan F.; Zhang J.; Yu S.; Liu S.; Xue Y.; Li L.;	Dominant point mutation in a tetraspanin gene assoc	2018	PNAS	83
	Karp D.S.; Chaplin-Kramer R.; Meehan T.D.; Martin E.A.; DeCle	Crop pests and predators exhibit inconsistent respon	2018	PNAS	366
	Mathew L.G.; Ponnuraj J.; Mallappa B.; Chowdary L.R.; Zhang	ABC transporter mis-splicing associated with resistan	2018	Scientific Reports	49
*	McManus R.; Ravenscraft A.; Moore W.	Bacterial associates of a gregarious riparian beetle w	2018	Frontiers in Microbiology	15
	Morris E.E.; Stock S.P.; Castrillo L.A.; Williams D.W.; Hajek A.I	Characterisation of the dimorphic Deladenus bedding	2018	Nematology	2
	Nielsen M.E.; Levin E.; Davidowitz G.; Papaj D.R.	Colour plasticity alters thermoregulatory behaviour in	2018	Animal Behaviour	2
*	Palting J.D.; Ferguson D.C.; Moore W.	A new species of hypoprepia from the mountains of	2018	ZooKeys	1

	Peña-Cardeña A.; Grande R.; Sánchez J.; Tabashnik B.E.; Bra	The C-terminal protoxin region of Bacillus thuringiens	**2018**	J. Biological Chemistry	24
*	**Pruitt J.N.; Wright C.M.; Lichtenstein J.L.L.; Chism G.T.; McEw**	Selection for Collective Aggressiveness Favors Socia	**2018**	Current Biology	18
	Roder A.C.; Stock S.P.	Influence of Xenorhabdus (Gamma-Proteobacteria: En	**2018**	J. Invertebrate Pathology	3
	Rothman J.A.; Carroll M.J.; Meikle W.G.; Anderson K.E.; McFre	Longitudinal Effects of Supplemental Forage on the	**2018**	Microbial Ecology	28
*	**Russell A.L.; Buchmann S.L.; De Sabino W.O.; Papaj D.R.**	Brawls bring buzz: Male Size Influences Competition	**2018**	J. Insect Science	4
*	**Russell A.L.; Mauerman K.B.; Golden R.E.; Papaj D.R.**	Linking components of complex signals to morpholog	**2018**	Animal Behaviour	9
*	**Schaller J.C.; Davidowitz G.; Papaj D.R.; Smith R.L.; Carrière Y**	Molecular phylogeny, ecology and multispecies aggr	**2018**	PLoS ONE	7
	Smith G.P.; Johnson C.A.; Davidowitz G.; Bronstein J.L.	Linkages between nectaring and oviposition preferer	**2018**	Ecological Entomology	11
	Song Z.-S.; Bartlett C.R.; O'Brien L.B.; Liang A.-P.; Bourgoin T.	Morphological phylogeny of Dictyopharidae (Hemipte	**2018**	Systematic Entomology	15
	Souvannaseng L.; Hun L.V.; Baker H.; Klyver J.M.; Wang B.; Pa	Inhibition of JNK signaling in the Asian malaria vecto	**2018**	PLoS Pathogens	20
*	**Stouthamer C.M.; Kelly S.; Hunter M.S.**	Enrichment of low-density symbiont DNA from minute	**2018**	J. Microbiological Methods	7
*	**Vandervoet T.F.; Ellsworth P.C.; Carrière Y.; Naranjo S.E.**	Quantifying conservation biological control for manag	**2018**	J. Economic Entomology	20
	Wang L.; Ma Y.; Wan P.; Liu K.; Xiao Y.; Wang J.; Cong S.; Xu D	Resistance to Bacillus thuringiensis linked with a cad	**2018**	Insect Biochemistry & Molecular Bi	29
	Wilson J.K.; Tseng A.S.; Potter K.A.; Davidowitz G.; Hildebranc	The effects of the alkaloid scopolamine on the perfo	**2018**	Arthropod-Plant Interactions	4
	Wilson J.K.; Woods H.A.; Kessler A.	High levels of abiotic noise in volatile organic compou	**2018**	Oecologia	6
	Wolfin M.S.; Raguso R.A.; Davidowitz G.; Goyret J.	Context dependency of in-flight responses by Mandu	**2018**	J. Experimental Biology	7
	Wone B.W.M.; Pathak J.; Davidowitz G.	Flight duration and flight muscle ultrastructure of unfe	**2018**	Arthropod Structure & Developmer	4
	Zimmerman J.R.	A Synopsis of Oak Gall Wasps (Hymenoptera: Cynipi	**2018**	J. the Kansas Entomological Socie	7
	Akbar W.; Gowda A.; Ahrens J.E.; Stelzer J.W.; Brown R.S.; Bo	First transgenic trait for control of plant bugs and thri	**2019**	Pest Management Science	23
	Allan C.W.; Matzkin L.M.	Genomic analysis of the four ecologically distinct cac	**2019**	BMC Genomics	10
	Anderson J.A.; Ellsworth P.C.; Faria J.C.; Head G.P.; Owen M.D	Genetically engineered crops: Importance of diversified	**2019**	Frontiers in Bioengineering & Biotec	70
	Benowitz K.M.; Amukamara A.U.; Mckinney E.C.; Moore A.J.	Development and the effects of extended parenting	**2019**	Ecological Entomology	5
	Benowitz K.M.; Coleman J.M.; Matzkin L.M.	Assessing the architecture of Drosophila mojavensis	**2019**	G3: Genes, Genomes, Genetics	5
	Benowitz K.M.; McKinney E.C.; Cunningham C.B.; Moore A.J.	Predictable gene expression related to behavioral va	**2019**	Behavioral Ecology	7
	Bernaba M.; Power E.; Campion J.; Gotzek D.; Schmidt J.O.; K	Unconscious Woman in Shock and Covered with Ant	**2019**	American J. Medicine	0
	Bernays E.A.	An unlikely beginning: A fortunate life	**2019**	Annual Review of Entomology	1
*	**Bondy E.C.; Hunter M.S.**	Determining the egg fertilization rate of Bemisia taba	**2019**	J. Visualized Experiments	2
	Carrière Y.; Degain B.; Unnithan G.C.; Harpold V.S.; Li X.; Taba	Seasonal Declines in Cry1Ac and Cry2Ab Concentra	**2019**	J. Economic Entomology	17
	Carrière Y.; Yelich A.J.; Degain B.A.; Harpold V.S.; Unnithan G	Gossypol in cottonseed increases the fitness cost of	**2019**	Crop Protection	10
	De Luca P.A.; Buchmann S.; Galen C.; Mason A.C.; Vallejo-Mar	Does body size predict the buzz-pollination frequenc	**2019**	Ecology & Evolution	28
*	**Doremus M.R.; Kelly S.E.; Hunter M.S.**	Exposure to opposing temperature extremes causes	**2019**	PLoS Pathogens	14
*	**Duong D.A.; Espinosa-Artiles P.; Orozco R.A.; Molnár I.; Patric**	Draft Genome Assembly of the Entomopathogenic B	**2019**	Microbiology Resource Announcer	3
	Ferro K.; Peuß R.; Yang W.; Rosenstiel P.; Schulenburg H.; Kur	Experimental evolution of immunological specificity	**2019**	PNAS	32

*	**Gowda V.; Gronenberg W.**	Brain composition and scaling in social bee species di	**2019**	Apidologie	9
	Hagler J.R.; Mostafa A.M.	A Gut Analysis Technique for Pinpointing Egg-Speci	**2019**	J. Insect Science	3
*	**Hun L.V.; Luckhart S.; Riehle M.A.**	Increased Akt signaling in the fat body of Anopheles	**2019**	J. Insect Physiology	8
	Jalali M.A.; Mehrnejad M.R.; Ellsworth P.C.; Riddick E.	Inferring Biological Control Potential of Adult Predato	**2019**	J. Economic Entomology	1
	Kelemen E.P.; Cao N.; Cao T.; Davidowitz G.; Dornhaus A.	Metabolic rate predicts the lifespan of workers in the	**2019**	Apidologie	12
*	**Kusakabe A.; Peterson B.F.; Rivera Orduño B.; Stock S.P.**	Ecological characterization of Heterorhabditis sonore	**2019**	Zoology	6
*	**Leitner N.; Charbonneau D.; Gronenberg W.; Dornhaus A.**	Peripheral sensory organs vary among ant workers b	**2019**	Behavioural Processes	3
	Li S.; Hussain F.; Unnithan G.C.; Dong S.; UlAbdin Z.; Gu S.; Ma	A long non-coding RNA regulates cadherin transcript	**2019**	Pesticide Biochemistry & Physiolog	19
*	**Miguelena J.G.; Baker P.B.**	Effects of Urbanization on the Diversity, Abundance,	**2019**	Environmental Entomology	9
	Moore A.J.; Benowitz K.M.	From phenotype to genotype: the precursor hypothe	**2019**	Current Opinion in Insect Science	5
	Moore W.; Di Giulio A.	Out of the burrow and into the nest: Functional anat	**2019**	PLoS ONE	3
	Muzzi M.; Moore W.; Di Giulio A.	Morpho-functional analysis of the explosive defensiv	**2019**	Micron	10
	Ni X.; Cottrell T.E.; Buntin G.D.; Li X.; Wang W.; Zhuang H.	Monitoring of brown stink bug (Hemiptera: Pentatomi	**2019**	Insect Science	4
*	**Oduwole O.A.; Ameh S.; Esu E.S.; Oringanje C.M.; Meremikwu**	Assessing agreement of hemoglobin and three- fold	**2019**	Nigerian J. Clinical Practice	2
	Prudic K.L.; Timmermann B.N.; Papaj D.R.; Ritland D.B.; Oliver	Mimicry in viceroy butterflies is dependent on abunda	**2019**	Communications Biology	10
	Roder A.C.; Wang Y.; Butcher R.A.; Stock S.P.	Influence of symbiotic and non-symbiotic bacteria on	**2019**	J. Experimental Biology	5
	San-Blas E.; Campos-Herrera R.; Dolinski C.; Monteiro C.; And	Entomopathogenic nematology in Latin America: A b	**2019**	J. Invertebrate Pathology	16
	Schulz N.K.E.; Sell M.P.; Ferro K.; Kleinhölting N.; Kurtz J.	Transgenerational developmental effects of immune	**2019**	Frontiers in Physiology	15
	Stock S.P.	Partners in crime: symbiont-assisted resource acquisi	**2019**	Current Opinion in Insect Science	15
	Stock S.P.; Campos-Herrera R.; El-Borai F.E.; Duncan L.W.	Steinernema khuongi n. sp. (Panagrolaimomorpha, S	**2019**	J. Helminthology	13
*	**Stouthamer C.M.; Kelly S.E.; Mann E.; Schmitz-Esser S.; Hunte**	Development of a multi-locus sequence typing syster	**2019**	BMC Microbiology	7
	Tabashnik B.E.; Carrière Y.; Gassmann A.	Global Patterns of Resistance to Bt Crops Highlightin	**2019**	J. Economic Entomology	110
	Tyler Flockhart D.T.; Larrivée M.; Prudic K.L.; Ryan Norris D.	Estimating the annual distribution of monarch butterf	**2019**	Facets	7
	von Arx M.; Moore A.; Davidowitz G.; Arnold A.E.	Diversity and distribution of microbial communities in	**2019**	PLoS ONE	17
	Wang L.; Ma Y.; Guo X.; Wan P.; Liu K.; Cong S.; Wang J.; Xu D	Pink bollworm resistance to Bt toxin Cry1Ac associate	**2019**	Toxins	23
	Wang L.; Wang J.; Ma Y.; Wan P.; Liu K.; Cong S.; Xiao Y.; Xu D	Transposon insertion causes cadherin mis-splicing ar	**2019**	Scientific Reports	24
	Wang Y.; Quan Y.; Yang J.; Shu C.; Wang Z.; Zhang J.; Gatehou	Evolution of asian corn borer resistance to Bt Toxins	**2019**	Toxins	11
	Wilson J.K.; Ruiz L.; Davidowitz G.	Dietary protein and carbohydrates affect immune fun	**2019**	Physiological & Biochemical Zoolo	26
	Wilson J.K.; Ruiz L.; Duarte J.; Davidowitz G.	The nutritional landscape of host plants for a special	**2019**	Ecology & Evolution	17
*	**Yanahan A.D.; Moore W.**	Impacts of 21st-century climate change on montane	**2019**	Diversity & Distributions	14
	Zhang M.; Wei J.; Ni X.; Zhang J.; Jurat-Fuentes J.L.; Fabrick J	Decreased Cry1Ac activation by midgut proteases as	**2019**	Pest Management Science	20
*	**Attygalle A.B.; Xu S.; Moore W.; McManus R.; Gill A.; Will K.**	Biosynthetic origin of benzoquinones in the explosive	**2020**	Science of Nature	9
*	**Baker P.B.; Miguelena J.G.**	Field distance effects of fipronil and chlorfenapyr as	**2020**	Sociobiology	1

	Behrens-Bradley N.; Smith S.; Beatty N.L.; Love M.; Ahmad N.;	Kissing Bugs Harboring Trypanosoma cruzi, Frequen	2020	American J. Medicine	14
	Benowitz K.M.; Coleman J.M.; Allan C.W.; Matzkin L.M.	Contributions of cis- And trans-Regulatory Evolution	2020	Genome Biology & Evolution	5
*	Bockoven A.A.; Bondy E.C.; Flores M.J.; Kelly S.E.; Ravenscraft	What Goes Up Might Come Down: the Spectacular Sp	2020	Microbial Ecology	10
	Carrière Y.; Brown Z.; Aglasan S.; Dutilleul P.; Carroll M.; Head	Crop rotation mitigates impacts of corn rootworm resi	2020	PNAS	21
	Carrière Y.; Brown Z.S.; Downes S.J.; Gujar G.; Epstein G.; On	Governing evolution: A socioecological comparison c	2020	Ambio	46
	Carrière Y.; Degain B.A.; Harpold V.S.; Unnithan G.C.; Tabashr	Gene Flow between Bt and Non-Bt Plants in a Seed	2020	J. Economic Entomology	12
	Clark S.E.; Magrane E.; Baumgartner T.; Bennett S.E.K.; Bogar	6&6: A Transdisciplinary Approach to Art-Science Co	2020	BioScience	6
*	Comeau G.; Zinna R.A.; Scott T.; Ernst K.; Walker K.; Carrière	Vertical transmission of zika virus in aedes aegypti pr	2020	American J. Tropical Medicine & H	5
*	Corby-Harris V.; Deeter M.E.; Snyder L.; Meador C.; Welchert A	Octopamine mobilizes lipids from honey bee (Apis me	2020	J. Experimental Biology	9
*	Dalenberg H.; Maes P.; Mott B.; Anderson K.E.; Spivak M.	Propolis envelope promotes beneficial bacteria in the	2020	Insects	17
*	Doremus M.R.; Stouthamer C.M.; Kelly S.E.; Schmitz-Esser S.;	Cardinium Localization During Its Parasitoid Wasp Ho	2020	Frontiers in Microbiology	6
	Fabrick J.A.; LeRoy D.M.; Unnithan G.C.; Yelich A.J.; Carrière	Shared and Independent Genetic Basis of Resistanc	2020	Scientific Reports	8
	Fabrick J.A.; Mathew L.G.; LeRoy D.M.; Hull J.J.; Unnithan G.C	Reduced cadherin expression associated with resista	2020	Pest Management Science	14
*	Fattorini S.; Mantoni C.; Bergamaschi D.; Fortini L.; Sánchez F.	Activity Density of Carabid Beetles along an Urbanisa	2020	Acta Zoologica Academiae Scienti	1
*	Francois C.L.; Davidowitz G.	Genetic color polymorphism of the whitelined sphinx	2020	J. Insect Science	2
	Fritz M.L.; Nunziata S.O.; Guo R.; Tabashnik B.E.; Carrière Y.	Mutations in a novel cadherin gene associated with	2020	G3: Genes, Genomes, Genetics	8
*	Gutiérrez E.H.J.; Walker K.R.; Ernst K.C.; Riehle M.A.; Davidow	Size as a proxy for survival in Aedes aegypti (Diptera	2020	J. Medical Entomology	4
	Huang J.; Xu Y.; Zuo Y.; Yang Y.; Tabashnik B.E.; Wu Y.	Evaluation of five candidate receptors for three Bt to	2020	Insect Biochemistry & Molecular Bi	30
	Jaworski C.C.; Allan C.W.; Matzkin L.M.	Chromosome-level hybrid de novo genome assemblie	2020	Molecular Ecology Resources	8
	Keaton Wilson J.; Ruiz L.; Davidowitz G.	Within-host competition drives energy allocation trade	2020	PeerJ	2
	Kelemen E.P.; Davidowitz G.; Dornhaus A.	Size variation does not act as insurance in bumble b	2020	Animal Behaviour	9
	Khallaf M.A.; Auer T.O.; Grabe V.; Depetris-Chauvin A.; Ammag	Mate discrimination among subspecies through a cor	2020	Science Advances	21
*	Klein B.A.; Busby M.K.	Slumber in a cell: Honeycomb used by honey bees f	2020	PeerJ	1
	Klotz S.A.; Schmidt J.O.	Autochthonous Chagas Disease: How Are These Inf	2020	American J. Medicine	3
	Li J.; Aidlin Harari O.; Doss A.-L.; Walling L.L.; Atkinson P.W.;	Can CRISPR gene drive work in pest and beneficial	2020	Evolutionary Applications	10
	Luckhart S.; Riehle M.A.	Midgut Mitochondrial Function as a Gatekeeper for M	2020	Frontiers in Cellular & Infection Mic	5
	McCall A.C.; Davidowitz G.; Bronstein J.L.	How high are the costs inflicted by an herbivorous pc	2020	Arthropod-Plant Interactions	4
	McKnight T.A.; Cannings R.A.	Molecular phylogeny of the genus Lasiopogon (Dipte	2020	Zootaxa	0
	Muñoz-Valencia V.; Kähkönen K.; Montoya-Lerma J.; DÍaz F.	Characterization of a New Set of Microsatellite Marke	2020	J. Economic Entomology	1
*	Oduwole O.A.; Oringanje C.M.; Oduola A.O.; Nwachuku N.S.; M	Species composition of Anopheles (Diptera: Culicida	2020	J. Medical Entomology	1
	Pinkerton M.G.; Thompson S.M.; Hodges A.C.; Leppla N.C.; Pal	Laboratory Rearing of Bagrada hilaris (Hemiptera: Pent	2020	Florida Entomologist	0
	Rahimian R.; Shirazi F.M.; Schmidt J.O.; Klotz S.A.	Honeybee Stings in the Era of Killer Bees: Anaphyla	2020	American J. Medicine	10
	Ravenscraft A.; Thairu M.W.; Hansen A.K.; Hunter M.S.	Continent-Scale Sampling Reveals Fine-Scale Turno	2020	Frontiers in Microbiology	4

*	**Sherbrooke S.; Carrière Y.; Palumbo J.C.**	Evaluation of Trap Cropping for Control of Diamondb	**2020**	J. Economic Entomology	2
	Tabashnik B.E.; Carrière Y.; Brewer M.	Evaluating Cross-resistance between Vip and Cry To	**2020**	J. Economic Entomology	34
	Tabashnik B.E.; Liesner L.R.; Ellsworth P.C.; Unnithan G.C.; Fa	Transgenic cotton and sterile insect releases synergi	**2020**	PNAS	51
	Wang J.; Jin H.; Schlenke T.; Yang Y.; Wang F.; Yao H.; Fang C	Lipidomics reveals how the endoparasitoid wasp Pte	**2020**	Biochimica et Biophysica Acta - Mc	5
	Wang J.; Ma H.; Zhao S.; Huang J.; Yang Y.; Tabashnik B.E.; W	Functional redundancy of two ABC transporter protei	**2020**	PLoS Pathogens	50
	Wang J.; Xu D.; Wang L.; Cong S.; Wan P.; Lei C.; Fabrick J.A.;	Bt resistance alleles in field populations of pink bollw	**2020**	Pest Management Science	9
	Wang L.; Ma Y.; Wei W.; Wan P.; Liu K.; Xu M.; Cong S.; Wang J	Cadherin repeat 5 mutation associated with Bt resist	**2020**	Scientific Reports	8
	Barrett M.; Schneider S.; Sachdeva P.; Gomez A.; Buchmann S	Neuroanatomical differentiation associated with alter	**2021**	J. Comparative Physiology A: Neu	6
*	**Bordini I.; Ellsworth P.C.; Naranjo S.E.; Fournier A.**	Novel insecticides and generalist predators support co	**2021**	Biological Control	16
	Carrière Y.; Degain B.A.; Tabashnik B.E.	Effects of gene flow between Bt and non-Bt plants in	**2021**	Pest Management Science	11
*	**Corby-Harris V.; Bennett M.M.; Deeter M.E.; Snyder L.; Meador**	Fatty acid homeostasis in honey bees (Apis mellifera	**2021**	Apidologie	3
	Davidowitz G.	Habitat-centric versus species-centric approaches to	**2021**	Current Opinion in Insect Science	3
*	**Degrandi-Hoffman G.; Corby-Harris V.; Carroll M.; Toth A.L.; Ga**	The importance of time and place: nutrient compositi	**2021**	Insects	12
	Deng Z.; Zhang Y.; Li Y.; Huang K.; Chen X.; Zhang M.; Huang J	Identification and characterization of the masculinizin	**2021**	International J. Molecular Sciences	1
	Diaz F.; Allan C.W.; Markow T.A.; Bono J.M.; Matzkin L.M.	Gene expression and alternative splicing dynamics a	**2021**	BMC Genomics	3
	Diaz F.; Kuijper B.; Hoyle R.B.; Talamantes N.; Coleman J.M.; M	Environmental predictability drives adaptive within- ar	**2021**	Functional Ecology	6
	Fabrick J.A.; LeRoy D.M.; Mathew L.G.; Wu Y.; Unnithan G.C.; Y	CRISPR-mediated mutations in the ABC transporter g	**2021**	Scientific Reports	12
*	**Harrington K.; Carrière Y.; Mostafa A.M.**	Re-evaluating the Economic Injury Level for Alfalfa W	**2021**	J. Economic Entomology	4
*	**Hun L.V.; Cheung K.W.; Brooks E.; Zudekoff R.; Luckhart S.; Ri**	Increased insulin signaling in the Anopheles stepher	**2021**	Insect Biochemistry & Molecular Bi	2
	Janzen T.; Diaz F.	Individual-based simulations of genome evolution wit	**2021**	Methods in Ecology & Evolution	0
	Kavanaugh D.H.; Maddison D.R.; Simison W.B.; Schoville S.D.;	Phylogeny of the supertribe nebriitae (Coleoptera, ca	**2021**	ZooKeys	6
	Klotz S.A.; Smith S.L.; Schmidt J.O.	Kissing bug intrusions into homes in the southwest u	**2021**	Insects	2
	Li S.; Chen S.; Xie X.; Dong S.; Li X.	Identification of wild-type cyp321a2 and comparison	**2021**	Insects	3
	Lue C.-H.; Buffington M.L.; Scheffer S.; Lewis M.; Elliott T.A.; Li	DROP: Molecular voucher database for identification	**2021**	Molecular Ecology Resources	12
	Mortimer N.T.; Fischer M.L.; Waring A.L.; Pooja K.R.; Kacsoh B	Extracellular matrix protein N-glycosylation mediates	**2021**	PNAS	2
*	**Oringanje C.; Delacruz L.R.; Han Y.; Luckhart S.; Riehle M.A.**	Overexpression of activated ampk in the anopheles s	**2021**	Genes	6
	Qi L.; Dai H.; Jin Z.; Shen H.; Guan F.; Yang Y.; Tabashnik B.E.;	Evaluating Cross-Resistance to Cry and Vip Toxins in I	**2021**	Frontiers in Microbiology	4
	Sabino W.O.; Alves-dos-Santos I.; Queiroz E.P.; de Faria L.B.;	Nesting biology of Centris (Paracentris) burgdorfi (Ap	**2021**	J. Apicultural Research	3
	Sames W.J.; Mann J.G.; Kelly R.; Evans C.L.; Varnado W.C.; B	Distribution of culex coronator in the USA	**2021**	J. the American Mosquito Control A	4
	Schmidt J.O.	Everybody loves stinging insects!	**2021**	American Entomologist	2
	Simão-Gurge R.M.; Thakre N.; Strickland J.; Isoe J.; Delacruz I	Activation of anopheles stephensi pantothenate kina	**2021**	Biomolecules	2
	Van Den Berg J.; Prasanna B.M.; Midega C.A.O.; Ronald P.C.;	Managing Fall Armyworm in Africa: Can Bt Maize Sus	**2021**	J. Economic Entomology	14
	Wang J.; Yan Z.; Xiao S.; Wang B.; Fang Q.; Schlenke T.; Ye G	Characterization of a cell death-inducing endonuclea	**2021**	Pest Management Science	2

	Yang F.; Kerns D.L.; Little N.S.; Santiago González J.C.; Tabas	Early warning of resistance to bt toxin vip3aa in helic	**2021**	Toxins	11
	Zhao S.; Jiang D.; Wang F.; Yang Y.; Tabashnik B.E.; Wu Y.	Independent and Synergistic Effects of Knocking ou	**2021**	Toxins	15
	Benowitz K.M.; Allan C.W.; Degain B.A.; Li X.; Fabrick J.A.; Tab	Novel genetic basis of resistance to Bt toxin Cry1Ac i	**2022**	Genetics	5
*	**Brophy M.; Riehle M.A.; Mastrud N.; Ravenscraft A.; Adamson**	Genetic Variation in Rhipicephalus sanguineus s.l. Ti	**2022**	International J. Environmental Res	2
*	**Brophy M.; Walker K.R.; Adamson J.E.; Ravenscraft A.**	Tropical and Temperate Lineages of Rhipicephalus s	**2022**	J. Medical Entomology	0
	Cavallaro M.C.; Medeiros M.J.; Halloran S.; Millar J.G.	Identification and Bioassays of Sex-Specific Compou	**2022**	J. Economic Entomology	1
	Cavallaro M.C.; Sanders C.J.; Hladik M.L.	Measured efficacy, bioaccumulation, and leaching of	**2022**	Pest Management Science	0
	Contreras H.L.; Goyret J.; Pierce C.T.; Raguso R.A.; Davidowit	Eat, Drink, Live: Foraging behavior of a nectarivore w	**2022**	J. Insect Physiology	2
	Davidowitz G.; Bronstein J.L.; Tigreros N.	Flight-Fecundity Trade-offs: A Possible Mechanistic L	**2022**	Frontiers in Plant Science	0
	de A. Caetano C.; de O. Sabino W.; Cordeiro G.D.; Buchmann S	Scientific note about the negative impacts of male co	**2022**	Apidologie	0
	Diaz F.; Allan C.W.; Chen X.; Coleman J.M.; Bono J.M.; Matzkin	Divergent evolutionary trajectories shape the postma	**2022**	Communications Biology	0
*	**Doremus M.R.; Stouthamer C.M.; Kelly S.E.; Schmitz-Esser S.;**	Quality over quantity: unraveling the contributions to c	**2022**	Heredity	3
	Fabrick J.A.; Heu C.C.; LeRoy D.M.; DeGain B.A.; Yelich A.J.; U	Knockout of ABC transporter gene ABCA2 confers re	**2022**	Scientific Reports	1
*	**Gutiérrez E.H.J.; Riehle M.A.; Walker K.R.; Ernst K.C.; Davidow**	Using body size as an indicator for age structure in fi	**2022**	Parasites & Vectors	0
*	**Hunter M.S.; Umanzor E.F.; Kelly S.E.; Whitaker S.M.; Ravenscr**	Development of Common Leaf-Footed Bug Pests Dep	**2022**	Applied & Environmental Microbiolo	3
	Hurtado J.; Revale S.; Matzkin L.M.	Propagation of seminal toxins through binary expres	**2022**	Scientific Reports	1
*	**Ikagawa R.M.; Moore W.**	Molecular phylogeny and revision of species groups	**2022**	ZooKeys	0
	Isoe J.; Petchampai N.; Joseph V.; Scaraffia P.Y.	Ornithine decarboxylase deficiency critically impairs nitr	**2022**	FASEB J.	0
*	**Jankauski M.; Ferguson R.; Russell A.; Buchmann S.**	Structural dynamics of real and modelled Solanum st	**2022**	J. the Royal Society Interface	6
*	**Joy T.; Chen M.; Arnbrister J.; Williamson D.; Li S.; Nair S.; Bro**	Assessing Near-Infrared Spectroscopy (NIRS) for Eva	**2022**	Insects	4
	Kelly S.E.; Moore W.; Hall W.E.; Hunter M.S.	Hiding in plain sight: Cryptic enemies are found on co	**2022**	Ecology and Evolution	0
*	**Kusakabe A.; Wang C.; Xu Y.-M.; Molnár I.; Stock S.P.**	Selective Toxicity of Secondary Metabolites from the	**2022**	Microbiology Spectrum	8
	Moore W.; Scarparo G.; Di Giulio A.	Foe to frenemy: predacious ant nest beetles use mu	**2022**	Current Opinion in Insect Science	1
	Naranjo S.E.; Cañas L.; Ellsworth P.C.	Mortality dynamics of a polyphagous invasive herbivo	**2022**	Pest Management Science	0
*	**Palting J.D.; Moore W.**	Molecular phylogeny of Lichen Tiger Moths (Lepidop	**2022**	ZooKeys	0
*	**Shaible T.M.; Matzkin L.M.**	Physiological and life history changes associated witl	**2022**	Biology open	0
	Smith G.P.; Davidowitz G.; Alarcón R.; Papaj D.R.; Bronstein J	Sex differences in the foraging behavior of a genera	**2022**	Insect Science	4
	Smith G.P.; Davidowitz G.; Raguso R.A.; Bronstein J.L.	Proboscis curling in a pollinator causes extensive pol	**2022**	Ecological Entomology	2
	Tabashnik B.E.; Unnithan G.C.; Yelich A.J.; Fabrick J.A.; Denn	Responses to Bt toxin Vip3Aa by pink bollworm larva	**2022**	Pest Management Science	1
	Thakre N.; Simão Gurge R.M.; Isoe J.; Kivi H.; Strickland J.; De	Manipulation of pantothenate kinase in Anopheles s	**2022**	Insect Biochemistry & Molecular Bi	0
*	**Wagner D.L.; Matson T.A.; Palting J.D.**	A New Norape from the Southwestern United States	**2022**	J. the Lepidopterists' Society	0
	Wang X.; Shi T.; Tang P.; Liu S.; Hou B.; Jiang D.; Lu J.; Yang Y	Baseline susceptibility of Helicoverpa armigera, Plutella	**2022**	Insect Science	2
	Yang F.; Kerns D.L.; Little N.; Brown S.A.; Stewart S.D.; Catcho	Practical resistance to Cry toxins and efficacy of Vip3	**2022**	Pest Management Science	5

	Barrett M.; Fischer B.; Buchmann S.	Informing policy and practice on insect pollinator decli	**2023**	Frontiers in Ecology and Evolution	0
*	**Bordini I.; Naranjo S.E.; Fournier A.; Ellsworth P.C.**	Spatial scale of non-target effects of cotton insecticide	**2023**	PLoS ONE	0
	Britton S.; Davidowitz G.	The effect of diet on melanin pigmentation in animals	**2023**	Functional Ecology	0
	Carrière Y.; Tabashnik B.E.	Fitness Costs and Incomplete Resistance Associated	**2023**	Insects	0
	Cruz A.R.; Davidowitz G.; Moore C.M.; Bronstein J.L.	Mutualisms in a warming world	**2023**	Ecology Letters	0
*	**Deeter M. E.; Snyder L.A.; Meador C.; Corby-Harris V.**	Accelerated abdominal lipid depletion from pesticide	**2023**	J. Experimental Biology	0
	Fabrick J.A.; Li X.; Carrière Y.; Tabashnik B.E.	Molecular Genetic Basis of Lab- and Field-Selected I	**2023**	Insects	4
	Guan F.; Dai X.; Hou B.; Wu S.; Yang Y.; Lu Y.; Wu K.; Tabashn	Refuges of conventional host plants counter domina	**2023**	iScience	0
	Guan F.; Dai X.; Yang Y.; Tabashnik B.E.; Wu Y.	Population Genomics of Nonrecessive Resistance to	**2023**	J. Economic Entomology	1
	Hammer T.J.; Kueneman J.; Argueta-Guzmán M.; McFrederick	Bee breweries: The unusually fermentative, lactobacilli-	**2023**	Frontiers in Microbiology	0
	Moreyra N.N.; Almeida F.C.; Allan C.; Frankel N.; Matzkin L.M.;	Phylogenomics provides insights into the evolution o	**2023**	Molecular Phylogenetics & Evoluti	1
	Pfeiler E.; Nazario-Yepiz N.O.	On the proposed replacement neotype of Telegonus	**2023**	Systematics & Biodiversity	0
	Robinson S.D.; Deuis J.R.; Touchard A.; Keramidas A.; Mueller	Ant venoms contain vertebrate-selective pain-causin	**2023**	Nature Communications	0
	Tabashnik B.E.; Carrière Y.; Wu Y.; Fabrick J.A.	Global perspectives on field-evolved resistance to tra	**2023**	J. Economic Entomology	0
	Tabashnik B.E.; Fabrick J.A.; Carrière Y.	Global Patterns of Insect Resistance to Transgenic B	**2023**	J. Economic Entomology	6
	Taylor W.T.T.; Librado P.; Icu M.H.T.; Gover C.S.C.; Arterberry	Early dispersal of domestic horses into the Great Pla	**2023**	Science	1
	Tigreros N.; Kozhoridze G.; Davidowitz G.; Ziv Y.	Influence of the direct and indirect effects of habitat	**2023**	Landscape Ecology	0
					4649

Book Chapters (9)

	Carrière Y.; Fabrick J.A.; Tabashnik B.E.	Advances in managing pest resistance to Bt crops: F	2016	Advances in Insect Control & Resi	13
	Luján R.; Cupp E.W.	Human onchocerciasis: New immunodiagnostic assay	2018	Biotechnology for Biological Contro	0
	Schmidt J.O.	Arthropod toxins and venoms	2018	Medical & Veterinary Entomology	2
*	**Bondy E.C.; Hunter M.S.**	Sex ratios in the haplodiploid herbivores, Aleyrodidae	2019	Advances in Insect Physiology	4
	Tigreros N.; Davidowitz G.	Flight-fecundity tradeoffs in wing-monomorphic insect	2019	Advances in Insect Physiology	36
*	**Doremus M.R; Hunter M.S.**	The saboteur's tools: Common mechanistic themes a	2020	Advances in Insect Physiology	10
	Mazza A.; Brousseau R.; Tabashnik B.; Masson A.L.	Receptor binding studies on lipid vesicles using the b	2021	Quantitive Analysis Of Biospec	0
	Carrière Y.; Onstad D.W.	The role of landscapes in insect resistance managen	2022	Insect Resistance Management: B	1
	Davis S.; Schlenke T.	Behavioral defenses against parasitoids: Genetic an	2022	Animal Behavior & Parasitism	2

Appendix D2. 24 extramural grants and contracts awarded to UA Department of Entomology for $7.9M in fiscal year 2023 (July 1, 2022 to June 30, 2023).

Lead PI [a]	Title	Source	Start Date	End Date	Amount to UA Entomology
Ellsworth, Peter	Resistance Monitoring	Bayer Crop Science	04/11/2023	01/31/2024	$21,775
Ellsworth, Peter	Improving Insect Management Strategies in Arizona Cotton	Cotton Incorporated	01/01/2023	12/31/2023	$21,000
Ellsworth, Peter	Selectivity of Cotton Insecticides Drive Eco-toxicological Gains & Improve Arizona Cotton	Cotton Incorporated	01/01/2023	12/31/2023	$60,000
Ellsworth, Peter	Acquisition of Goods & Services	United States Department of Agriculture	09/01/2022	08/31/2023	$50,888
Ellsworth, Peter [b]	A Western Integrated Pest Management Center Led by California, Arizona, Oregon, & Utah	United States Department of Agriculture	09/01/2022	08/31/2026	$360,000
Ellsworth, Peter [c]	Building a Climate Smart Domestic Rubber Industry & a Solution for Growers to a Water	United States Department of Agriculture	04/14/2023	04/01/2028	$1,243,134
Gouge, Dawn [d]	Advancing Vector-borne Disease Surveillance in American Indian Communities	National Institutes of Healt	09/01/2022	07/31/2023	$115,125
Gouge, Dawn [e]	Promoting Integrated Pest Management in Affordable Housing	US Department of Housing & Urban	11/24/2022	11/23/2023	$45,098
Hunter, Martha [f]	Symbiont Transmission Constraints & Consequences in an Orchard Bug Pest	United States Department of Agriculture	05/01/2023	04/30/2026	$646,180
Ikagawa, Raine (EIS Student)	Molecular Phylogeny of Brachinine Bombardier Beetles Utilizing Ultraconserved Elements	The Coleopterists Society	08/01/2022	07/31/2023	$5,000
Li, Xianchun	Bench Fees for Mahreen Hanif (visiting student)	Higher Education Commission (Pakistan)	03/01/2023	08/31/2023	$3,500
Matzkin, Luciano	Development of Functional Genomics Tools in Cactophilic Drosophila	National Science Foundation	10/01/2022	09/30/2026	$1,155,403
Matzkin, Luciano	Sequencing & Annotation of the Western Tarnished Plant Bug (*Lygus hesperus*) Genome	United States Department of Agriculture	08/01/2022	07/31/2024	$34,850
Moore, Wendy	Facilitating Collections-Based Research on Insect Pollinators of the Sonoran Desert Region	National Science Foundation	02/01/2023	01/31/2026	$477,610
Palumbo, John	Development of Monitoring Tool for Managing Tospovirus Damage to Lettuce	Arizona Department of Agriculture	10/03/2022	09/30/2024	$57,286
Palumbo, John	Thrips & INSV Management in Desert Lettuce	Arizona Iceberg Lettuce Research Council	09/01/2022	08/31/2023	$25,986
Palumbo, John	Areawide Monitoring of Lettuce Insects in Yuma	Arizona Iceberg Lettuce Research Council	09/01/2022	08/31/2023	$6,443
Palumbo, John	Insecticide Alternatives in Melons	California Melon Research Advisory	03/01/2023	02/29/2024	$13,082
Palumbo, John [g]	Survey of Potential Reservoirs of Impatients Necrotic Spot Virus	Arizona Department of Agriculture	10/18/2022	09/30/2023	$47,229
Palumbo, John [g]	Monitoring the Vector-mediated Movement of INSV into Arizona & Secondary Distribution	Arizona Iceberg Lettuce Research Council	09/01/2022	08/31/2023	$5,150
Riehle, Michael [h]	How to Starve a Parasite: Manipulating CoA Biosynthesis to Control *Plasmodium*	National Institutes of Health	04/13/2023	03/31/2027	$2,472,491
Tabashnik, Bruce	Sustaining Efficacy of Bt Cotton Against Lepidopteran Pests	Cotton Incorporated	02/01/2023	12/31/2023	$32,500
Tabashnik, Bruce	Acquisition of Goods & Services	United States Department of Agriculture	09/01/2022	08/31/2023	$16,829
Walker, Kathleen [i]	Genetic Variation & Endosymbiont Diversity of *Rhipicephalus sanguineus*	Centers for Disease Control	07/01/2022	06/30/2027	$987,337
				Total	**$7,903,895**

[a] Leads the entire project except in 4 cases indicated by superscripts c-e & i (see footnotes below).
[b] Total $1M including $640K to co-PIs not in UA ENTO
[c] Ellsworth is co-PI, total $35M including $34M to collaborators not in UA ENTO
[d] Gouge is co-PI, total $1.1M including $1M to collaborators not in UA ENTO
[e] Gouge is co-PI, total $1.33M including $1.29M to collaborators not in UA ENTO
[f] Total listed includes $96K subaward to co-PI at University of Texas
[g] PI is Samuel Discua Duarte, a postdoc supervised by Dr. Palumbo
[h] Total listed includes $1.2M subaward to collaborator at University of Idaho
[i] Walker is co-PI, total $2M including $1M to collaborators not in UA ENTO

Appendix E1. Rubric for Self-Assessing Entomology Teaching Quality

Indicate the self-assessment rating with a brief rationale in the appropriate cell.			Criteria for Assessing Teaching Quality
Exemplary	**Developing**	**Needs Development**	
High quality reflected by strong SCS scores (Figs. E1, E2) & strong peer evaluations			**Expectations for Teaching Quality**: A department is EXEMPLARY for this criterion if it has established a set of expectations for high-quality teaching at all levels of the curriculum that are clearly conveyed to all instructors. Expectations are based upon effective teaching practices demonstrated to improve student learning outcomes. All instructors are held to these expectations to the extent that is appropriate to the classes they teach and the terms of their appointments.
Teaching excellence is emphasized as part of recruiting. Several faculty participate in FLCs.			**Support for Teaching Development**: A department is EXEMPLARY for this criterion if it has in place standard processes for encouraging professional development towards high quality teaching across the whole unit. These processes include the provision of clear information about and ready access to resources, inside and outside the department that can help all instructors develop the quality of their teaching. All these processes are aligned with the department's established expectations for teaching quality. Avenues for development may include, but need not be limited to, peer coaching, consultations with UCATT, and support for attending workshops and conferences focused on enhancing the quality of teaching.
Evaluating teaching is a key part of recruiting, annual reviews, as well as P&T reviews.			**Evaluation of Teaching**: A department is EXEMPLARY for this criterion if it has an established and transparent process for evaluating teaching quality for all instructors. The evaluation criteria are tightly linked to the department's established set of expectations for teaching quality. The evaluation process includes, but is not limited to, student evaluations, peer evaluation of teaching, and instructor self- reflection. Evaluating teaching quality is a key part of annual reviews as well as promotion and tenure reviews.
High quality reflected by strong SCS scores (Figs. E1, E2) & strong peer evaluations			**Applying Findings to Teaching Improvements**: A department is EXEMPLARY for this criterion if it has an ongoing process that includes steps in which teaching evaluations are reviewed and incorporated into department plans for both programmatic and individual goals improvement. All steps of this application phase are linked to the department's established set of expectations for teaching quality.

Appendix E2. Student Course Survey Questions and Categories

Assessment
1. I received feedback on course work/assignments that helped me learn.
2. I received feedback on my course work/assignments throughout the semester.

Instruction
3. I was encouraged to analyze and/or apply the concepts and skills taught in this course.
4.The course material and activities (D2L site, assigned readings, presentations, etc.) helped me learn in this course.
5. The course presentations, materials, procedures, and deadlines were clearly organized.

Learning
6. I feel I learned the subject matter well enough to help another student in this course.
7. The learning goals for this course were clear to me.
8. This course expanded my knowledge and skills in this subject matter.
9. This course helped me to connect the concepts and skills we learned to the world around me.

Interactions
10. I regularly/frequently had the opportunity to ask questions about concepts and skills in this course.
11. I was treated with respect in this course.
12. In this course, I was encouraged to participate through class activities, projects, and/or assignments.

Appendix E3. Student Survey Scores for Undergraduate (ENTO) Courses, 2020-Spring 2023

Course	Term	Enrolled	Responded	Assessment	Instruction	Learning	Interactions
160	Summer 2020	5	3	100%	100%	100%	100%
160	Summer 2020	17	7	83%	89%	88%	90%
160	Fall 2020	21	13	100%	100%	96%	92%
160	Fall 2020	97	60	98%	96%	91%	93%
160	Spring 2021	45	23	98%	96%	95%	99%
160	Fall 2021	186	117	91%	88%	86%	93%
160	Spring 2022	114	75	87%	92%	92%	93%
160	Summer 2022	17	3	100%	89%	100%	100%
160	Fall 2022	157	88	90%	89%	87%	90%
160	Spring 2023	132	59	87%	92%	86%	91%
170	Fall 2020	103	40	83%	90%	86%	97%
170	Spring 2021	27	4	50%	75%	75%	82%
170	Spring 2021	165	29	83%	92%	91%	93%
170	Summer 2021	12	6	100%	83%	88%	100%
170	Fall 2021	82	24	83%	81%	77%	86%
170	Spring 2022	193	53	82%	98%	92%	95%
170	Fall 2022	135	30	80%	78%	79%	89%
170	Spring 2023	95	20	73%	75%	81%	87%
300	Fall 2020	23	11	100%	100%	100%	100%
300	Fall 2022	22	8	100%	100%	100%	100%
401	Fall 2020	2	2	100%	100%	100%	100%
407	Spring 2022	20	9	100%	96%	100%	100%
407	Spring 2023	25	7	100%	100%	100%	100%
415	Fall 2020	26	12	92%	94%	94%	100%
415	Fall 2021	26	13	89%	97%	98%	100%
415	Fall 2022	24	12	100%	100%	98%	100%
417	Fall 2020	6	5	100%	100%	100%	100%
417	Fall 2022	5	4	75%	83%	81%	100%
432	Fall 2020	27	17	94%	90%	74%	92%
432	Fall 2021	25	11	100%	85%	82%	100%
432	Fall 2022	12	4	100%	100%	94%	100%
436	Spring 2021	12	3	100%	100%	100%	100%
436	Spring 2022	9	4	63%	92%	88%	100%
436	Spring 2023	12	5	100%	100%	100%	100%
457	Spring 2021	19	12	92%	94%	98%	100%
457	Spring 2022	27	14	89%	95%	96%	98%
457	Spring 2023	25	11	100%	100%	98%	100%
468	Fall 2020	20	8	94%	96%	91%	92%
468	Fall 2021	24	4	50%	58%	75%	67%
468	Fall 2022	17	5	80%	100%	100%	100%

Appendix E4. Student Survey Scores for Graduate (EIS) Courses, 2020-Spring 2023

Course	Term	Enrolled	Responded	Assessment	Instruction	Learning	Interactions
501	Fall 2020	7	5	100%	100%	100%	100%
517	Fall 2020	24	16	97%	79%	94%	100%
517	Fall 2022	8	7	86%	91%	89%	100%
532	Fall 2019	10	9	100%	100%	92%	100%
532	Fall 2020	3	2	100%	100%	100%	100%
532	Fall 2021	1	1	100%	100%	100%	100%
532	Fall 2022	3	2	100%	100%	100%	100%
536	Spring 2021	10	5	100%	93%	90%	100%
536	Spring 2022	7	2	100%	100%	100%	100%
536	Spring 2023	6	4	100%	92%	100%	100%
544	Fall 2019	15	10	50%	80%	83%	93%
544	Fall 2021	12	6	92%	83%	92%	100%
553	Fall 2020	17	8	88%	100%	97%	100%
557	Spring 2022	5	1	100%	100%	100%	100%
557	Spring 2023	6	3	100%	100%	100%	100%
596	Fall 2019	21	14	50%	88%	91%	100%
596	Fall 2020	10	6	83%	100%	100%	100%
596	Spring 2021	10	6	100%	100%	96%	100%
596	Fall 2021	10	4	75%	100%	100%	100%
596	Spring 2022	13	5	60%	73%	95%	100%
596	Fall 2022	8	5	80%	93%	100%	100%
596	Spring 2023	7	3	100%	100%	100%	100%

Appendix E5. Curriculum Vitae of the 18 Core Entomology Faculty

Yves Carrière

Education

1986 MSc. Laval University, Sainte-Foy, QC, Canada
1991 PhD. Simon Fraser University, Burnaby, BC, Canada

Experience

1992-1993 NSERC Postdoctoral Fellow, McGill University
1994-1995 FCAR Postdoctoral Fellow, McGill University
1996-1998 Adjunct Professor. Department of Plant Sciences, Laval University
1998-2003 Assistant Professor, Department of Entomology, The University of Arizona
2003-2006 Associate Professor, Department of Entomology, The University of Arizona
2006-present Professor, Department of Entomology, The University of Arizona

Selected Recent Synergistic Activities, Honors, and Awards

2015-17 Invited Participant, SESYNC Pursuit: Socio-ecological governance of resistance evolution (NSF funded)
2017 Fellow, Entomological Society of America (ESA)
2020 Panel Member, USDA Office of Scientific Quality Review (OSQR). National Program Crop and Quarantine
2021 Plant-Insect Ecosystem Integrated Pest Management Team Award, Entomological Society of America
2021 Panel Member, USDA-NIFA Biotechnology Risk Assessment Grants (BRAG) Program
2023 Lifetime Achievement Award in Entomology, ESA, Plant-Insect Ecosystems Section

Selected Publications (55 since 2016, total 241; Google scholar citations: 17,494; *h*-index: 66)

Carrière Y. and D. W. Onstad. 2023. The role of landscapes in insect resistance management. Pp. 329-380. In: D. W. Onstad & L. M. Knolhoff, eds., Insect Resistance Management: Biology, Economics & Prediction, 3rd Ed. Academic Press. Elsevier, UK.

Carrière, Y., Tabashnik, B.E. 2023. Fitness costs and incomplete resistance associated with delayed evolution of practical resistance to Bt crops. Insects. 14: 214.

Benowitz, K. M., Allan C. W., Degain, B. A., Li, X., Fabrick, J. A., Tabashnik, B. E., Carrière, Y., and Matzkin, L. M. 2022. Novel genetic basis of resistance to Bt toxin Cry1Ac in *Helicoverpa zea*. Genetics. 221: iyac037

Joy, T., Chen, M., Arnbrister, J., Williamson, D., Li, S., Nair, S., Brophy, M., Madera Garcia, V., Walker, K., Ernst, K., Gouge, D., Carrière Y., and M. A. Riehle. 2022. Assessing near-infrared spectrophotometry (NIRS) for evaluation of *Aedes aegypti* population age structure in Arizona. Insects. 13: 360.

Tabashnik, B. E., L. R. Liesner, P. C. Ellsworth, G.C. Unnithan, J. A. Fabrick, S. E. Naranjo, X. Li, T. J. Dennehy, L. Antilla, R.T. Staten, and Y. Carrière. 2021. Genetically engineered cotton synergizes eradication of the pink bollworm a century after its invasion of the United States. Proceedings of the National Academy of Sciences USA. 118: e2019115118

Van den Berg, J., B. M. Prasanna, C. A. O. Midega, P. C. Ronald, Y. Carrière, and B. E. Tabashnik. 2021. Managing fall armyworm in Africa: Can Bt maize sustainably improve control? Journal of Economic Entomology. 114: 1934-1949.

Carrière, Y., Brown, Z. S., Downes, S. J., Gujar, G., Epstein, G., Omoto, C., Storer, N. P., Mota-Sanchez, D., Søgaard Jørgensen, P., and Carroll, S. P. 2020. Governing evolution: a socio-ecological comparison of resistance management for insecticidal transgenic Bt crops among four countries. AMBIO. 49: 1-16.

Carrière, Y., Brown, Z., Aglasan, S., Dutilleul, P., Carroll, M., Head, G., Tabashnik, B. E. Søgaard Jørgensen, P., and Carroll, S. P. 2020. Crop rotation mitigates impacts of corn rootworm resistance to transgenic Bt corn. PNAS. 117: 18385-18392.

Carrière, Y., Degain, B. A., Yelich, A. J., Unnithan, G. C., Harpold, V. S., Kim, J. H., Mathew, J. G., Head, G. P., Rathore, K. S., Fabrick, J. A., and Tabashnik, B. E. 2019. Gossypol in cottonseed increases the fitness cost of resistance to Bt cotton in pink bollworm. Crop Protection. 126: 104914126.

Søgaard Jørgensen, P., Aktipis, A., Brown, Z., Carrière, Y., et al. 2018. Antibiotic and pesticide susceptibility and the anthropocene operating space. Nature Sustainability. 1: 632-641.

Tabashnik, B. E. and Carrière Y. 2017. Surge in insect resistance to transgenic crops and prospects for sustainability. Nature Biotechnology. 35: 926-935.

Carrière Y., Fabrick, J. A. and Tabashnik, B. E. 2016. Can pyramids and seed mixtures delay resistance to Bt crops? Trends in Biotechnology. 34: 291-302.

Goggy Davidowitz

Education

Hebrew University of Jerusalem, Israel	Biology	B.Sc.	1986
Hebrew University of Jerusalem, Israel	Zoology	M.Sc.	1989
University of Arizona	Ecology & Evolutionary Biology	Ph.D.	1998

Experience

2018-present	Affiliated Faculty, Controlled Environment Agriculture Center
2018-present	Full Professor, Department of Entomology, University of Arizona (UA)
2013-2018	Associate Professor, Department of Entomology, UA
2009-2013	Assistant Professor, Department of Entomology, UA
2011-present	Joint Faculty Member, Dept. of Ecology and Evolutionary Biology, UA
2007-2008	Program Director, Division of Integrative Organismal Systems, National Science Foundation
1999-2002	Research Associate, Department of Biology, Duke University

Synergistic Activities, Honors and Awards

2023	Fellow, American Association for the Advancement of Science
2018	University Distinguished Scholar, UA
2017	Visiting Eminent Ecologist, Kellogg Biological Station, Michigan State University
2011-2017	NSF CAREER Award ($972,000)
2009-2018	Associate Editor, Functional Ecology

Patents Pending

2022 Grasshopper Harvesting System (PCT/US22/26786)
2021 Solar Tower to Dry Food Waste on a Large Scale (PCT/US21/48651).

Selected Publications (88 total)

Cruz, A. R., **Davidowitz, G**., Moore, C., Bronstein, J. L. (2023). Mutualisms in a Warming World. *Ecology Letters* 26:1432-1451.

Britton S. and **G. Davidowitz** (2023). The effects of diet on melanin pigmentation in animals. *Functional Ecology* 37:206-217.

Davidowitz, G., J. Bronstein, N. Tigreros (2022). Flight-fecundity tradeoffs, a possible mechanistic link in plant-herbivore-pollinator systems. *Frontiers in Plant Science* 13:843506.

Slagle M. L., **G. Davidowitz** (2022). Substrate composition effect on growth of *Cotinis mutabilis* larvae: a case for detritivore scarabs in the insect agriculture industry. *Journal of Insects as Food and Feed* 8:937-949

Davidowitz G. (2021). Habitat-centric versus species-centric approaches to edible insects for food and feed. *Current Opinion in Insect Science* 48:37-43.

Johnson, C.A., G. P. Smith K. Yule, **G. Davidowitz**, J. L. Bronstein, and R. Ferriere (2021). Coevolutionary transitions from antagonism to mutualism explained by the Co-Opted Antagonist Hypothesis. *Nature Communications* 12:1-11.

Tigreros N., and **G. Davidowitz** (2019). Flight-fecundity tradeoffs in wing-monomorphic insects. *Advances in Insect Physiology* 0065-2806.

Levin, E., G. Lopez-Martinez, B. Fane, **G. Davidowitz**. (2017). Hawkmoths use nectar sugar to reduce oxidative damage from flight. *Science* 355:733-735.

Davidowitz, G., D.A. Roff, H. F. Nijhout. (2016). Synergism and antagonism of proximate mechanisms enable and constrain the response to simultaneous selection on body size and development time: an empirical test using experimental evolution. *The American Naturalist* 188: 499-520.

Von Arx M., J. Goyret, **G. Davidowitz**, and R.A. Raguso. (2012). Floral humidity as a reliable sensory cue for profitability assessment by nectar-foraging hawkmoths. *Proceedings of the National Academy of Sciences USA* 109: 9471-9476.

Stillwell, R.C., W. Blanckenhorn, T. Teder, **G. Davidowitz**, and C.W. Fox. (2010). Sex differences in phenotypic plasticity of body size and variation in sexual size dimorphism – from physiology to ecology. *Annual Review of Entomology* 55:227-245

Riffell, J.A., R. Alarcón, L. Abrell, **G. Davidowitz**, J. L. Bronstein, and J. G. Hildebrand. (2008). Behavioral consequences of innate preferences and olfactory learning in hawkmoth-flower interactions. *Proceedings of the National Academy of Science USA* 105:3404-3409.

Peter C. Ellsworth

Education

Ph.D.	Entomology (Minor: Crop Science), North Carolina State University, 1990
M.S.	Entomology, University of Missouri at Columbia, 1985
B.S.	Entomology (Minor: Latin), University of New Hampshire, 1981

Experience

2013 – present	**Co-Director**, Western Regional IPM Center, USDA-NIFA at UC-Davis
2004 – present	**IPM Coordinator**, Cooperative Extension, University of Arizona
2003 – present	**Director** of the Arizona Pest Management Center (APMC), Univ. of Arizona
2002 – present	**Full Specialist / Professor**, IPM, Dept. of Entomology, University of Arizona
2009 – 2019	**Pesticide Coordinator**, Pesticide Safety Education Program, University of Arizona
1996 – 2002	**Associate Specialist / Professor**, IPM, Department of Entomology, University of Arizona
1991 – 1996	**Assistant Specialist / Professor**, IPM, Department of Entomology, University of Arizona

Synergistic Activities, Honors and Awards (recent & selected)

2022 Cooperative Extension Faculty of the Year, University of Arizona
2022 USDA AFRI Critical Agricultural Research & Extension Panel Manager (12 panelists / 45 proposals / $6.9M)
2022 USDA CPPM Applied Research & Development Program Panel Manager (18 panelists / 63 proposals / $5M)
2021 Perry L. Adkisson Distinguished Speaker Award, Texas A&M University
2021 IPM Team Award for the Arizona Pink Bollworm Project, Entomological Society of America
2021 Recognition Award for Excellence in Cotton IPM, Corteva Agriscience and the National Cotton Council
2016 Outstanding Advisory Council Member Award, Central Arizona College
2014 Award for Excellence in IPM, Entomological Society of America & Syngenta Crop Protection
2014 Award for Excellence in Integrated Pest Management, Pacific Branch Entomological Society of America
2012 Pesticide Environmental Stewardship Program Gold Tier Shining Star Award to APMC from US EPA
2011 Distinguished Achievement Award in Extension, Pacific Branch of the Entomological Society of America
2010 Outstanding Journal Article Award, Western Agricultural Economics Association
2009 Harold Gunderson Memorial Lecture in Entomology, Iowa State University
2009 APMC Team Program Award, Honorable Mention, Western Region Extension Directors
2002 Faculty Member of the Year, 'Ag' 100 Council of Alumni of CALS, University of Arizona

Publications (books, book chapters, key recent journal and Extension articles)

Asiimwe, P, CR Brown, PC Ellsworth, DD Reisig, L Bertho, C Jiang, A Schapaugh, G Head, L Burzio. 2023. Transgenic cotton expressing Mpp51Aa2 does not adversely impact beneficial non-target Hemiptera in the field. Crop Protection (*in press*).

Bordini I, Naranjo SE, Fournier A, Ellsworth PC. 2023. Spatial scale of non-target effects of cotton insecticides. PLOS ONE 18(5): e0272831.

Naranjo SE, Cañas, L, Ellsworth PC. 2022. Mortality dynamics of a polyphagous invasive herbivore reveal clues in its agroecosystem success. Pest Management Science 78:

Tabashnik, BE, LR Liesner, PC Ellsworth, GC Unnithan, JA Fabrick, SE Naranjo, X Li, TJ Dennehy, L Antilla, RT Staten, Y Carrière. 2021. Transgenic cotton and sterile insect releases synergize eradication of pink bollworm a century after it invaded the United States. PNAS. 118.

Bordini IC, Ellsworth PC, Naranjo SE, Fournier AJ. 2021. Novel insecticides and generalist predators support conservation biological control in cotton. Biol. Control, 154.

Naranjo, SE, GB Frisvold, PC Ellsworth. 2019, Economic Value of Arthropod Biological Control. Chapter 4, In, The Economics of Integrated Pest Management of Insects. Onstad, DW & PR Crain, eds. CABI, pp. 49–85.

Reisig, D, PC Ellsworth, E Hodgson. 2019, The Roles of Soft Technologies and Cooperative Extension in Solving Wicked IPM Problems. Chapter 9, Ibid. pp. 155–178.

Akbar, W, Gowda, …Ellsworth, PC, Godfrey, LD and Clark, TL (2019), First transgenic trait for control of plant bugs and thrips in cotton. Pest. Manag. Sci. https://doi.org/10.1002/ps.5234

Anderson JA, Ellsworth PC, Faria JC, Head GP, Owen MDK, Pilcher CD, Shelton AM, Meissle M. Genetically Engineered Crops: Importance of Diversified Integrated Pest Management for Agricultural Sustainability. Frontiers in bioengineering and biotechnology 2019;7 24. https://doi.org/10.3389/fbioe.2019.00024

Vandervoet, T.F., P.C. Ellsworth, Y. Carrière, S.E. Naranjo. 2018. Quantifying Conservation Biological Control for Management of Bemisia tabaci (Hemiptera: Aleyrodidae) in Cotton, Journal of Economic Entomology, Volume 111, Issue 3, 28 May 2018, pp. 1056–1068, https://doi.org/10.1093/jee/toy049

Farrar, James, Peter C Ellsworth, et al.; Assessing Compatibility of a Pesticide in an IPM Program, Journal of Integrated Pest Management, V9(1), 1/1/2018, 3, https://doi.org/10.1093/jipm/pmx032

Ellsworth, P.C., A. Fournier, G. Frisvold and Naranjo, S.E. 2017. Chronicling the Socio-economic Impact of Integrating Biological Control, Technology, and Knowledge over 25 years of IPM in Arizona. In Proc. 5th Int'l. Symposium on Biological Control of Arthropods, P.G. Mason et al. eds. CABI, Langkawi, Malaysia. Sept. 11–15, 2017. pp. 214–216. https://www.cabi.org/cabebooks/FullTextPDF/2017/20173267495.pdf

Alfred J. Fournier

Education

Ph.D.	Entomology, Purdue University, West Lafayette, IN. May 2005.
M.S.	Entomology (IPM track), University of Maryland, College Park, MD. May 1997.
B.S.	Biology, George Washington University, Washington, DC., May 1992.

Experience

2023 – present	**Associate Specialist & Associate Professor**, Entomology, University of Arizona
2018 – 2023	**Associate Specialist**, Entomology, University of Arizona
2012 – present	**Coordinator,** Southwestern IPM Network, Western IPM Center, University of California Davis
2011 – 2018	**Associate Specialist and Adjunct Scientist**, Entomology, University of Arizona
2007 – 2011	**Assistant Specialist and Adjunct Scientist**, Entomology, University of Arizona
2005 – present	**IPM Program Manager & Assoc. Director**, Arizona Pest Management Center, University of Arizona Cooperative Extension, Maricopa Agricultural Center, Maricopa, AZ

Synergistic Activities, Honors and Awards (recent & selected)

2023	USDA-NIFA, Applied Research and Development Program, grant panel member
2012	Gold Tier Shining Star Award, U.S. EPA to the Arizona Pest Management Center
2009	Award of Excellence, UA IPM Extension Program, Western Extension Directors' Association
2008	Outstanding Work & Dedication to Crop Protection Industry, Arizona Crop Protection Association
2007	Outstanding Contributions to National IPM in Schools Effort, U.S. Environmental Protection Agency

Selected Grants (funded)

2023 – 2024	**$99,990**. Ellsworth, P.C. & A.J. Fournier. Advancing US Cotton IPM. Better Cotton's Large Farm Growth and Innovation Fund.
2022 – 2026	**$360,000**. Ellsworth, P.C. & A.J. Fournier. A Western Integrated Pest Management Center Led by California, Arizona, Oregon, and Utah; Signature Program Area: Crop Pest Losses & Impact Assessment; Regional IPM Information Network.
2021 – 2024	**$854,873.** Ellsworth, P.C., A.J. Fournier. USDA-NIFA CPPM, Extension Implementation Program. The Arizona Pest Management Center: Supporting Adoption of High-Impact IPM Programs in Diverse Environments.
2021 – 2023	**$129,912.** Fournier, A.J., P.C. Ellsworth, W. Dixon, J. Peterson. USDA-AMS, Specialty Crops Block Grant Program. Pesticide Data Impacts Registration Review Outcomes for Specialty Crops.
2020 – 2023	**$747,964.** MacLean, M.F., A.J. Fournier, P. Beamer, A.F. Arellano, E.J. Bedrick. 2020. National Institute of Environmental Health Sciences. Prenatal Exposure to Pesticide Mixtures and Childhood ADHD. National Institute of Environmental Health Sciences.

Selected Publications

Furlong, M.A., K.C. Paul, K.L. Parra, A.J. Fournier, P.C. Ellsworth, M.G. Cockburn, A.F. Arellano, E. Bedrick, P.I. Beamer, B. Ritz. 2023. Pre-Conception and First Trimester Exposure To Pesticides And Associations With Stillbirth. American Journal of Epidemiology. 23 pp. (submitted 6/30/23)

Bordini, I., S.E. Naranjo, A.J. Fournier, P.C. Ellsworth. 2023. Spatial Scale of Non-Target Effects of Cotton Insecticides. PLOS ONE. 25 pp. https://doi.org/10.1371/journal.pone.0272831

Bordini IC, Ellsworth PC, Naranjo SE & Fournier AJ. 2021. Novel Insecticides and Generalist Predators Support Conservation Biological Control in Cotton. Biological Control, 154. https://doi.org/10.1016/j.biocontrol.2020.104502.

Farrar, J.J., P.C. Ellsworth, R. Sisco, M.E. Baur, A. Crump, A.J. Fournier, M.K. Murray, P.C. Jepson, C.M. Tarutani, K.W. Dorschner. 2018. Assessing Compatibility of a Pesticide in an IPM Program. Journal of Integrated Pest Management, 9(1): 3. https://doi.org/10.1093/jipm/pmx032

Crump, A., J. Farrar, A. J. Fournier, and P. C. Ellsworth. 2018. Employing California Pesticide Use Data for Evaluating Integrated Pest Management Programs and Informing Pesticide Policy and Regulation. In, Managing and analyzing pesticide use data for pest management, environmental monitoring, public health, and policy. American Chemical Society, Chapter 11, pp. 225-237. DOI: 10.1021/bk-2018-1283.ch011. (Invited)

Dawn Heather Gouge

Education

University of Wales, UK	Applied Biology	BSc 1990
University of Reading, UK	Entomology/Nematology	PhD 1994

Experience

2016-present	Professor and Specialist since July 2016 – present.
2007-2016	Associate Professor and Associate Specialist, Dept. of Entomology, University of Arizona.
2000-2007	Assistant Professor and Assistant Specialist, Dept. of Entomology, University of Arizona.
1998-2000	Assistant Professor, Dept. of Entomology, Texas A&M University
1995-1998	Postdoctoral Research Associate, USDA-ARS, Western Cotton Research Lab, AZ.

Selected Recent Synergistic Activities, Honors and Awards

2011-present	Editorial Board member, Entomological Society of America Journal of Integrated Pest Management.
2018	International IPM Award of Excellence – Practitioner Award, 9th International IPM Symposium, Denver, CO.
2018-2022	Steering Committee Co-Chair & Student & Early Career Scientist Co-chair, 10th International IPM Symposium 2022.
2022-present	Steering Committee Co-Chair, 11th International IPM Symposium 2025.
2022-present	U. S. Environmental Protection Agency, Pesticide Program Dialog Committee, Federal Advisory Committee Act Member.
2022	Beyond the Field and Into the Community. 10th International IPM Symposium, February 28-March 3, Denver, CO. Invited.

Selected recent publications

Gouge, D.H. 2023. Sonoran desert mosquitoes: a story about water, heat, housing and WNV. Wing Beats, Vol. 34:12-25.

Gouge, D. H., Lame, M. L., Stock, T. W., Rose, L. F., Hurley, J. A., Lerman, D. L., Nair, S., Nelson, M. A., Gangloff-Kaufmann, J., McSherry, L., Connett, J. F., Graham, L., and Green, T. A. 2023. Improving environmental health in schools. Current Problems in Pediatric and Adolescent Health Care. https://doi.org/10.1016/j.cppeds.2023.101407.

Selected active grants

Gouge, D. H., Li, S., Nair, S. October 2022 – November 2023. Promoting Integrated Pest Management in Affordable Housing. U.S. Department of Housing and Urban Development, $45,098.

Gouge, D. H., Walker, K. R., Li, S., Nair, S. September 2022 – August 2026. Advancing Vector-borne Disease Surveillance in American Indian Communities in Arizona. National Institutes of Health - Inter Tribal Council of Arizona, Inc. The Native American Research Centers for Health (NARCH) 12 Grant, $439,881.

Gouge, D. H., Walker, K. R. June 2023 – May 2024. Using K-12 Schools as Information Hubs to Improve Environmental Health. U.S. Centers for Disease Control and Prevention - State of Arizona, Department of Health Services. A part of the University of Arizona Center for Rural Health - Advancing Health Equity, Addressing Disparities Program, $241,760.

Martha S. Hunter

Education

Brown University	Biology	BA, 1980
Cornell University	Entomology	MS, 1987
Cornell University	Entomology	PhD, 1991

Experience

2007-present	Professor, Dept. of Entomology, University of Arizona.
2011-present	Joint Professor, Dept. of Ecology & Evolutionary Biology, University of Arizona.
2002-2007	Associate Professor, Dept. of Entomology, University of Arizona.
1996-2002	Assistant Professor, Dept. of Entomology, University of Arizona.
1993-1996	Assistant Research Scientist and Visiting Member of the Graduate Faculty, Dept. of Entomology, Texas A&M University.
1993	Postdoctoral Research Associate, Dept. of Entomology, Texas A&M University.
1991-1992	NATO Postdoctoral Research Fellow, & NSF International Programs Postdoctoral Fellow, Imperial College at Silwood Park, University of London.

Synergistic Activities, Honors and Awards

2010-present	**Chair**, Graduate Interdisciplinary Program in Entomology and Insect Science, University of Arizona
2015	**David E. Cox Faculty Teaching Award**, College of Agriculture and Life Sciences, University of Arizona
2016	**Honored Faculty**, Graduate Interdisciplinary Programs, University of Arizona
2017	**Fellow**, American Academy for the Advancement of Science (AAAS)
2018	**Fellow**, Japan Society for the Promotion of Science
2019	**Annual H.R. MacArthur Speaker**, Simon Fraser University, Vancouver, Canada.
2019	**Keynote speaker**, Yosemite Symbiosis Workshop.
2019	**Keynote speaker**, Eighth International Conference on Molecular Insect Science. Sitges, Spain.
2020	**Annual Al Royce Lecturer** University of California, Riverside, Department of Entomology,
2021	**Fellow**, Entomological Society of America
2022	**Eminent Researcher Award**, Division of Agriculture, Life and Veterinary Sciences and Cooperative Extension, University of Arizona

Current funding (2023)

2023-2026 Principal Investigator, USDA NIFA, *Symbiont transmission contstraints and consequences in the orchard bug pest* Leptoglossus zonatus. Co-PI Alison Ravenscraft. $646,180 total, $550,360 for the Hunter laboratory.

2020-2024 Principal Investigator, NSF IOS, *Collaborative Research: The saboteur's tools: Mechanisms for host reproductive manipulation by the bacterial arthropod symbiont* Cardinium hertigii. Other PIs: Stephan Schmitz-Esser and Manuel Kleiner, $1,200,000 total, $375,000 for the Hunter laboratory. June 15, 2020 – June 14, 2024.

Selected publications since 2016 (90 total)

Gebiola, M., S.E. Kelly, P. Hammerstein, M. Giorgini, and **M.S. Hunter** 2016. "Darwin's corollary" and cytoplasmic incompatibility induced by *Cardinium* may contribute to speciation in *Encarsia* wasps (Hymenoptera: Aphelinidae). *Evolution.* 70: 2447–2458.

Gebiola, M., M. Giorgini, S.E. Kelly, P. Feree, **M.S. Hunter** 2017. Cytological analysis of cytoplasmic incompatibility induced by *Cardinium* suggests convergent evolution with its distant cousin *Wolbachia. Proceedings of the Royal Society, Series B.* 284:20171433.

Doremus, M.R., S.E. Kelly and **M.S. Hunter** 2019. Exposure to opposing temperature regimes causes comparable effects on *Cardinium* density but contrasting effects on *Cardinium*-caused cytoplasmic incompatibility. *PLoS Pathogens.* 15: e1008022

Doremus, M.R., C.M. Stouthamer, S.E. Kelly, S. Schmitz-Esser, **M.S. Hunter** 2020. *Cardinium* localization during its parasitoid wasp host's development provides insights into cytoplasmic incompatibility. *Frontiers in Microbiology* 11: 606399

Hunter, M.S., E.F. Umanzor, S.E. Kelly, S.M. Whitaker, A. Ravenscraft 2022. Development of common leaf-footed bug pests depends on the presence and identity of their environmentally-acquired symbionts. *Applied and Environmental Microbiology* 88:e01778-21

Michele Lanan

Education

2004	BA Biology, Pomona College, Claremont CA
2010	PhD Insect Science and Entomology, University of Arizona

Experience

2010-2014	NIH Postdoctoral Excellence in Research and Teaching Fellow, University of Arizona
2014-2017	Herbert Reich Chair of the Natural Sciences, Deep Springs College, CA
2017-2022	Resident Research Scientist, American Museum of Natural History's Southwest Research Station, Portal AZ
2022-present	Assistant Professor of Practice, Department of Entomology, University of Arizona

Synergistic Activities, Honors and Awards

2009	NSF Graduate STEM Fellow in K-12 Education (GK-12)
2010-2014	NIH Postdoctoral Excellence in Research and Teaching Fellowship
2014	Academic Program Review Committee, Entomology Department, University of Arizona
2014-2017	Faculty Committee, Deep Springs College
2014-2017	Applications Committee, Deep Springs College
2016	Staff Hiring Committee, Deep Springs College
2020-2022	Conservation Chair, Secretary, Cochise County Cavers chapter of National Speleological Society
2019	Invited speaker, Institute for Evolution and Biodiversity, Münster, Germany
2021	Invited speaker, Rutgers University
2022-present	Member, Curriculum Committee, Department of Entomology, University of Arizona

Selected Publications

Sawh, I., Bae, E., Camilo, L., Lanan, M., Lucky, A., Menezes, H., Fiorentino, G., Sosiak, C., Khadempour, L., Barden, P. 2023. The first fossil replete ant worker establishes living food storage in the Eocene. Myrmecological News 33: 139-147.

Lanan, M., In Starr, C. K. 2019. Extrafloral Nectar, Encyclopedia of social insects. Springer Nature Living Reference.

Lanan, M., In Starr, C. K. 2019. Honeydew, Encyclopedia of social insects. Springer Nature Living Reference.

Lanan, M. C. Rodriguez, P. A., Agellon, A., Jansma, P., Wheeler, D. 2016. A bacterial filter protects and structures the gut microbiome of an insect. The ISME Journal 10 (8): 1866-1876.

Lanan, M. C. 2014. Spatiotemporal resource distribution and foraging strategies of ants (Hymenoptera: Formicidae). Myrmecological News, invited review 20: 53-70.

Fitzpatrick, G., Lanan, M. C., Bronstein, J. 2014. Thermal tolerance affects mutualist attendance in an ant-plant mutualism. Oecologia 176(1): 129-138.

Anderson, K. E., Carroll, M. J., Sheehan, T., Lanan, M. C., Mott, B. M., Maes, P., Corby-Harris, V. 2014. Hive-stored pollen of honey bees: many lines of evidence are consistent with pollen preservation, not nutrient conversion. Molecular Ecology 23: 5904-5917.

Lanan, M. C., Bronstein, J. 2013. An ants-eye view of an ant-plant protection mutualism. Oecologia 172(3): 779-790.

Lanan, M.C., Dornhaus, A., Jones, E., Waser, A., Bronstein J., 2012. The trail less traveled: individual decision-making and its effect on group behavior. PLoS ONE 7(10): e47976.

Lanan, M. C., Dornhaus, A., Bronstein, J., 2011. The function of polydomy: the ant Crematogaster torosa preferentially forms new nests near food sources and fortifies outstations. Behavioral Ecology and Sociobiology 65(5): 959-968.

Lanan, M. C., Bronstein, J. 2009. Review of: Bernhard Stadler and Tony Dixon (2008) Mutualism: Ants and Their Insect Partners. Myrmecological News 12: 138.

Xianchun Li

Education

2000-2003 PhD in Entomology, University of Illinois at Urbana-Champaign
1986-1990 MS in Insect Physiology & Toxicology, Nanjing Agricultural University, Nanjing, P. R. China
1980-1984 BS in Plant Protection, Southwest Agricultural University, Chongqing, P. R. China

Experience

2017-present Professor, Department of Entomology, University of Arizona.
2010-2017 Associate Professor, Department of Entomology, University of Arizona.
2004 -2010 Assistant Professor, Department of Entomology, University of Arizona.
2003-2004 Best Postdoctoral Fellowship, Banding & Best Department of Medical Research, U. of Toronto.
1997-2000 Visiting Scholar, Department of Entomology, University of Illinois at Urbana-Champaign.
1995-1997 Associate Professor, Department of Plant Protection, Nanjing Agricultural University
1990-1995 Lecturer, Department of Plant Protection, Nanjing Agricultural University
1984-1990 Assistant Professor, Department of Plant Protection, Nanjing Agricultural University.

Synergistic Activities, Honors and Awards

2022 Invited speaker, Pacific Branch Meeting, Entomological Society of America
2021 IPM Team Award, Entomological Society of America.
2021-present. Editorial Board Member, *Insects*
2012-present Editorial Board and Advisory Panel Member, *Nature Scientific Reports*
2012-2021 Editorial member, *Journal of Insect Science*

Current Grants

2021-2024 PI, NSF of China, Types and mechanisms of the combined action/cross-resistance of Bt toxins and plant allelochemicals. Total award: $378,125
2019-2023 Co-PI, Zhengzhou University, Molecular genetic mechanisms of host range difference among closely related sister species. Total award: $1,529,850.
2022-2024 PI, Syngenta, Susceptibilities of Cry1Ac and/or Cry2Ab-resistant and -susceptible corn earworm to Syngenta insecticidal lead proteins. Total award: $104,440.

Selected Recent Publications (total of 2 books, 5 book chapters, and 150 journal articles; h-index 39, 7123 citations)

Deng, Z., Ren, Y., Guo, L., Xie, X., Wang, L., & **Li, X**. (2023). Genome-wide analysis of G-quadruplex in *Spodoptera frugiperda*. *International Journal of Biological Macromolecules*, 226, 840-852.

Deng, Z., Zhang, Y., Gao, C., Shen, W., Wang, S., Ni, X., Liu, S., & **Li, X.** (2022). A transposon-introduced G-quadruplex motif is selectively retained and constrained to downregulate CYP321A1. *Insect Science*, 29(6), 1629-1642.

Pang, R., Xing, K., Yuan, L., Liang, Z., Chen, M., Yue, X., Dong, Y., Ling, Y., He, X., **Li, X.**, & Zhang, W. (2021). Peroxiredoxin alleviates the fitness costs of imidacloprid resistance in an insect pest of rice. *PLoS Biology*, 19(4), e3001190.

Tabashnik, B. E., Liesner, L. R., Ellsworth, P. C., Unnithan, G. C., Fabrick, J. A., Naranjo, S. E., **Li, X**., Dennehy, T. J., Antilla, L., Staten, R. T., & Carrière, Y. (2021). Transgenic cotton and sterile insect releases synergize eradication of pink bollworm a century after it invaded the United States. *PNAS*, 118(1).

Li, X., Deng, Z., & Chen, X. (2020). Regulation of insect P450s in response to phytochemicals. *Current Opinion in Insect Science*, 43, 108-116.

Wang, S., Zhang, M., Huang, J., Li, L., Huang, K., Zhang, Y., Li, Y., Deng, Z., Ni, X., & **Li, X**. (2020). Inductive and synergistic interactions between plant allelochemical flavone and Bt toxin Cry1Ac in *Helicoverpa armigera*. *Insect Science*.

Li, S., Hussain, F., Unnithan, G. C., Dong, S., UlAbdin, Z., Gu, S., Mathew, L. G., Fabrick, J. A., Ni, X., Carrière, Y., Tabashnik, B. E., & **Li, X.** (2019). A long non-coding RNA regulates cadherin transcription and susceptibility to Bt toxin Cry1Ac in pink bollworm, *Pectinophora gossypiella. Pesticide Biochemistry and Physiology*, 158, 54-60.

Zhang, S., Gu, S., Ni, X., & **Li, X**. (2019). Genome size reversely correlates with host plant range in *Helicovrerpa* species. *Frontiers in Physiology*, 10, 29.

Deng Z, Zhang S, Gu S, Ni X, Zeng W, **Li X.** (2018). Useful Bicistronic Reporter System for Studying Poly(A) Site-Defining cis Elements and Regulation of Alternative Polyadenylation. *Int J Mol Sci.* 19(1):279.

Wei, J., Liang, G., Wu, K., Gu, S., Guo, Y., Ni, X., & **Li, X**. (2018). Cytotoxicity and binding profiles of activated Cry1Ac and Cry2Ab to three insect cell lines. *Insect Science*, 25(4), 655-666.

L. Paulina Maldonado-Ruiz (scheduled to start January 2024 as Assistant Professor, Department of Entomology, UA)

Education

2010	BSc., Biochemistry and Pharmacology (Minor: Microbiology), Universidad Michoacana, Mexico
2015	MSc., Master in Health Sciences (Microbial Genetics), Universidad Michoacana, Mexico
2021	PhD., Entomology, Kansas State University, KS, USA

Experience

2021-present	Postdoctoral Research Associate. Department of Entomology, Kansas State University.
2018	Visiting scholar, Biology Centre of South Bohemia, Czech Republic
2015-2016	College Instructor/Lecturer. Universidad Montrer, College of Nutrition, Mexico
2015- 2015	Lab Technician. Microbial Molecular Genetics Laboratory, Universidad Michoacana
2015	Visiting Scholar. College of Veterinary Medicine, Kansas State University

Recent Synergic Activities, Honors and Awards

2023	**Seminar Speaker**. "Novel approaches to mitigate tick-associated illness," Department of Entomology, University of Arizona.
2023	**Associate editor.** Journal of Insect Science, Entomological Society of America (ESA)
2022	**Early Career Professional Award**. Henry and Sylvia Richardson Research Grant, ESA
2022	**Seminar Speaker.** "No guts, no glory! Tick gut microbiome and its implication for an innovative management strategy*"*. Department of Biology. Pittsburg State University. Pittsburg KS
2022	**Co-organizer.** Virtual Symposium "Arthropod-Microorganisms-Host interactions". Joint Annual Meeting of ESA, Entomological Society of Canada, and Entomological Society of British Columbia, Vancouver, Canada.
2022-present	**Member**, Departmental Seminar Committee. Department of Entomology, Kansas State University
2021-present	**Organizer of the Journal Club.** "Modern Entomological Studies". Kansas State University
2021	**Postdoc/Early Career Award**. American Society for Tropical Medicine and Hygiene
2020	**Graduate Student Mini-Grant**. Department of Entomology, Kansas State University
2016-2020	**Officer** for the student club (Popenoe Entomology Club). Outreach event coordinator (2016-2018), Vice president (2018), President (2018-2019).

Selected Publications since 2019 (12 total)

Maldonado-Ruiz, L.P., Reif, K.E., Ghosh, A., Foré, S., Johnson, R.L. and Park Y. (**submitted**). High levels of alpha-gal with large variations in the salivary glands of lone star ticks fed on human blood.

Holguin-Rocha, A.F., Calle-Tobon, A., Vásquez, G.M., Astete, H., Fisher, M.L. Tobon-Castano, A., Velez-Tobon, G., **Maldonado-Ruiz, L.P.,** Silver, K. Park, Y. and Berlin Londono-Renteria. **(2023).** Diversity of the bacterial and viral communities in the tropical horse tick, *Dermacentor nitens,* in Colombia" *Pathogens* 12, no. 7: 942.

Olajiga, O.M., **Maldonado-Ruiz, L.P**., Fatehi, S., Cardenas, J.C., Gonzalez, M.U., Gutierrez-Silva, L.Y., Londono-Renteria, B., and Park,Y. (**2022**). Association of dengue infection with anti-alpha-gal antibodies, IgM, IgG, IgG1, and IgG2. *Frontiers in immunology,* 13:1021016.

Maldonado-Ruiz, L.P., Kim D., and Park Y. (**2022**). Osmoregulatory physiology in Ixodidae ticks: An alternative target for management of ticks. *Journal of Asian-Pacific Entomology,* 61(1), 91-100.

Maldonado-Ruiz, **L.P.**, Boorgula, G.D., Kim, D., Fleming S. and Y. Park (**2022**). Tick intrastadial feeding and its role on IgE production in the Murine Model of Alpha-gal syndrome: The tick "transmission" Hypothesis*. Frontiers in Immunology,* 13, 844262,

Maldonado-Ruiz, **L.P.**, Davis, B.N. Park J.J. and Y. Park (**2022**). Dermal secretion physiology and thermoregulation in the lone star tick *Amblyomma americanum. Tick and Tick-borne disease,* 13 (4), 101962.

Soohoo-Hui, A., Li, Z., **Maldonado-Ruiz, L. P.**, Zhang, G., & Swale, D. R. (**2021**). Neurochemical regulation of *Aedes aegypti* salivary gland function. *Journal of Insect Physiology*, 129, 104193.

Maldonado-Ruiz, L. P., Neupane, S., Park, Y., & Zurek, L. (**2021**). The bacterial community of the lone star tick (*Amblyomma americanum*). *Parasites & Vectors*, 14(1), 49.

Maldonado-Ruiz, L. P., Park, Y., & Zurek, L. (**2020**). Liquid water intake of the lone star tick, *Amblyomma americanum*: Implications for tick survival and management. *Scientific Reports*, 10(1), 6000.

Maldonado-Ruiz, L. P., et al., (**2019**). Differential tick salivary protein profiles and human immune responses to lone star ticks (*Amblyomma americanum*) from the wild vs. a laboratory colony. *Frontiers in Immunology*, 10, 1996. doi:10.3389/fimmu.2019.01996.

Luciano Matias Matzkin

Education

University of California at Irvine	Biological Sciences	BS, 1996
State University of New York at Stony Brook	Ecology and Evolution	PhD, 2003

Experience

2017-present	Associate Professor, Dept. of Entomology, University of Arizona
2017-present	Joint Associate Professor, BIO5 Institute, University of Arizona
2017-present	Joint Associate Professor, Dept. of Ecology and Evolutionary Biology (EEB), University of Arizona
2014-2018	Adjunct Faculty Investigator, HudsonAlpha Institute for Biotechnology
2011-2017	Assistant Professor, Dept. of Biological Sciences, University of Alabama in Huntsville
2008-2011	Assistant Research Scientist, Dept. of Ecology, Behavior & Evolution, UC San Diego
2007-2008	Research Associate, Dept. of Ecology and Evolutionary Biology, University of Arizona
2003-2007	NIH Postdoctoral Excellence in Research and Teaching Fellow, EEB, University of Arizona

Synergistic Activities, Honors and Awards

2023-2027	PI, NIH grant: Investigating a novel role of ejaculate RNA in fertility, $2.5M total, $1.5M to UA
2023-2027	Sole PI, NSF grant: Development of functional genomics tools in cactophilic *Drosophila,* $1.15M
2022-present	Executive Committee Member, Ecosystem Genomics Graduate Interdisciplinary Program, UA
2021-2022	Member, Larry Sandler Award Selection Committee, Genetics Society of America,
2022	Outreach talk, UA Insect Festival, "Come fly with me: A look into the fantastic world of *Drosophila*"
2020	Invited participant, National Academies of Science, Engineering, and Medicine. Next Steps for Functional Genomics: A Workshop, Washington, D.C.
2017-present	Leader, interactive booth with cactophilic and transgenic *Drosophila* at UA Insect Festival
2018-present	Diversity, Equity & Inclusion Committees. Chair, Entomology Committee & Member, CALES Committee
2018-present	Associate Editor, Ecology and Evolution (Wiley)
2018-present	Editorial Board Member, Communications Biology (Springer Nature)
2018-present	Ad-hoc grant reviewer (10) for NSF, Austrian Science Fund and Fondation pour la Recherche Médicale
2017-present	Grant Panel Member: NSF, Enabling Discovery through Genomics 2023; USDA, Pests and Beneficial Species in Agricultural Production Systems 2022; NSF, Animal Behavior, 2017

Selected Publications (48 total)

Moreyra, N. N., Almeida, F. C., Carson, C. W., Frankel, N, **Matzkin, L. M.** and Hasson, E. 2022. Phylogenomics provides insights into the evolution of cactophily and host plant shifts adaptation in *Drosophila*. *Molecular Phylogenetics & Evolution* 178: 107653.

Shaible, T. M. and **Matzkin, L. M.** 2022. Physiological and life history changes associated with seasonal adaptation in the cactophilic *Drosophila mojavensis*. *Biology Open* 11 10: bio059610.

Diaz, F., Allan, C. W., Chen, X., Coleman, J. M., Bono, J. M. and **Matzkin, L. M.** 2022. Divergent evolutionary trajectories shape the postmating transcriptional profiles of conspecific and heterospecifically mated cactophilic *Drosophila* females. *Communications Biology* 5:842.

Hurtado, J., Revale, S., and **Matzkin, L. M.** 2022. Propagation of seminal toxins through binary expression gene drives can suppress polyandrous populations. *Scientific Reports* 12:6332.

Benowitz, K. M., Allan, C. W., Degain, B. A., Li, X., Fabrick, J. A., Tabashnik, B., Carriere, Y, and **Matzkin, L.M**. 2022. Novel genetic basis of resistance to Bt toxin Cry1Ac in *Helicoverpa zea*. *Genetics* 221:1.

Diaz, F., Kuijper, B., Hoyle, R. B., Coleman, J. M., Talamantes, N. and **Matzkin, L. M.** 2021. Environmental predictability drives adaptive within- and transgenerational plasticity of heat tolerance across life stages and climatic regions. *Functional Ecology* 35:153-166.

Khallaf, M.A., Auer, T.O., Grabe, V., Depetris-Chauvin, A. Ammagarahalli, B., Zhang, D., Lavista-Llanos, S., Kaftan, F., Weibflog, J., **Matzkin L. M.**, et al. 2020. A male pheromone promotes incipient isolation through conserved peripheral sensory pathways. *Science Advances* 625:eaba5279.

Allan, C. W. and **Matzkin, L. M.** 2019. Genomic analysis of the four ecologically distinct cactus host populations of *Drosophila mojavensis*. *BMC Genomics* 201:732.

Bono, J. M.†, **Matzkin, L. M.**†, Kelleher, E. S., Markow, T. A. 2011. Postmating transcriptional changes in reproductive tracts of con- and heterospecifically-mated *Drosophila mojavensis* females. *Proceedings of the National Academy of Sciences* 108:7878-7883. †Authors contributed equally.

Drosophila 12 Genomes Consortium **Matzkin, L. M.** co-author. 2007. Evolution of genes and genomes on the *Drosophila* phylogeny. *Nature* 450:203-218.

Tristan A. McKnight

Education

Ph.D. 2017.	Ecology and Evolutionary Biology	University of Michigan
B.S. 2011	Biology	Brigham Young University

Experience

2019-present	Assistant Professor of Practice, Dept. of Entomology, University of Arizona
2018, 2019	Adjunct Assistant Professor, First Year Program, St. Lawrence University

Synergistic Activities, Honors and Awards

2023-present	**Service**: Curriculum committee, College of Agriculture, Life & Environmental Sciences
2020-present	**Service**: General Education committees (dept & college) and curriculum refresh for ENTO 160D1
2022	**Outreach**: Invited Podcast Speaker, Humans & Wildlife Show, https://www.humansandwildlife.com/34-soviet-propaganda-and-the-potato-beetle
2019	**Outreach:** Arizona Insect Festival
2019	**Workshop instructor**: Cincinnati Museum Center Edge of Appalachia Preserve, Asilidae identification

Selected publications (since 2016)

COSEWIC. (in review) COSEWIC status report on Pacific Lasiopogon (*Lasiopogon pacificus*). Committee on the Status of Endangered Wildlife in Canada. Ottawa. ix + 45 pp.

Cannings, R.A., Cohen, C.M., & **McKnight, T.A**. (2023). A list of English common names for the robber flies (Diptera: Asilidae) of North America north of Mexico. Robber Flies of the World. Website: https://www.robberfliesoftheworld.com/NA_CommonNames.php

McKnight, T.A. & Cannings, R.A. (2020) Molecular phylogeny of the genus *Lasiopogon* (Diptera: Asilidae) and a taxonomic revision of the bivittatus section. *Zootaxa*, 4835(1): 1–115.

Haab, K.A.*, **McKnight, T.A**. & McKnight, K.B. (2019) Phenology and ethology of adult *Lasiopogon slossonae* Cole and Wilcox robber flies (Diptera: Asilidae) in a New York riparian habitat. *Proceedings of the Entomological Society of Washington*, 121(4): 594–615.

Clement, R.A.*, Frandsen, P.B., **McKnight, T.A**. & Nelson, C.R. (2018) Fly family diversity shows evidence of livestock grazing pressure in Mongolia (Insecta: Diptera). *Journal of Insect Conservation*, 22 (2): 231–243.

McKnight, T.A. & Cannings, R.A. (2017) Description and phylogenetic classification of *Stackelberginia cerberus* sp. nov. (Diptera: Asilidae), comprising the first record of this genus from the Nearctic. *Zootaxa*, 4306 (4): 567–579.

*Undergraduate students supervised by Dr. McKnight.

Wendy Moore

Education

Vanderbilt University	General Biology	BS, 1991
College of Charleston	Marine Biology	MS, 1996
University of Arizona	Entomology	PhD, 2006

Professional Experience

2016–present	Associate Professor & Curator, Department of Entomology, University of Arizona (UA)
2010–2016	Assistant Professor & Curator, UA Insect Collection (UAIC), Department of Entomology, UA
2008–present	Research Associate, Arizona-Sonora Desert Museum. Tucson, AZ

Selected Synergistic Activities, Honors and Awards

2023	University of Arizona Provost Investment Fund Awardee, $200,000
2019–present	Tucson Bee Collaborative. Vertically Integrated Project. Founder/Organizer/Fundraiser.
2019–2021	NSF, HSI-Hispanic Serving Institutions, Division of Undergraduate Education. $297,159 (UA budget: $66,323)
2018-present	Development Liaison, Department of Entomology. Helped raise $1,131,183 including in-kind gifts and cash gifts to the department, excluding the cash gifts to my programs.
2018	One of three entomologists featured in the 30-minute documentary "INSECTA: Science that Stings."
2017–present	Developed Course-based Undergraduate Research Experiences (CUREs) to engage underserved students. 365 UA and Pima Community College students have participated to date.
2016–present	>$5.4 million in research grants, primarily from NSF (continual NSF funding as PI since 2008)
2016–present	Course development and delivery: Discovering Biodiversity (UA-CURE); Insect Systematics; Insect Biology; Secrets of Success: A Natural History of Terrestrial Arthropods; Presentation Skills: Critical Listening and Speaking
2016–present	75 individuals mentored including major advisor for 8 MS and 6 PhD students, primary mentor for 5 postdoctoral scientists
2010–present	Arizona Insect Festival. Event Founder/Organizer/Fundraiser. 5000 visitors annually.

Selected Publications (57 total including 5 books, 10 book chapters, 42 refereed journal articles, >6300 citations)

Brusca RC, G Giribet, W Moore. 2023. Invertebrates. Fourth Edition. New York: Oxford University Press. 1099 pp. [Best-selling textbook on invertebrate zoology in the world]

Ikagawa R and W Moore. 2022. Molecular phylogeny and revision of species groups of Nearctic bombardier beetles (Carabidae, Brachininae, *Brachinus* (*Neobrachinus*)). ZooKeys 1131, 155–171.

Kelly S, W Moore, WE Hall, M Hunter. 2022. Cryptic enemies of the economically- and culturally-important scale insect, cochineal (Hemiptera: Dactylopiidae). Ecology and Evolution 12 (8): e9151.

Palting JD and W Moore 2022. Molecular phylogeny of lichen tiger moths (Lepidoptera, Erebidae, Arctiinae, Lithosiini): a contribution toward classifying Western Hemisphere genera. ZooKeys 1108: 119–139.

Moore W, G Scarparo, A Di Giulio. 2022. Foe to Frenemy: predacious Ant Nest Beetles use multiple strategies to fully integrate into ant nests. Current Opinion in Insect Science, 52: 100921.

Attygalle AB, S Xu, W Moore, R McManus, A Gill, K Will. 2020. Biosynthetic origin of benzoquinones in the explosive discharge of the bombardier beetle *Brachinus elongatulus*. The Science of Nature 107:26

Yanahan AD and W Moore 2019. Impacts of 21st-century climate change on montane habitat in the Madrean Sky Island Archipelago. Diversity and Distributions 25 (10): 1625–1638.

Muzzi M, W Moore, A Di Giulio. 2019. Morpho-functional analysis of the explosive defensive system of basal bombardier beetles (Carabidae: Paussinae: Metriini). Micron 119: 24–38.

Moore W and A Di Giulio. 2019. Out of the burrow and into the nest: functional anatomy of three life history stages of *Ozaena lemoulti* (Coleoptera: Carabidae) reveals an obligate life with ants. PLoS ONE 14(1): e0209790.

Irwin ME and W Moore. 2019. Foundations of an IPM program: detection, identification, and quantification. In: Kogan M. & Heinrichs E. (eds), Integrated Management of Insect Pests: Current and Future Developments. Cambridge: Burleigh Dodds Science Publishing.

Hughes, GB and W Moore. 2018. Monophyly of the subfamily Neobisiinae (Pseudoscorpiones: Neobisiidae). Journal of Arachnology 46:481–487.

Schaller JC, G Davidowitz, DR Papaj, RL Smith, Y Carrière, W Moore. 2018. Molecular phylogeny, ecology, and multispecies aggregation behaviour of bombardier beetles in Arizona. PLoS ONE 13(10): e0205192.

McManus R, A Ravenscraft, and W Moore. 2018. Bacterial associates of a gregarious riparian beetle with explosive defensive chemistry. Frontiers in Microbiology 9:2361.

John C. Palumbo

Education

University of Arizona	Entomology	BS 1982
University of Arizona	Entomology	MS 1985
Oklahoma State University	Entomology	PhD 1989

Experience 2002-present, Extension Specialist/Professor, Dept of Entomology, University of Arizona (UA).
1996-2002 Asso. Extension Specialist/Assoc. Professor, Dept. of Entomology, UA
1990-1996 Asst. Extension Specialist/Asst. Professor, Dept. of Entomology, UA

Synergistic Activities, Honors, and Awards

Award for Excellence in Integrated Pest Management, *Entomological Society of America*, 2023
Award for Excellence in Integrated Pest Management, *Entomological Society of America, Pacific Branch*, 2023
Distinguished Outreach Faculty Award, *University of Arizona,* 2023
Outstanding Contribution to Agriculture Award, *California Association of Pest Control Advisors*, 2022
John Palumbo Endowed Chair in Integrated Pest Management, *University of Arizona, ALVSCE*, 2020
Outstanding Contribution to Agriculture Award, *Yuma County Farm Bureau Association*, 2015
Distinguished Achievement Award in Extension, *Entomological Society of America*, 2014
Distinguished Achievement Award in Extension, *Entomological Society of America*, *Pacific Branch*, 2014
UA/CALS Faculty Member of the Year Award, *Arizona Agriculture "100" Council*, 2011
Outstanding Contribution to Agric. Award, *California Association of Pest Control Advisors, Desert Chapter*, 2008
Distinguished Service Award, *Yuma Fresh Vegetables Association*, 2005
Distinguished Service to Agriculture Award, *Yuma County Farm Bureau Association*, 2001

Selected publications

1. Palumbo, J.C. and S. J. Castle. 2009. IPM for fresh-market lettuce production in the desert southwest: the produce paradox. Pest Management Sci., 65:1311-1320.
2. Ghidiu, G., T. Kuhar, J. Palumbo, and D. Schuster. 2012. Drip Chemigation of Insecticides as a Pest Management Tool in Vegetable Production. J. Integ. Pest Mngmt. 3(3): 2012.
3. Carriere, Y, B. Degain, K. A. Hartfield, K. D. Nolte, S. E. Marsh, C. Ellers-Kirk, W.J.D. Van Leeuwen, L. Liesner, P.Dutilleul and J. C. Palumbo. 2014. Assessing Transmission Of Crop Diseases By Insect Vectors in a Landscape Context. J. Econ. Entomol. 107: 1-10.
4. Carriere, Y., Degain, B., Leisner, L., Dutilleul, P., & Palumbo, J. C. 2017. Validation of landscape-based model for whitefly transmission of cucurbit yellow stunting disorder virus to fall melons. J. Econ Entomol. 110: 2002-2009.
5. Palumbo, J.C., T.M. Perring, J Millar, and D.A. Reed. 2016. Biology, Ecology and Management of an Invasive Stink Bug, Bagrada hilaris in North America, Annual Review of Entomology. Vol 61 (pp. 453–473).
6. Bundy, S., Perring, T., Reed, D., Palumbo, J. C., Grasswitz, T., & Jones, W. A. 2018. Bagrada hilaris (Burmeister). In J.E. McPherson (ed), Invasive Stink Bugs and Related Species (Pentatomidae): Biology, Higher Systematics, Semiochemistry, and Management.
7. Reed, D.A., Palumbo, J.C., Perring, T.M., May, C., 2013. *Bagrada hilaris* (Burmeister), a new stink bug attacking cole crops in the southwestern United States. J Integ. Pest Mangmt. 4(3) 2013.
8. Palumbo JC, Prabhaker N, Reed DA, Perring TP, Castle SJ, Huang T. 2015. Susceptibility of Bagrada hilaris (Hemiptera: Pentatomidae) to insecticides in laboratory and greenhouse bioassays, J. Econ. Entomol. 108: 672-682.
9. Pinkerton, Morgan, Sage M. Thompson, Amanda C. Hodges, Norman C. Leppla, John C. Palumbo. 2020. Laboratory rearing of *Bagrada hilaris* (Hemiptera: Pentatomidae) under quarantine conditions in Florida. Florida Entomol. Vol 103: 401-403
10. Sherbrooke, S., Y. Carriere, J.C. Palumbo. 2020. Evaluation of Trap Cropping for Control of Diamondback Moth (Lepidoptera: Plutellidae) in a Broccoli Production System, J. Econ. Entomol. Vol 113: 1864-1871.
11. Lawton, D, A.D. Huesth, G. G. Kennedy, […] and M. Zuefle, 2022. Pest population dynamics are related to a continental overwintering gradient. PNAS Vol. 119, No. 37:1-8.

Michael A. Riehle

Education

University of Wisconsin, Madison, WI	BS	1994	Entomology/Zoology
University of Wisconsin, Madison, WI	MS	1996	Entomology
University of Georgia, Athens, GA	PhD	2002	Entomology

Experience

2016-Present	Professor, Department of Entomology, University of Arizona
2005-Present	Professor, BIO5 Institute, University of Arizona
2010-Present	Professor, Entomology & Insect Science GIDP, University of Arizona
2010-2016	Associate Professor, Department of Entomology, University of Arizona
2005-2010	Assistant Professor, Department of Entomology, University of Arizona
2003-2004	Post-Doctoral Fellow, Department of Molecular Microbiology and Immunology, Johns Hopkins School of Public Health, Baltimore, MD
2002-2003	Research Associate, Department of Genetics, Case Western Reserve University, Cleveland, OH

Synergistic Activities, Honors and Awards

2005-Present	Member, Institutional Biosafety Committee, Chair 2016-present, University of Arizona
2012-Present	Executive Committee member, Entomology & Insect Science Graduate Interdisciplinary Program
2019-Present	Instructor, Biology of Vector Borne Diseases course, University of Idaho
2014-2023	Mentor, KEYS Research Internship program for high school students, University of Arizona
2019	Organizer: Eighth International Symposium on Molecular Insect Science, Sitges, Spain
2018	Fellow, American Association for the Advancement of Science (AAAS)
2014	Medical, Urban and Veterinary Entomology Award, Pacific Branch, Entomological Society of America
2010	Time magazine's 50 best inventions of 2010: Malaria-proof mosquito (#1 in Health & Medicine)
2006	New Scholar Award in Aging, Ellison Medical Foundation

Selected publications (57 total)

1. Ernst KC, Walker KR, Castro-Luque AL, Schmidt C, Joy TK, Brophy M, Reyes-Castro P, Díaz-Caravantes RE, Encinas VO, Aguilera A, Gameros M, Cuevas Ruiz RE, Hayden MH, Alvarez G, Monaghan A, Williamson D, Arnbrister J, Gutiérrez EJ, Carrière Y, Riehle MA. Differences in longevity and temperature-driven extrinsic incubation period correlate with varying dengue risk in the Arizona–Sonora desert region. Viruses. 15(4):851. (2023)
2. Thakre N, Gurge RM, Isoe J, Kivi H, Strickland J, Delacruz LR, Rodriguez AM, Haney R, Sadeghi R, Joy T, Chen M, Luckhart S, Riehle MA. Manipulation of pantothenate kinase in *Anopheles stephensi* suppresses pantothenate levels with minimal impacts on mosquito fitness. Insect Biochemistry and Molecular Biology. 149. (2022)
3. Joy T, Chen M, Arnbrister J, Williamson D, Li S, Nair S, Brophy M, Garcia VM, Walker K, Ernst K, Gouge DH, Carrière Y, Riehle MA. Assessing Near-Infrared Spectroscopy (NIRS) for evaluation of *Aedes aegypti* population age structure. Insects 13(4):360 (2022)
4. Hun LV, Cheung KW, Brooks E, Zudekoff R, Luckhart S, Riehle MA. Increased insulin signaling in the *Anopheles stephensi* fat body regulates metabolism and enhances the host response to both bacterial challenge and *Plasmodium falciparum* infection, Insect Biochemistry and Molecular Biology. (2021)
5. Simão-Gurge RM, Thakre N, Strickland J, Isoe J, Delacruz LR, Torrevillas BK, Rodriguez AM, Riehle MA, & Luckhart S. Activation of *Anopheles stephensi* pantothenate kinase and coenzyme A biosynthesis reduces infection with diverse *Plasmodium* species in the mosquito host. Biomolecules. (2021)
6. Oringanje, C., Delacruz, LR., Han, Y., Luckhart, S., & Riehle, MA. Overexpression of activated AMPK in the *Anopheles stephensi* midgut impacts mosquito metabolism, reproduction and *Plasmodium* resistance. Genes, 12(1), 119. (2021)
7. Comeau, G., Zinna, RA., Scott, T., Ernst, K., Walker, K., Carrière, Y., & Riehle, MA. Vertical transmission of Zika virus in *Aedes aegypti* produces potentially infectious progeny. American Journal of Tropical Medicine and Hygiene, 103(2), 876-883. (2020)
8. Hun, L., Luckhart, S. and Riehle, M.A. Increased Akt signaling in the fat body of *Anopheles stephensi* extends lifespan and increases lifetime fecundity through modulation of insulin-like peptides. Journal of Insect Physiology, p.103932. (2019)
9. Souvannaseng, L., Hun, L.V., Baker, H., Klyver, J.M., Wang, B., Pakpour, N., Bridgewater, J.M., Napoli, E., Giulivi, C., Riehle, M.A. and Luckhart, S. Inhibition of JNK signaling in the Asian malaria vector *Anopheles stephensi* extends mosquito longevity and improves resistance to *Plasmodium falciparum* infection. PLoS Pathogens, 14(11), p.e1007418. (2018)
10. Ernst, K.C., Walker, K.R.,…Carrière Y., and Riehle, M.A. *Aedes aegypti* (Diptera: Culicidae) Longevity and Differential Emergence of Dengue Fever in Two Cities in Sonora, Mexico. Journal of Medical Entomology, 54, 204-211. (2017)
11. Klionsky, Daniel J., et al. Guidelines for the use and interpretation of assays for monitoring autophagy. Autophagy 12.1: 1-222. (2016)
12. Neafsey D.E., et al. Highly evolvable malaria vectors: The genomes of 16 Anopheles mosquitoes. Science. 347(6217): 43 (2015)

Todd Schlenke

Education

1996-2001	Ph.D.	Zoology	UT Austin
1991-1995	B.S.	Integrative Biology	UC Berkeley

Experience

2016-present	Associate Professor	Entomology	University of Arizona
2013-2016	Associate Professor	Biology	Reed College
2006-2013	Assistant Professor	Biology	Emory University
2002-2005	Postdoc	Mol Biol and Genetics	Cornell University
2001-2002	Postdoc	Population Biology	UC Davis

Synergistic Activities, Honors, and Awards

2023	Research Poster Forum Award; Division of Agriculture, Life & Veterinary Sciences, & Cooperative Extension, UA
2020-present	NSF Early-concept Grant for Exploratory Research, Development of Functional Genetic Tools for Endoparasitoid Wasps
2020-present	Executive Committee, Genetics Graduate Interdisciplinary Program (GIDP)
2020	Chair, CALS Dean's Research Advisory Council
2019-present	Co-organizer, Arizona Insect Festival
2019-2020	Science Fair Judge, Davis Bilingual Elementary School
2019	Chair, CALS Post-Tenure Review Committee
2019	Invited Seminar, Zhejiang University, Host Parasite Interactions Using *Drosophila*
2018-2019	Co-organizer, Arizona PopGroup meeting on population genomics and adaptation
2018	Co-organizer, ESA workshop on *Drosophila*-Parasitoid Food Webs
2017-2020	Executive Committee, EIS GIDP
2017	Invited Seminar, Dartmouth College, Antagonistic Coevolution Between Hosts and Parasites
2014-present	Panelist for four NSF and two NIH grant panels
2014	Elected AAAS Fellow

Selected Publications

Extracellular matrix protein N-glycosylation mediates immune self-tolerance in *Drosophila* melanogaster; Mortimer NT, Fischer ML, Waring AL, Pooja KR, Kacsoh BZ, Brantley SE, Keebaugh ES, Hill J, Lark C, Martin J, Bains P, Lee J, Vrailas-Mortimer AD, **Schlenke TA***; PNAS* 118, e2017460118 (2021)

Lipidomics reveals how the endoparasitoid wasp *Pteromalus puparum* manipulates host energy stores for its young; Wang J, Jin H, **Schlenke TA**, Yang Y, Wang F, Yao H, Fang Q, Ye G; *Biochimica et Biophysica Acta - Molecular and Cell Biology of Lipids* 1865, 1-10 (2020)

Characterization of a cell death-inducing endonuclease-like venom protein from the parasitoid wasp *Pteromalus puparum* (Hymenoptera: Pteromalidae); Wang J, Yan Z, Xiao S, Wang B, Fang Q, **Schlenke TA**, Ye G; *Pest Management Science* 77, 224-233 (2020)

Fruit flies diversify their offspring in response to parasite infection; Singh ND, Criscoe DR, Skolfield S, Kohl KP, Keebaugh ES, **Schlenke TA**; *Science* 349, 747-750 (2015)

Parasitoid wasp venom SERCA regulates Drosophila calcium levels and inhibits cellular immunity; Mortimer NT, Goecks J, Kacsoh BZ, Mobley JA, Bowersock GJ, Taylor J, **Schlenke TA**; *PNAS* 110, 9427-9432 (2013)

Fruit flies medicate offspring after seeing parasites; Kacsoh BZ, Lynch ZR, Mortimer NT, **Schlenke TA**; *Science*, 339, 947-950 (2013)

Alcohol consumption as self-medication against blood-borne parasites in the fruit fly; Milan N, Kacsoh BZ, **Schlenke TA**; *Current Biology* 22, 488-493 (2012)

Bruce E. Tabashnik

Education

Stanford University	Biological Sciences	PhD, 1981
University of Michigan	Zoology	BS, 1975

Experience

1996-present	Head, Department of Entomology, University of Arizona
2015-present	Regents Professor, Department of Entomology, University of Arizona
1996-2014	Professor, Department of Entomology, University of Arizona
1983-1996	Assistant (1983-1987), Associate (1988-1991), and Full (1991-1996) Professor, Department of Entomology, University of Hawaii
1981-1983	Postdoctoral Scientist, Department of Entomology, Michigan State University

Selected Synergistic Activities, Honors and Awards

2023 Member, National Academy of Sciences
2021 Louis Malassis International Scientific Prize for Agriculture and Food, Distinguished Scientist, Agropolis Fondation
2021 Researcher of the Year Award, International Cotton Advisory Committee
2021 World Expert, Bacterial Toxins, Expertscape, top 0.005% of 216,325 authors worldwide (2011-21)
2021 IPM Team Award, Plant-Insect Ecosystems Section, Entomological Society of America
2020 Lifetime Achievement Award, Plant-Insect Ecosystems Section, Entomological Society of America
2019 Fellow, Royal Entomological Society, United Kingdom
2018 Award for Eradication of Pink Bollworm from the United States, U.S. Department of Agriculture
2015 Nan-Yao Su Award for Innovation and Creativity in Entomology, Entomological Society of America
2010 Fellow, American Association for the Advancement of Science
2007 Fellow, Entomological Society of America
1992 Award for Excellence in Integrated Pest Management, Entomological Society of America

Selected Publications (400 total including 312 in refereed journals, 31 book chapters, 1 edited book, and 1 patent; >34,600 citations, $h = 97$)

2023. Tabashnik, B. E., J. A. Fabrick and Y. Carrière. Global patterns of insect resistance to transgenic Bt crops: The first 25 years. J. Econ. Entomol. 116: 297-309.

2023. Fabrick, J. A., X. Li, Y. Carrière and B. E. Tabashnik. Molecular genetic basis of lab- and field-selected Bt resistance in pink bollworm. Insects 14: 201.

2023. Guan, F., X. Dai, B. Hou, S. Wu, Y. Yang, Y. Lu, K. Wu, B. Tabashnik and Y. Wu. Refuges of conventional host plants counter dominant resistance of cotton bollworm to transgenic Bt cotton. iScience 26: 106768.

2023. Guan, F., X. Dai, Y. Yang, B. E. Tabashnik and Y. Wu. 2023. Population genomics of nonrecessive resistance to Bt toxin Cry1Ac in *Helicoverpa armigera* from northern China. J. Econ. Entomol. 116: 310-320.

2022. Yang, F., D. L. Kerns, N. Little, S. A. Brown, …and B. E. Tabashnik. Practical resistance to Cry toxins and efficacy of Vip3Aa in Bt cotton against *Helicoverpa zea*. Pest Manag. Sci. 78: 5234-5242.

2021. Tabashnik, B. E., L. R. Liesner, P. C. Ellsworth, G. C. Unnithan, …and Y. Carrière. Transgenic cotton and sterile insect releases synergize eradication of pink bollworm a century after it invaded the United States. PNAS 118: e2019115118.

2017. Wan, P., D. Xu, S.-B. Cong, …Wu, L. Wang, K.-M. Wu, Y. Carrière, A. Mathias, X. Li and B. E. Tabashnik. Hybridizing transgenic Bt cotton with non-Bt cotton counters resistance in pink bollworm. PNAS 114: 5413-5418.

2017. Tabashnik, B. E. and Y. Carrière. Surge in insect resistance to transgenic crops and prospects for sustainability. Nature Biotechnology 35: 926-935.

Natasha Tigreros

Education

2013 Ph.D. in Biology, Tufts University
2007 M.S. in Biology, Eastern Illinois University
2002 B.S. in Biology, Universidad del Valle, Colombia

Experience

2023- Assistant Professor, Department of Entomology, University of Arizona
2021-2023 Research Scientist, Department of Entomology, University of Arizona
2017-2021 Postdoctoral Scholar, Department of Entomology, University of Arizona
2014- 2017 Postdoctoral Researcher, Department of Entomology, Cornell University
Fall 2013 Biostatistics Instructor, Tufts University
Summer 2013 Research Fellow, Harvard University
2002-2004 Associate Researcher, Center of Endangered Species, Colombia

Synergistic Activities, Honors and Awards

2021-2024 NSF Award – Division of Integrative Organismal Systems ($928,174): *How does nutrient acquisition within and across life stages modulate resource allocation tradeoffs?*
2021-present Outreach: Insect Discovery – Providing NSF funds and helping to coordinate with Native American 4H youth development students on the Hualapai Reservation
2022 Mentor – Women in STEM Mentorship Program, University of Arizona
2020 Member, Entomology DEI committee, University of Arizona

Selected Publications (19 total)

Tigreros, N., G Kozhoridze, G. Davidowitz, & Y. Ziv (2023) Influence of the direct and indirect effects of habitat fragmentation, via microclimate change, on animal locomotion. *Journal of Landscape Ecology* 38: 847–859.

Montovan, K., **N. Tigreros,** & J. Thaler (2022) Modeling size dependent fitness trade-offs of foraging in the presence of predators. *Journal of Theoretical Ecology* 15: 177-189.

Davidowitz, G., J. Bronstein & **N. Tigreros** (2022) Flight fecundity tradeoffs, a possible mechanistic link in plant-herbivore-pollinator systems. *Frontiers in Plant Science* 13: 1-9.

Tigreros, N., A.A. Agrawal & J. Thaler (2021) Genetic variation in parental effects contributes to the evolutionary potential of antipredator plasticity. *American Naturalist* 197: 164-175

Tigreros, N., R.H. Norris, & J. Thaler (2019) Maternal effects across life stages: larvae experiencing predation risk increase offspring provisioning. *Ecological Entomology* 44: 738-744

Tigreros, N. & G. Davidowitz (2019) Flight fecundity tradeoffs in wing-monomorphic insects. *Advances in Insect Physiology* 56: 1-41.

Tigreros, N., E. Wang & J. Thaler (2018) Prey nutritional state drives divergent behavioural and physiological responses to predation risk. *Functional Ecology* 32: 982-989.

Tigreros, N., R.H. Norris, E. Wang & J. Thaler (2017) Maternally induced intraclutch cannibalism: an adaptive response to predation risk? *Ecology Letters* 20: 487-494.

Kathleen R. Walker

Education

1991-1997	University of California - Ph.D. in Entomology.
1982-1987	Harvard/Radcliffe University - B.A. cum laude in Biology.

Experience

2019-present	Associate Specialist & Assoc. Professor, Dept. of Entomology, Univ. of Arizona
2014-2019	Assistant Specialist and Asst. Professor, Dept. of Entomology, Univ. of Arizona
2011-2013	Assistant Professor, Dept. of Entomology, University of Arizona
2006-2011	Senior Program Coordinator – Insect Discovery program, Univ. of Arizona
2002-2005	NIH Postdoctoral Researcher, Center for Insect Science, Univ. of Arizona
2000-2001	Diplomacy Fellow (AAAS), U.S. AID, Washington, DC
1998-2000	Environmental Science Fellow (AAAS), U.S. EPA, Washington, DC

Synergistic Activities, Honors and Awards

2006-present	Director, Insect Discovery Outreach/Extension Program
2011-present	Co-organizer, Arizona Insect Festival
2022-present	Leadership team member, Pacific Southwest Center of Excellence in Vector Biology
2019-present	Extension collaboration with Tohono O'odham Nation: Tick-borne disease prevention

Recent Federal Grants Awarded

2022-2027	Centers for Disease Control & Prevention (CDC), Centers of Excellence Grant *Pacific Southwest Center of Excellence in Vector Biology* (**PacVec**). UC Davis, primary institution. Walker PI of subaward of $987,337 to University of Arizona.
2022-2026	NIH, Native American Research Centers for Health. *Advancing Vector-borne Disease Surveillance in American Indian Communities*. Intertribal Council of Arizona, primary institution. D. Gouge PI and Walker co-PI of subaward of $439,881 to University of Arizona.
2017-2022	CDC, *Impacts of targeted larviciding and ULV adulticiding on the abundance and age structure of* Aedes aegypti *in south-central Arizona*. Walker PI, Co-PIs M. Riehle, K. Ernst, D. Gouge. Total funding $1,250,000.

Selected Recent Publications

Ernst KC, Walker KR, Castro-Luque AL, Schmidt C, Joy TK, Brophy M, Reyes-Castro P, Díaz-Caravantes RE, Encinas VO, Aguilera A, Gameros M, Cuevas Ruiz RE, Hayden MH, Alvarez G, Monaghan A, Williamson D, Arnbrister J, Gutiérrez EJ, Carrière Y, Riehle MA. Differences in Longevity and Temperature-Driven Extrinsic Incubation Period Correlate with Varying Dengue Risk in the Arizona-Sonora Desert Region. Viruses. 2023. Mar 26;15(4): 851.

Brophy M, Walker KR, Adamson JE, Ravenscraft A. 2022. Topical and Temperate Lineages of *Rhipicephalus sanguineus s.l.* Ticks (Acari: Ixodidae) Host Different Strains of *Coxiella*-like Endosymbionts. J Med Entomol. 59(6): 2022-2029.

Brophy M, Riehle MA, Mastrud N, Ravenscraft A, Adamson JE, Walker KR. 2022. Genetic variation in *Rhipicephalus sanguineus* s.l. ticks across Arizona. Int J Environ Res Public Health 1;19(7):4223.

Tarter K, Levy C, Yaglom H, Adams L, Plante L, Casal M, Gouge D, Rathman R, Stokka D, Weiss J, Venkat H, Walker K. 2019. Using citizen science to enhance surveillance of the mosquito vector *Aedes aegypti* in Arizona. J Am Mosq Control Assoc. 35:11-18.

Walker KR, Williamson D, Carrière Y, Reyes-Castro P, Haenchen S, Hayden M, Jeffrey Gutierrez E., Ernst KC. 2017. Socioeconomic and human behavioral factors associated with *Aedes aegypti* (Diptera: Culicidae) immature habitat in Tucson, AZ. J Med Entomol. 55(4): 955-963.

Appendix F1. Department of Entomology staff

Title	Name	FTE
Administration		
Business Manager, Senior	Doty, Rachel	1
Office Specialst, Senior	Green, Nirka	0.75
IT Staff		
Systems Administrator III	Picazzo Jr., Martin	0.2
Research & Extension Staff		
Assistant In Extension, Agronomic Crops IPM	Dayoob, Naomi	1
Assistant In Extension, Cotton IPM	Carlos Bordini, Isadora	1
Assistant In Extension, Entomology	Unnithan, Gopalan	0.49
Assistant In Extension, IPM Assessment/Pesticide Education	Dixon II, Wayne	1
Associate In Extension, Community IPM	Nair, Shakunthala	1
Associate In Extension, Public Health IPM	Li, Shujuan	1
Curatorial Assistant I	Simon, Jacob	0.49
Farm Attendant, Senior	Lizarraga, Gregoria	1
Horticultural Technician	Garcia, Joshua	0.48
Laboratory Coordinator I	Bland, Tanner	0.49
Laboratory Manager	Allan, Carson	1
Manager, Research Laboratory	Degain, Benjamin	1
Manager, Research Laboratory	Kelly, Suzanne	1
Manager, Research Laboratory	Yelich, Alexander	1
Manager, UAIC Collection	Hall, Wesley	1
Outreach Instructional Assistant II	Hardy, Jasmine	0.49
Photographer I	Martinez, Carlos	0.49
Research Specialist	Chavez, Leonard	1
Research Specialist, Senior	Buck, Norman	0.03
Research Technician	Bojorquez, Francisco	1
Research Technician	Partida, Jose	1
Research Technician	Soto-Shoumaker, Jenet	1
Research Technician I	Alvarez, Aida	0.3
Research Technician I	Arthur, Cauy	1
Research Technician I	Bojorquez, Franscisco	0.49
Research Technician I	Cahill, Madeleine	1
Research Technician I	Carrière-Walker, Jeremy	0.5
Research Technician I	Gay, Micah	1
Research Technician I	Husok, Oona	0.49
Research Technician I	Partida, Sebastian	1
Research Technician II	Castrezana, Sergio	0.9
Research/Laboratory Aide	Brown, Alexa	1
Research/Laboratory Aide	Ruiz, Javier	1
Research/Laboratory Aide	Tabashnik, Gabriel	0.35
Research/Laboratory Aide	Thacker, Emily	0.49
Research/Laboratory Aide	Thacker, Makayla	0.49
Research/Laboratory Glassware Att.	Garcia, Joshua	0.48
Researcher/Scientist IV	Isoe, Jun	1
Technical Expert	Hedgcock, Charles	0.15

Appendix F2. EIS GIDP Bylaws

BYLAWS

THE UNIVERSITY OF ARIZONA

Graduate Interdisciplinary Program in ENTOMOLOGY and INSECT SCIENCE
Approved October 19, 2009

PREAMBLE

Graduate Interdisciplinary Programs (GIDPs) report to the Vice President for Research, Graduate Studies and Economic Development through the Director of GIDPs.

The Graduate Interdisciplinary Program (GIDP) in Entomology and Insect Science offers the M.S. and Ph.D. degrees. In the following Articles and Bylaws, operating procedures, and policies of the Program are outlined. This organization and structure must conform to the guidelines for GIDPs.

Article 1. Membership in the Graduate Program.

Membership in the Graduate Interdisciplinary Program in Entomology and Insect Science is open to faculty at the University of Arizona who are willing to make a commitment to the GIDP. This commitment should be expressed through participation in developing and maintaining the GIDP, teaching courses, serving as host faculty for first year laboratory rotations, and serving as Major Professor. Tenured or tenure-eligible faculty will hold regular memberships, and untenured or non-tenure-eligible faculty will hold associate memberships.

Criteria for membership are a commitment to interdisciplinary approaches as well as activity and excellence in research or extension as demonstrated by research funding, publication record and service as advisors to students. Members of the Graduate Interdisciplinary Program will be reviewed periodically by the Executive Committee to ensure that they continue to meet these standards.

Membership can be proposed by candidates themselves or through nomination by a current member of the Program. Consideration of candidacy is initiated by submission of curriculum vitae and a letter of commitment to the Executive Committee. If the Executive Committee votes to recommend membership, a request is then submitted to the Director of Graduate Interdisciplinary Programs for approval and appointment. New members will present an introductory seminar to the insect science community at large.

The members of the Entomology and Insect Science GIDP will meet at least once a year to review the state of the program.

Article 2. Executive Committee (EC) and Chair of the Graduate Interdisciplinary Program in Entomology and Insect Science.

The GIDP in Entomology and Insect Science is administered by a Chair and an Executive Committee (EC), consisting of five to seven members. The Executive Committee will be made up of three faculty members with primary appointments in entomology and three faculty members with primary appointments elsewhere. The Chair is appointed for a renewable three-year term and EC members are appointed for renewable three-year terms. Both the Chair and the EC members will be chosen by vote by participating faculty that hold regular memberships. Nominations from participating faculty for both positions will be received by the EC. A faculty member may run for one or both positions. Fifty-one percent of the members will constitute a quorum. Majority vote of those present at a meeting or 51% return of ballots will rule. The roster of elected members will be forwarded to the Director of Interdisciplinary Graduate Programs for approval and appointment. The EC will also have 1 student member elected by the students to a renewable 1 year term.

A) The responsibilities of the **Executive Committee** are to:

1. Devise and implement procedures to be followed in selecting and reviewing members of the Entomology and Insect Science GIDP;
2. Devise and implement appropriate policies and procedures for the operation of the graduate program, such as admissions, curriculum, student supervision, completion of degree program requirements, and decisions regarding program resources;
3. Appoint GIDP faculty members to serve on the GIDP's two standing committees: the Graduate Student Admissions and Recruitment Committee (GS-ARC) and the Graduate Student Advisory and Progress Committee (GS-PAC**)** (see Article 3);
4. Appoint other ad hoc committees as needed for effective operation;
5. Act on recommendations of the GSAPC regarding academic counsel to new students and evaluations of students at various stages of progress through the Program;
6. Prepare and submit annual reports of the Entomology and Insect Science program's activities and accomplishments to the Director of Graduate Interdisciplinary Program;
7. Ensure that regular academic program reviews, consistent with the Board of Regents and USDA requirements, are carried out;
8. Facilitate interaction and communication within the Program in Entomology and Insect Science and with supporting academic units heads and deans;
9. Seek funding from appropriate University, State, Federal and private sources;
10. Solicit nominations to vacated slot(s) on the Executive Committee to ensure continuity over time.

B) The responsibilities of the **Chair of the Executive Committee (and of the GIDP).**

1. Administers the Program and activities of the EC with the assistance of the program coordinator of the GIDP;

2. Convenes and chairs meetings of the EC;
3. Acts on behalf of the EC and the GIDP to implement policies of the Program;
4. Serves as representative of the Program to the University Administration, granting agencies, prospective students, etc.;
5. Prepares and submits an annual report of activities and accomplishments of the Program according to University regulations.

The GIDP's Program Coordinator works closely with the Chair of the EC as well as the students, faculty, EC and standing committees to ensure timely fulfillment of the policies of the UA and the Program in Entomology and Insect Science, as well as the flow of information among all concerned.

Article 3. Standing Committees of the Graduate Program.

In addition to the EC, two standing committees carry important responsibilities for the operation and welfare of the Program.

1. Graduate Student Admissions and Recruitment Committee (GS-ARC).

The GS-ARC is responsible for evaluating applications from prospective graduate students for admission to the Program, organizing the campus visits of finalists, recommending students to the EC for admission to the Program, and coordinating efforts to recruit admitted students. GS-ARC also advises the EC with respect to publicizing the Program.

2. Graduate Student Progress and Advisory Committee (GS-PAC). The committee will--

-advise all first-year students who have not identified an advisor, and solicit and evaluate progress reports from all students.

- include at least 3 members of the Program's faculty, one of whom serves as Chair. The Committee members and Chair are appointed for renewable 3-year terms by the EC.

- solicit and evaluate progress reports from all students monitoring the progress of all students through annual review of student progress reports and reports of individual advisory committees, making recommendations about student advancement, probation, or termination to the EC.

- advise the EC regarding Program policies and procedures as well as revisions of the Program Handbook. Student input will be encouraged.

Article 4. Amendments.

The bylaws shall be amended or revised by movement of the EC and a two-thirds positive vote by the regular membership of the Program.

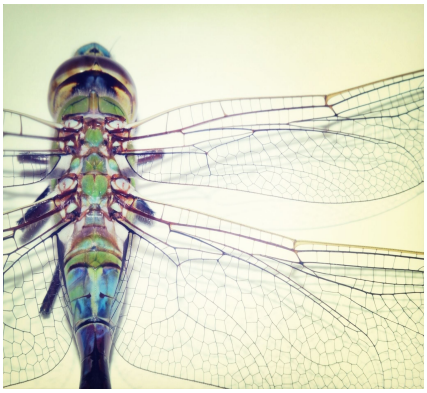
APPENDIX I.1

Graduate Interdisciplinary Program in Entomology and Insect Science

Student Handbook

2023 - 2024

Note: This handbook contains new guidelines for EIS graduation requirements in accordance with motions passed by faculty in May 2019. ***Students who matriculated prior to Fall 2022 should follow the guidelines for degree requirements as outlined from their first year of the program.***



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Welcome

Welcome to the Graduate Interdisciplinary Program in Entomology and Insect Science (GIDP-EIS). During your time in the program, whether as a master's or Doctoral candidate, you are encouraged to bridge scientific disciplines in ways that bring fresh perspectives to questions in insect biology. The program faculty is here to assist you in developing your individualized degree program and in designing and accomplishing your research. So, welcome, and best of luck in your graduate training.

Using this Handbook

This handbook describes the Program's current regulations and procedures, as well as the various requirements that must be met for the PhD and MS degrees. Please use the links provided in this handbook to review up-to-date information on Graduate College and EIS GIDP policies. ***It is GIDP policy that the student holds final responsibility for being aware of and responding to all GIDP and Graduate College policies, requirements, formats, and deadlines as they pertain to progression towards and completion of their degree.***

If you have any questions about the program, please contact the GIDP-EIS Graduate Program Coordinator, Paula Nielsen **pnielsen322@arizona.edu**

Contacts & Physical Resources and Facilities

Molly (Martha) Hunter, Chair GIDP in Entomology & Insect Science Marley Building, 641 (520) 621-9350 **mhunter@arizona.edu**	**Paula Nielsen, Graduate Program Coordinator** GIDP in Entomology & Insect Science Marley Building, 641C (520) 621-0847 **pnielsen322@arizona.edu**
Hayley Krall, Graduate Degree Counselor Graduate College, University of Arizona **hayleykral@arizona.edu** (520) 621-0119	**Graduate Student Representative** Please check EIS website for current student representative
EIS Breakroom – Marley 6th Floor	**EIS Mailroom (Forbes 410)** Entomology and Insect Science c/o Department of Entomology 1145 E. 4th St., PO Box 210036 Tucson, AZ 85721-0036

About the EIS Program

The Graduate Interdisciplinary Program (GIDP) in Entomology and Insect Science (EIS) offers Master of Science and Doctor of Philosophy degrees. The faculty of the EIS GIDP currently includes members representing seven departments: Entomology, Ecology and Evolutionary Biology, Epidemiology, School of Natural Resources and the Environment, Neuroscience, Molecular and Cellular Biology Geography. For an updated list of faculty and their research interests, please refer to the **EIS Program website.**

In addition to coursework and research opportunities, EIS Graduate students also have access to a variety of seminars, workshops, and conferences sponsored by the EIS GIDP, the Dept. of Entomology, the Graduate College and other programs and organizations on campus.

What is a GIDP?

Graduate Interdisciplinary Programs or GIDPs are PhD, Masters, and minor programs with collaborative relationships between all colleges across campus creating unique opportunities in interdisciplinary research. GIDPs transcend departmental boundaries by facilitating cutting edge teaching and research at the nexus of traditional disciplines. The high value placed on interdisciplinary research and education is indicative of The University of Arizona's enthusiasm and commitment to fostering innovation and creativity among its faculty and students.

To learn more about other GIDPS at the University of Arizona visit the **GIDP website**

Affiliation

EIS students' affiliation (for publications or presentations) is "Graduate Interdisciplinary Program in Entomology and Insect Science, 1145 E. 4th St., PO Box 210036, Tucson, AZ 85721." This is true even though your advisor (who may be a co-author on your work) has a separate, departmental affiliation (e.g., Dept. of Entomology or Dept. of Ecology and Evolutionary Biology). The EIS program and the two programs that preceded it also have close relationships with the Department of Entomology, and the College of Agriculture & Life Sciences (the college in which Entomology is housed), and these institutions should be gratefully acknowledged for any funding granted. You may also claim dual affiliation in manuscripts with the department of your advisor.

The GIDP in Entomology and Insect Science is administered by an Executive Committee. The Executive Committee is chaired by the Program Chair and includes six faculty members and a student representative. The Executive Committee of the GIDP in Entomology and Insect Science formulates policies and procedures for the operation of the graduate program in such areas as admissions, curricula, student supervision, and completion of degree program requirements.

Program Committees

In addition to the Executive Committee, there are two other standing committees for the program. The Admissions Committee coordinates all recruiting and admissions procedures. The Advisory Committee is relevant for current students. The Advisory (Progress) Committee solicits and evaluates annual progress reports from all students (more information on progress reports is available in Section 3, Advising and Progress).

Student Participation in Program Administration

At the end of each school year, the students in the EIS Graduate Program elect a Graduate Student Representative from among their peers to serve a one-year term, beginning the following fall.

The EIS Graduate Student Representative for the 2022-2023 Academic Year is Meagan Ash.

The primary duties of the Graduate Representative are:

- To bring the questions and concerns of the students in the Program to the attention of the Program Chair, and vice versa.
- Help the Program management develop Program policy as needed.
- Assist with the organization of the annual recruitment workshop in the Spring semester and other Program activities when appropriate.
- Appoint student committee members for EIS Awards in Education and Leadership (see Program Awards below).

EIS GIDP students are encouraged to work with the Executive Committee to improve any aspect of the Program, including, but not limited to, examinations, application processes, course requirements and electives, and research and funding opportunities. *To ensure that messages are not lost, students should direct comments through the Graduate Representative*. If there is a conflict of interest or some other complication that prohibits this path of action, please contact the EIS Program Coordinator to discuss.

Program Retreat

The EIS GIDP has historically hosted a program retreat, in the spring of every other year, and hope to start this again post-pandemic. Potential changes to program policy and activities are discussed by attending students and faculty. Student input is valued. Faculty then break off and settle on proposed motions for program changes. Motions are put forth to all EIS faculty for a vote. All changes to EIS GIDP policy will be promptly shared with students via the student email listserv.

Student Rights and Responsibilities

Responsibility for meeting EIS GIDP and University requirements ultimately rests with the student – students should not expect reminders of deadlines from the program.

Students are entitled to the following rights as members of the EIS GIDP:

- Right to representation through an elected Graduate Student Representative
- Right to appeal as outlined in Appendix 2: Student Appeals
- Right to understandable information on all degree requirements
- Right to understandable information on program progress through:
  - consistent assessments,
  - meetings with faculty advisors at least once per semester, and
  - timely feedback (maximum 6 week turn-around) on degree requirements,
- Right to prompt notification of changes in Program policy via the student listserv

Students are responsible for making Satisfactory Academic Progress (Appendix 1) and meeting the other expectations of the Graduate College and the EIS GIDP as outlined in this Handbook.
EIS students are also expected to abide by all relevant ethical and academic standards of the University as outlined below.

- **Academic Integrity**

- **Responsible Conduct of Research**
- **Graduate College Academic Policies**

Advising and Progress

Student advisors, Graduate Committees, and the Advisory Committee work together to ensure that students stay on track to degree completion. *Students are expected to meet with their committees and to complete progress reports annually.*

Expectations for Satisfactory Academic Progress

A student making satisfactory academic progress maintains a 3.0 GPA in program courses and is making timely progress on the steps to their degree as outlined in this handbook.

Failure to Achieve Satisfactory Progress

In the rare circumstances that a student fails to meet program guidelines for satisfactory progress, the student will receive written notification with a clear statement of what the student must do and a date by which such actions must be completed. The Graduate College will receive a copy of letters of unsatisfactory progress. Students will be given an opportunity to appeal or rebut, as described in Appendix 2: Student Appeals. Students who fail to improve by the deadlines specified may be dismissed from the program.

Advisors

You will meet with your advisor frequently during your program. Students generally come in with an advisor, but in the unusual circumstance that they are considering more than one faculty member as an advisor, they should select an advisor before the start of the second semester of study. This selection will be influenced by discussion with the potential advisor, research rotations, and individual meetings with the Program faculty.

If you are an undecided first year student, communicate with the faculty whose laboratories you are considering joining to make sure they are also willing to advise you. Please check the degree requirements and tracking in GradPath to make sure you stay moving ahead in your degree progress.

Annual Progress Report

Annual progress reports are required from all current students. Progress reports are generally due at the end of May, after the second semester has concluded – students will receive a notification in the Spring semester on the deadline for progress reports. The Advisory committee then meets to discuss all the student reports. Each student and their advisor receive a letter with the summary of the Committee's thoughts and concerns. When there's concern about the progress of a student, the report and letter from the Committee will be forwarded to the EIS Chair for further discussion with the student and advisor. Copies of all letters from the Advisory Committee will be filed with the Executive Committee and in the students' files. If students fail to make progress in successive years, the student may be consulted and then notified of milestones that must be reached by certain dates (see failure to achieve satisfactory progress, above). In rare circumstances, the Advisory Committee may recommend probation or dismissal.

The format for annual progress reports is available in Appendix 3.

Graduate Committees

Who can serve and what do they do?

The Graduate Committee, with your major advisor, will: (1) advise you on preparation of a Plan of Study, (2) supervise your research (3) conduct the comprehensive examination, and (4) evaluate and edit the dissertation and conduct the final examination and dissertation defense.

Students should select a Graduate Committee in the first year, **before the start of the third semester of study**. This selection will be influenced by discussions with your advisor and individual meetings with the Program faculty. If you are considering inviting a particular faculty member for your committee, you should establish a time to meet, and then plan to discuss your research plans, and ask whether they would be willing to serve on your Graduate Committee.

Note: Graduate Committees may change over the course of a student's program. Changes may occur because of a change of the student's research focus, the departure of a faculty member to another institution, or, rarely, because of a conflict with a committee member.

Who can serve on your committee? Committee member requirements are available on the **Graduate College website**

In addition to the yearly required committee meetings, it is highly advisable to schedule a committee meeting when the thesis or dissertation has taken shape and the end is in sight (e.g., the semester before you defend). Present the research that will be in the final thesis/dissertation to your committee at this time and make sure that all members approve of the scope, rigor, and organization of the final product. At this time, your committee can decide when it requires a final draft of the paper to review. At minimum, committees generally require the complete and formatted thesis/dissertation two weeks before the defense.

Advisory Committee Progress Reports

Annual progress reports are required from all current students. They are generally due at the end of May, after the second semester has concluded. The Advisory committee then meets sometime during the summer to discuss all the student reports. Each student and their advisor will receive a letter with the summary of the Committee's thoughts and concerns. When there's concern about the progress of a student, the report and letter from the Committee will be forwarded to the EIS Chair for further discussion with the student and advisor. Copies of all letters from the Advisory Committee will be filed in the students' files. If students fail to make progress in successive years, the Advisory Committee may recommend probation or termination.

The Graduate Coordinator will send out requests for progress reports in the spring semester. A sample format for the progress reports is available in Appendix 3.

EIS Program Requirements

Enrollment Policy

- With the exception of students in their last year who may take fewer credits, students ordinarily take between six (minimum) and 12 (maximum) units of graduate course work in each fall and spring semester to remain in good standing in the Program. Work with your Major Advisor and the EIS Program Coordinator to make sure you are enrolled for the right number of units. International students may need to take a certain number of units to fulfil their visa requirements.

- MS students may register for 1-8 units of EIS 900 Research and/or EIS 910 Thesis per semester. PhD students may register for 1-9 units of EIS 900 Research and/or EIS 920 Dissertation per semester. By the end of your program, MS students need 8 units of EIS 910 Thesis credits and PhD students need 18 units of EIS 920 Dissertation credits. When you are taking less than a full load of graded courses, your enrollment will consist of mainly these two types of units.

- These policies are subject to change. Please refer to **University Enrollment Policies** for current information.

- See more specific details in the paragraphs below.

Courses and Registration

All EIS students will start their program with some required courses taken in the first or second year. There are few of these, but because they are generally offered only once in a two-year cycle, you will need to take them when they are offered. After that time, you will select your courses in consultation with your Advisor and Graduate Committee. PhD students will also select a minor and complete minor requirements. You will also need to meet the Graduate College requirements for your program. However, you will find that you have a great deal of flexibility to choose the courses most relevant to your interests and research direction. A complete list of Entomology and EIS courses are available on the **Registrar's website,** but any graduate level course approved by your committee can be considered, and our students take courses in programs across campus, including in Ecology & Evolutionary Biology, Molecular and Cell Biology, Epidemiology, School of Natural Resources and the Environment, Plant Sciences, GIDP in Neuroscience, Geography, and others**.**

	• **View the Schedule of classes by semester.** • **Put in EIS (or other prefix) under Subject Area and click Search.** • **If you wish to see the course description, click on the link under Section.** • **See more information about the courses below and pay careful attention to the checklist that follows.**

Letter Grade vs Non-Letter Grade and Schedule Changes

- Courses for a letter grade can be added online through **UAccess.**
- Non-letter grade enrollment can consist of Independent Study, Laboratory Rotation, or Research units (including dissertation and thesis).
- Non-letter grade units can be added by submitting an email request to the EIS Graduate Coordinator. Please include the desired course number, number of units, and supervising instructor in your email. Please confirm your plans with the supervising instructor prior to making the request.
- Deadlines exist for all schedule changes. Please be aware of these important deadlines by checking the **Registrar's website.**

Required Courses

EIS 596A, Current topics in Entomology & Insect Science (Seminar)

The program seminar has a different format in fall and spring. In the fall students read on the topic of their planned thesis or dissertation topic and write weekly summaries of their reading. During class period, students present papers they've read, with all students presenting at least twice during the semester. Students also discuss the joint Entomology/EIS seminar series talk of the previous week. The spring seminar is for proposal writing. Students work throughout the semester in writing a draft of their MS or PhD proposal, with class periods being devoted to discussion of scientific writing, peer reviews and sharing progress. PhD students are required to take fall & spring semester offerings in both their 1st and 2nd year in the program. MS students are required to take the fall and spring seminar in their 1st year in the program.

EIS 792, Research Rotation

During the first year in the EIS program, each PhD student must complete at least two laboratory rotations, one of which must be conducted in a laboratory other than that of the student's advisor. Laboratory rotations count for course credit. Lab rotations encourage you to have hands-on experience in areas of interest, to learn research methods in the field and to become acquainted with the laboratory work and research group of prospective dissertation advisors.

You will earn 3 units per semester for a maximum of 9 possible units earned for rotation. The length of rotations is 8 weeks, with about 10 hours of work per week expected in the lab. However, the rotation project can be continued beyond 8 weeks with the agreement of the student, rotation mentor, major advisor, and program coordinator. The number of units you earn is dependent on the number of rotations you do and the time it takes to complete each one. It is common to complete 1 & ½ rotations in a semester with the 2nd rotation beginning mid-semester, with completion taking place in the following semester (with or without a second semester of course enrollment). Students are encouraged to complete a third rotation if they like. Please note, you cannot register for rotation mid-semester, you must register prior to the semester start.

There is no set format for a given rotation project. Both the student and rotation host should design rotation projects to achieve specific goals for student development and expected outcomes for the project. Before the project begins, submit a rotation form to the EIS Program Coordinator. The rotation form is available on the **EIS website.** **Do fill these out – they provide a clear plan and prevent misunderstandings or revisions of the scope of the rotation as it progresses.**

At least two of three of the following core courses:

EIS 517, Insect Systematics (offered alternative years in the fall)
EIS 520, Insect Molecular Physiology (offered alternative years in the spring) *
EIS 544, Insect Ecology (offered alternative years in the fall)

*This course has not had sufficient enrollment to be offered in recent years.

Seminars and Group Meetings

Students are expected to participate actively in group meetings, seminars, and activities of the Program.

GradPath

Students are required to complete **GradPath** forms via UAccess as they progress through their degrees. Please review the GradPath requirements under your degree and complete forms by the stated deadlines. For additional information see **GradPath User Guides**

Learning Outcomes Assessment

Program assessment forms are used to evaluate and monitor strengths and weaknesses in learning of all students in the program; assessment forms are not used to grade or judge individual students. Learning outcome surveys will be linked to emails to students at the time of comprehensive exams (for PhD students) and final defenses (both MS and PhD students).

An explanation of the assessment process and the EIS program learning outcomes for both MS and PhD students can be found here: **Graduate student learning outcomes assessment**.

EIS program assessment self-reflection forms **must be completed** by students **and** graduate committee members for each of the following degree milestones:

- Oral Comprehensive Exams
- Final Thesis Exams/Dissertation Defenses

Entomology & Insect Science PhD Student Requirements

*Please familiarize yourself with the **Graduate College policies** for doctoral students.*

Minimum Credit Units: 63

Required Core Coursework:

Minimum credits for Major: 36
Minimum credits for Minor: 9
Minimum credits for dissertation: 18

These courses are all offered alternate years, so students will take them in their first or second year.

Units will include EIS courses, courses in the minor, other courses chosen from the schedule of classes and approved by the Graduate Committee, and research and independent study units. Eligible transfer courses may also be included in this tally.

1. **At least two of three of the following core courses:**
   - EIS 520 Insect Molecular Physiology (3 units) *
   - EIS 544 Insect Ecology (3 units)
   - EIS 517 Insect Systematics (4 units)

2. **EIS 596A Current topics in Entomology & Insect Science Seminar (1 -3 units)**
   Course is taken four (4) times, fall & spring semester in the first and second year of the program.

3. **At least two research rotations EIS 792 (3-6 units).**
   One rotation needs to be completed in a laboratory other than the advisor of record.

4. **EIS 920 Dissertation (18 units).**

5. **PhD minor in a program other than EIS, consisting of at least 9 units.**

* This course has not had sufficient enrollment to be offered in recent years.

EIS courses available to PhD majors

EIS 501	Ecological Physiology (3 units)
EIS 505	Aquatic Entomology (4 units)
EIS 513	Applied Biostatistics (3 units)
EIS 515R	Insect Biology (3 units)
EIS 532	Comparative Immunology (3 units)
EIS 536	Agro-ecology (3 units)
EIS 553	Functional and Evolutionary Genomics (4 units)
EIS 557	Medical-Veterinary Entomology (3 units)
EIS 588	Principles of Cellular and Molecular Neurobiology (3 units)
EIS 597C	Controlled Environment Agriculture IPM (3 units)
EIS 599	Independent Study (1 – 5 units)
EIS 660	Infectious Disease Epidemiology (3 units)
EIS 699	Independent Study (1 – 3 units)
EIS 900	Research (1 – 8 units)
EIS 920	Dissertation (1 – 8 units

In this interdisciplinary program, we encourage students to take courses in other programs that suit their developing interests, in consultation with their graduate committees.

Popular courses available to EIS PhD majors

BE 534	Biosystems analytics (Python for data analysis)
BE 587	Metagenomics
BIOS 576A	Biostatistics in public health
BIOS 576B	Biostatistics for research
ECOL 596W	Special topics in Ecology and Evolution: Practical and reproducible data science
ECOL 530	Conservation genetics
ECOL 528R	Microbial genetics
ECOL 506R	Conservation biology
ECOL 519	Introduction to modeling in biology
ECOL 526	Population genetics
ECOL 587R	Animal behavior
ECOL 600B	Fundamentals of ecology
ENVS 567	Introductory statistics and multivariate statistics with R
EPID 573A	Basic principles of epidemiology
PLP 550	Principles of plant microbiology
NRSC 572	Neurodevelopment in action

Elective Coursework

In the fall students taking the required EIS 596A seminar course will attend Entomology/EIS research seminars and, separately, read the literature in their own area of research, write summaries and twice per semester, present a paper relevant to their own research in the class meeting time. The spring semester EIS 596A seminar course will be a structured proposal writing workshop, with frequent peer, advisor, and course instructor review of drafts.

Minor Requirements

Minors must be in a program or department other than EIS. Nine (9) units are generally required for a minor. A member of the minor department or program must serve on the student's graduate committee and approve the units taken for fulfillment of the minor.

Speaking Requirement

PhD students who have completed their comprehensive exams must present two talks on their research progress, one of which may be on campus. Attending and presenting at conferences are excellent opportunities to share research results and develop scientific communication skills.

Teaching Requirement

University level teaching is considered essential training for an academic career. Therefore, PhD students must serve as a Teaching Assistant, or have an equivalent type of teaching experience for at least one semester sometime during their graduate program.

Time Limitation

PhD students must pass their Final Defense within 5 years of passing the Comprehensive Exam.

Steps to your Entomology & Insect Science PhD Degree

Choosing a Graduate Committee

The Graduate Committee must be chosen by the end of the second semester. The composition of your graduate committee must be submitted on GradPath. The Graduate College requires a minimum of three committee members to approve the dissertation, all of whom must be University of Arizona tenured, tenure-track, or equivalent. The fourth and fifth members, if any, may be UA faculty or approved special members. Things to keep in mind:

- It's best to have a minimum of 4. This is helpful if a committee member can't attend meetings or the dissertation defense. However, 5 or more members may provide logistical difficulty in scheduling.

- Three members must be regular faculty at the University of Arizona; however, it is possible to include a 4th person as a "Special Member" if that person has special skills and knowledge. A request must be submitted to the Graduate College for a "Special member". The request requires basic information and a CV for the proposed committee member.

- In GradPath there is a distinction between the Comprehensive Exam Committee and Doctoral Dissertation Committee. This means that a change in committee is possible. All changes must be entered into GradPath.

- Please see more details about **PhD Graduate Committees.**

GradPath Forms

GradPath Forms:

- Responsible Conduct of Research Statement *must be completed in the first semester*
- Plan of Study *by third semester in residence*
- Comprehensive Committee Appointment Form *before beginning of the Written Comprehensive Exam*
- Announcement of Doctoral Comprehensive Exam *at least 10 days before Oral Exam*
- Prospectus/Proposal Confirmation *no later than six months before Final Defense*
- Announcement of Final Oral Defense *at least 10 days before Final Defense*

Plan of Study

The plan of study lists:
(1) graduate courses the student intends to transfer from other institutions (if any).
(2) courses already completed at The University of Arizona which the student intends to apply toward the graduate degree; and
(3) planned additional coursework to be completed to fulfill degree requirements.

The Plan of Study must be entered into GradPath. The Graduate College requires electronic approval signatures for the Doctoral Plan of Study from the Chair of the EIS and the student's major advisor so students should be sure to have the program chair and major advisor "ok" coursework prior to submitting the form for signatures. The Plan of Study must be completed by the third semester in residence. Students often delay submitting a Plan of Study because their planned course are not definite. In fact, revisions to a Plan of Study occur frequently and are the norm. Do submit your Plan of Study on time – it can be amended multiple times.

Comprehensive Examination

The comprehensive examination is designed to ensure that PhD students are broadly trained, can synthesize new knowledge and think independently. Preparation for the comprehensive examination provides a rare opportunity to intensively read, think and write about one's discipline.

The comprehensive examination must be taken according to the **Graduate College regulations**. Under normal circumstances, the comprehensive examination should be taken in your second or third year.

The examination, which has written and oral parts, tests knowledge in both the major and minor areas of concentration.

The written exam consists of two parts:

The first part is a dissertation proposal, which should outline independent research, and is generally written according to the guidelines of a relevant funding agency (e.g., NIH, USDA, NSF).

The dissertation proposal can be developed in consultation with your committee.

In the second part, you will write an essay on a topic chosen by the Committee. This second assignment will give you an opportunity to develop a synthetic, critical essay in an area allied but separate from your dissertation problem and will be written without any consultation with other students or faculty.

The second essay will be turned in a week after being presented.

The oral exam is given by your Graduate Committee.

The oral examination involves broad questions across your general field of study as well as more specific questions within your area of specialization. You should demonstrate strong fundamental knowledge in areas pertaining to Entomology & Insect Science as well as in the discipline represented by your minor.

It may be advisable to speak to each member of your committee several weeks before your oral exam to ask them whether there is a particular body of work that they recommend you study (e.g., texts, papers, or topics). When the committee feels that the student is insufficiently prepared for the oral exam, they may postpone the exam, to allow more time for preparation. If the student is unprepared in the exam, the Committee will fail the student.

The Graduate College allows only one re-take of the oral exam. Comprehensive Exam Instructions can be found on the Graduate College **website**.

The Comprehensive Exam Committee Appointment Form and Announcement of Doctoral Comprehensive Exam should both be filed with the Graduate College via GradPath forms found in **UAccess**

Advancement to Candidacy

When the student has an approved doctoral Plan of Study on file, has satisfied all course work, residence requirements, and passed the written and oral portions of the Comprehensive Examination, the student has "advanced to candidacy" and is eligible to apply for certain fellowships that are exclusively for students at this advanced stage of their program (e.g., USDA Predoctoral Fellowship). The Graduate College will notify you by e-mail when you have advanced to doctoral candidacy. Students will be charged graduate candidacy fees. Students at this point must file a Doctoral Dissertation Committee Appointment (EISPHD) form with the Graduate College via GradPath forms found in **UAccess**

Deadlines for the submission of forms pertaining to doctoral programs can be found here **Important Degree Dates and Deadlines | The University of Arizona Graduate College**

Dissertation and Final Examination

In the months before your defense, you and your Graduate Committee will agree upon a schedule for completion of chapters, and submission of the dissertation to the Committee members. You are expected to provide the members of your committee with the final, polished version of the dissertation at least two weeks prior to the scheduled Final Examination, or defense.

The Announcement of Final Oral Defense (EISPHD) form must be on GradPath at least 10 days prior to the defense.

The defense consists of a scheduled, advertised public seminar by the candidate followed by an oral examination by your Graduate Committee that cannot exceed two hours. While the oral portion of the Comprehensive Examination is often broad ranging, the final oral examination is generally focused on the dissertation. The Graduate College requires a minimum of three members to approve the dissertation, all of whom must be University of Arizona tenured, tenure-track, or equivalent. The fourth and fifth members, if any, may be UA faculty or approved special members. If a committee has only three members, all must approve the dissertation.

If the committee requires revisions, those must be done in a timely manner, not to exceed one year. If the revisions are not completed by the dissertation submission deadline for the term when the student defends, the student will be required to register for the next semester and will graduate in the semester when the revisions are complete and approved. If revisions are not done by the end of the time to degree period, the student will have to re-take the comprehensive examinations to demonstrate currency of knowledge.

Exit Interview

Upon completion of the dissertation defense, students should schedule a meeting with the Program Chair. The purpose of this meeting is congratulatory as well as information-seeking. The department is committed to the quality of its graduate program, and the advice and experiences of successful students are valued.

Suggested Entomology & Insect Science PhD Timeline

Year One

fall

- **(Upon arriving in Tucson:) Initial meeting with Program Coordinator**
  Responsible Conduct of Research; submit GradPath form
  Visit with EIS faculty to select and plan lab rotations.
  Complete first laboratory rotation(s); turn in rotation(s) report

spring

Complete final rotation(s), turn in final rotation(s) report
Select Major Advisor (if did not arrive with one)
Develop Plan of Study with Major Advisor
Choose Graduate Committee; submit GradPath form
Annual Graduate Committee meeting for review of progress

Year Two

fall

- Submit final Plan of Study; **submit GradPath form**
  Appoint Comprehensive Examination Committee; **submit GradPath form**

spring

- Complete coursework
  In year 2 or 3 schedule and complete Written and Oral Comprehensive Exam; **submit GradPath form, submit self-reflection assessment form**
  Annual Graduate Committee meeting for review of progress

Year Three

fall

- Appoint Doctoral Dissertation Committee; **submit GradPath form**

spring

- Annual Graduate Committee meeting for review of progress

Year Four

fall

- Focus on dissertation research, completion of chapters, preparation of manuscripts for publication

spring

- Annual Graduate Committee meeting for review of progress

Year Five

fall

- Prepare for dissertation defense
  Meet with the Graduate Committee

spring

- Schedule Defense; **submit GradPath form**
  Final Defense; **submit self-reflection assessment form**
- Schedule exit interview with program chair

Entomology & Insect Science MS Student Requirements

*Please familiarize yourself with the **Graduate College policies** for master's degree students.*

Minimum Credit Units: 32

Required Core Coursework:

At least 15 units must be completed toward the MS requirements in letter-graded courses (vs. research or independent study units). **At least 24 credits** must be in non-thesis credits.

1. At least two of three of the following core courses:

- EIS 520 Insect Molecular Physiology (3 units) *
- EIS 544 Insect Ecology (3 units)
- EIS 517 Insect Systematics (4 units)

2. EIS 596A Current topics in Entomology & Insect Science Seminar (1 -3 units)
Course is taken two (2) times, fall & spring semester in the first year of the program.

3. EIS 910 Thesis (8 units).

*This course has not had sufficient enrollment to be offered in recent years.

EIS courses available to EIS MS majors

EIS 501	Ecological Physiology (3 units)
EIS 505	Aquatic Entomology (4 units)
EIS 513	Applied Biostatistics (3 units)
EIS 515R	Insect Biology (3 units)
EIS 532	Comparative Immunology (3 units)
EIS 536	Agro-ecology (3 units)
EIS 553	Functional and Evolutionary Genomics (4 units)
EIS 557	Medical-Veterinary Entomology (3 units)
EIS 588	Principles of Cellular and Molecular Neurobiology (3 units)
EIS 597C	Controlled Environment Agriculture IPM (3 units)
EIS 599	Independent Study (1 – 5 units)
EIS 660	Infectious Disease Epidemiology (3 units)
EIS 699	Independent Study (1 – 3 units)
EIS 900	Research (1 – 8 units)

In this interdisciplinary program, we encourage students to take courses in other programs that suit their developing interests, in consultation with their graduate committees.

Popular courses available to EIS MS majors

BE 534	Biosystems analytics (Python for data analysis)
BE 587	Metagenomics
BIOS 576A	Biostatistics in public health
BIOS 576B	Biostatistics for research
ECOL 596W	Special topics in Ecology and Evolution: Practical and reproducible data science
ECOL 530	Conservation genetics
ECOL 528R	Microbial genetics
ECOL 506R	Conservation biology
ECOL 519	Introduction to modeling in biology
ECOL 526	Population genetics
ECOL 587R	Animal behavior
ECOL 600B	Fundamentals of ecology
ENVS 567	Introductory statistics and multivariate statistics with R
EPID 573A	Basic principles of epidemiology
PLP 550	Principles of plant microbiology
NRSC 572	Neurodevelopment in action

Elective Coursework

n/a

Additional Requirements

No other requirements, although training in teaching with a teaching assistantship is encouraged.

Time Limitation

MS students must complete all degree requirements within 5 years. The expected timeline for MS students is 2-3 years.

Steps to your Entomology & Insect Science MS Degree

Choosing a Graduate Committee

The Graduate Committee must be chosen by the end of the second semester. Committee members must be submitted on GradPath. The Graduate College requires a minimum of three members to approve the thesis, all of whom must be University of Arizona tenured, tenure-track, or equivalent. Typically, MS graduate committees have three members, two faculty other than the advisor. A fourth faculty member can be included, or an approved special member. Things to keep in mind:

- Thesis **committees** must consist of three members; at least two must be members of the Graduate Faculty. If the third member is not a member of the Graduate Faculty, he or she must be approved by the Graduate College as a Special Member. Special Member requests are submitted by the Program Coordinator. The request requires basic information and a CV for the proposed committee member.

- Please see more details about **MS Graduate Committees**

GradPath Forms:

GradPath Forms:

- Responsible Conduct of Research Statement *should be completed before the end of the first semester*
- Plan of Study *by third semester in residence*
- Master's Committee Appointment Form *as soon as Plan of Study is approved*

Plan of Study

A Plan of Study lists:

(1) the graduate courses the student intends to transfer from other institutions (if any).

(2) the courses already completed at The University of Arizona which the student intends to apply toward the graduate degree; and

(3) additional coursework to be completed to fulfill degree requirements.

The Plan of Study must be entered into GradPath. The Graduate College requires electronic approval signatures for the Doctoral Plan of Study from the Chair of the EIS and the student's major advisor.

The Plan of Study must be completed by the third semester in residence. Students often delay submitting a Plan of Study because their planned course are not definite. In fact, revisions to a Plan of Study occur frequently and are the norm. Do submit your Plan of Study on time – it can be amended multiple times.

Final Examination

A typical thesis MS degree defense is similar to a PhD defense. The defense consists of a scheduled, advertised public seminar by the candidate followed by an oral examination by the Graduate Committee. The final examination is designed to ensure that MS students have a thorough understanding of their thesis project. The structure of the MS final examination is flexible and will be decided by the student's Graduate Committee. Students should consult their advisors on effective exam preparation. Following the defense, the thesis is submitted to the Graduate College.

A candidate who fails a final examination may, upon the recommendation of the program, be granted a second examination. The results of the second examination are final.

MS students may also decide to complete a non-thesis MS degree. This is generally a terminal degree (i.e. not a stepping stone to a PhD program), is awarded on the basis of completed coursework (with or without an additional project) and may be elected because of a student focus on outreach rather than research, or because the student's goals have changed. Students electing a non-thesis MS ordinarily have a final committee meeting to discuss the student's learning outcomes from the program and future plans.

Exit Interview

Upon completion of the Final Defense, students should schedule a meeting with the Program Chair. The purpose of this meeting is congratulatory as well as information-seeking. The department is committed to the quality of its graduate program, and the advice and experiences of graduating students are valued.

Suggested Entomology & Insect Science MS Timeline

fall — ***Year One***

- (Upon arriving in Tucson:) Initial meeting with Program Coordinator
  Select Major Advisor
  Responsible Conduct of Research; **submit GradPath form**

spring

Develop Plan of Study with Major Advisor; **submit GradPath form**
Choose Graduate Committee; **submit GradPath form**
Annual Graduate Committee meeting for review of progress

fall — ***Year Two***

- Finish coursework
  Thesis research

spring

- Graduate Committee meeting to discuss thesis results and presentation
  Schedule and complete Final Exam; **submit GradPath form, submit MS thesis to the Graduate College**
  Exit Interview; **submit self-reflection assessment form**

Steps for EIS MS student to transfer to the EIS PhD Program

- The student's advisor and/or committee members must approve.

- The student must complete a significant piece of writing and submit it to their advisor and the Program Chair. This could be the first chapter of the MS thesis, or a draft. The writing sample and request to change programs must be endorsed by the advisor and subsequently approved by the Admissions Committee.

- Once the EIS Admissions committee has approved the transition, the student must still "apply" through GradApp (and pay application fee) to the doctoral program. Students can make this transition at any time of year; the regular deadline for application to the program (Dec. 1 each year) does not apply.

Required for application:

- **The Statement of Purpose/Personal Statement**
  The student can upload a previous statement. No additional evaluation occurs at this stage, so no additional work is required.

- **CV**
  Any version (including your admissions application CV) will work. Or you can upload the 2-page CV submitted for the student progress report.

New letters of recommendation are not required.

- The student must send an email to degree counselor that he/she does not want to complete the MS. This will help establish the new PhD record in GradPath.

Hayley Krall
hayleykral@arizona.edu

- The student will let the Program Coordinator know that the application is submitted. The PC will close the application and will take action to recommend admission.

- The student must accept their admission. A PhD record will be established in GradPath for student.

Entomology & Insect Science Minor Student Requirements

(for students from other University of Arizona PhD programs)

Minimum Credit Units: 9

Required Core Coursework

9 units are required for the minor. Completion of these courses with a "B" average for the required units is necessary for granting of the minor.

A member of the GIDP EIS faculty must serve on the student's committee to represent the EIS minor and will approve the units selected. EIS does not require representation at the written Comprehensive Examination but does require an EIS GIDP faculty member to be present at the oral examination, and EIS-related material must be covered. The student's dissertation (Doctoral final oral examination) committee must contain one faculty GIDP EIS member. This committee member must be present at the dissertation defense, either in person or by teleconference.

EIS courses available

EIS 501	Ecological Physiology (3 units)
EIS 505	Aquatic Entomology (4 units)
EIS 513	Applied Biostatistics (3 units)
EIS 515R	Insect Biology (3 units)
EIS 517	Insect Systematics (4 units)
EIS 520	Insect Molecular Physiology (3 units) *
EIS 532	Comparative Immunology (3 units)
EIS 536	Agro-ecology (3 units)
EIS 544	Insect Ecology (3 units)
EIS 553	Functional and Evolutionary Genomics (4 units)
EIS 557	Medical-Veterinary Entomology (3 units)
EIS 588	Principles of Cellular and Molecular Neurobiology (3 units)
EIS 596A	Current topics in Entomology & Insect Science Seminar (1 -3 units)
EIS 597C	Controlled Environment Agriculture IPM (3 units)
EIS 599	Independent Study (1 – 5 units)
EIS 660	Infectious Disease Epidemiology (3 units)
EIS 699	Independent Study (1 – 3 units)
EIS 900	Research (1 – 8 units)

**This course has not had sufficient enrollment to be offered in recent years*

Financial Information

Entomology and Insect Science Program funding

Student funding is extremely varied. Students may be funded from fellowships, may be self-funded, or may be supported by Program funds or faculty grants in their first year while they take courses and do laboratory rotations.

Students in their second and subsequent years are funded by research assistantships from their advisors, teaching assistantships, training grant funds, or individual fellowships. All students are strongly encouraged to apply for individual fellowships as they are excellent training in summarizing research. If granted, fellowships and grants are prestigious and increase the probability of further funding and of securing positions after graduation. Fellowships also increase student independence. Students who are not legal residents of Arizona, but are on an RA or TA, receive a waiver of the out-of-state tuition charged by the University of Arizona.

Students who are self-funding, have less than a 'full time' (0.5) RA or TA, or who are on certain types of fellowships, may be responsible for some portion or all tuition charges. However, before you pay these, check with the EIS Program Coordinator to see whether we have GRS/GTS funds to distribute that can reduce or eliminate your financial liability. These are generally distributed once a year, so you may have to anticipate more than a semester in advance. Enrollment in the University's student health plan for the student is covered when a student holds an assistantship position.

Many EIS students have taken advantage of the TA opportunity in the Introductory Biology labs (MCB 181 or EEB 182). If you anticipate looking for a TA for the following year or semester, let the Program Chair know, and they will let you know when either program is accepting applications. Other Departments or programs may also have TAships that you can apply for – work with the Program Chair to make sure they know when you're looking for a position, and also when you've found one.

Scholarship Universe is a scholarship matching service exclusively for University of Arizona Students. When a student logs in, they are asked a series of questions and matched to scholarships based on their answers. Scholarship Universe matches Wildcats to thousands of UA and non-UA opportunities and can help you to apply for and receive scholarship awards quickly and easily. Very commonly, students who take the time to apply to SU get awarded small scholarships that a) are helpful financially and b) can and should be listed on one's CV. We urge everyone to do this.

Mandatory start of semester fees

All students are responsible for paying the mandatory UA fees charged on their Bursar's account. Log in to UAccess Student, click on the "Finances" tab and scroll down to "Account Summary." There, if you owe anything, you will see a breakdown of each charge. Fee amounts vary and depend on the number of units taken. Please be sure to pay these fees by the first day of class each semester. If you do not pay them by that date, you will be charged a late fee.

Multiple Means of Support

The University has strict regulations governing academic year employment limits. Details are available in the **GA Manual,** If you have specific questions, contact the **Graduate College** (520) 621-3471.

Additional Funding Opportunities

General Funding, Internal

The Graduate College
Financial resources page on their website where you will find a list of various funding opportunities for graduate students.

Graduate Center Office of Fellowship
The Office of Fellowships is a branch of the Graduate Center that assists graduate students in searching and applying for funding outside of the University of Arizona. They also offer grant writing workshops and presentation.

CALS Scholarships via Scholarship Universe
One application puts you into consideration for all CALS scholarships. Applications accepted January – March.

Research, Innovation & Impact
Provides access for faculty, students, and researchers to multiple funding databases.

Research Funding

- **Graduate & Professional Student Council Research Grants**
- **Willock Research Award**

UA Conference/Research Travel Funding

- **Carter Travel Award**
- **Raphael and Jolene Gruener Research Travel Award**
- **Graduate & Professional Student Council travel grant**

General Funding, External

- **USDA-National Institute for Food & Agriculture**
  There are two categories of awards. One is the predoc fellowship for for grad students advanced to candidacy, and the other is a postdoc fellowship.
- **NSF Graduate Research Fellowship**
  Students can apply as undergraduate seniors, and as doctoral students within the first year and before completing the fall term of the 2nd year. Those who are US citizens, nationals, or permanent resident aliens can apply. Graduate students may only apply one time.
- **Department of Energy Scholars Program**
  The DOE Scholars Program is a department-wide program designed to create a pipeline of highly qualified talent in disciplinary fields that support mission critical areas of the U.S. Department of Energy (DOE).
- **Howard Hughes Medical Institute**
  Applications announced by the university. Students apply at the university level and if selected to advance to the next level are then invited to apply to the HHMI application system.
- **Sigma Xi**
  To become a member of Sigma Xi, the Scientific Research Honor Society you must be recommended by a current member.

Hear about a new funding opportunity?

Please email the EIS Program Coordinator.

Program Awards

EIS Student Leadership Award	EIS Student Education Award	Carruth Award
Recognizes excellence in EIS graduate students who play a leadership role within the EIS program.	Recognizes an EIS graduate student who has excelled in education. Educational excellence can be achieved in any mix of TAships, laboratory mentoring, and outreach.	Recognizes an EIS graduate student who has completed exceptional work, as demonstrated by their annual Progress Report.

Award Allocation

One award per year which includes a cash award

Award Committee

The EIS student leadership award committee will consist of 2-3 EIS graduate students and one EIS faculty member. The Program Chair and the Student Executive Committee Member will jointly nominate the members of the committee. The EIS student education award committee will consist of 1 EIS graduate student and 2 program faculty. The Program Chair and the Student Executive Committee Member will jointly nominate the members of the committees.

The award is allocated by the EIS Advisory Committee, a standing committee of four EIS faculty members that reviews the annual Progress Reports.

Award Nominees

Students can self-nominate or be nominated by others for either Leadership or Education awards. The student then writes the application. The EIS Program Coordinator will send out a request for nominations, usually in the spring semester.

All students completing Progress Reports are automatically nominated for the Carruth Award.

Award Application

Applications should not exceed one page and should describe the achievements that make the student eligible for the award.

The award application is the Progress Report submitted by each student.

Important Links

Academic Resources

Graduate College

Provides information on Graduate College policies, contacts, information about resources, deadlines, and other useful information).

Graduate Student Academic Services (GSAS)

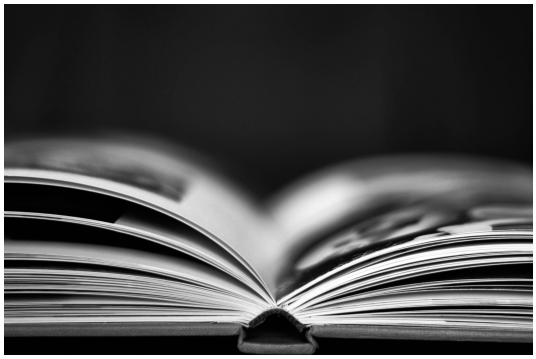
The Graduate Student Academic Services (GSAS) Office within the Graduate College is here to help students, faculty, and staff keep track of academic progress and the steps needed to complete a graduate or professional degree. Information on dates and deadlines can be found here.

Graduate Center

Serves as a hub for resources important to graduate students and postdoctoral fellows.

International Student Services

International graduate students in need of guidance, particularly in regard to travel and immigration.



UArizona Libraries

For library information, resources, and help.

Borrow Technology

Students in need of technology or equipment can check out items through the library.

University Information Technology Services (UITS)

UITS is available online to help with technology needs and support. Visit for their full range of services.

Office of Student Computing Resource (OSCR)

The Office of Student Computing Resource is now providing software assistance online. OSCR consultants can assist and guide you on how to use software to finish your projects.

Student IT Center

The Student IT Center features online learning and teaching technologies, including tools for collaboration and testing.

Writing Efficiency Sessions (WES)

WES are group writing sessions focused on productivity and output.

Summer Fellowship Application Development Program

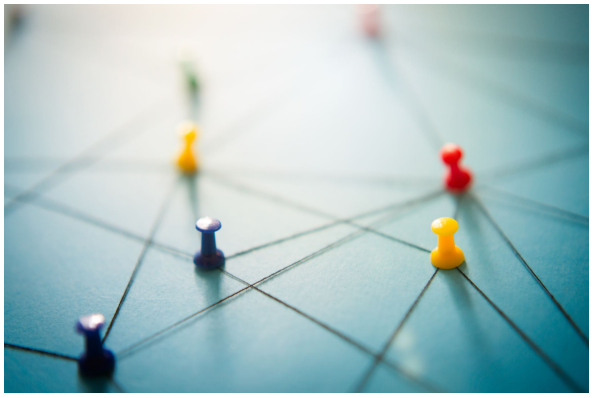
The Summer Fellowship Application Development Program offers deadlines and writing support to assist UArizona students in completing fellowship applications over the summer.

Personal Resources

Quick Link for New and Current Students

Here you will find information for:

- Academic Services, Policies and Procedures
- Costs and Funding
- Professional Development
- Child Care Subsidies and Family Friendly Information
- Health, Wellness and Safety
- Other UArizona Resources & Information
- Third-party Information & Resources



Campus Safety & Wellness

Resources to enhance students' safety and well-being. Including information on how to sign up for UA Alert to be notified of campus emergencies.

Campus Recreation

Included in your fees, it has three locations and open seven days a week.

Campus Pantry

The Campus Pantry aids students facing food insecurity. It has a new location and new hours during the current campus closure.

Campus Health

Campus Health is a one-stop-shop for health and wellness. From medical, mental health, and wellness services, to events, workshops, and student groups, they're here to support all students.

Counseling and Psych Services (CAPS)

Whether you're ready to start counseling or medication, have a question, seeking community, want to learn new skills, or just need to vent, there's a path for you. CAPS services are available to all enrolled University of Arizona students.

At Counseling and Psychiatric Services (CAPS) students can speak with licensed mental health professionals about things like:

- anxiety and depression
- eating and body image
- alcohol and drug concerns
- family, friend, roommate, and relationship problems
- sexual assault and relationship violence
- crises and trauma
- psychiatric medication
- And anything else you need to talk about.

Please call CAPS prior to going into the office. CAPS Main phone: 520-621-3334

Entomology & Insect Science Resources

Keys

Talk to your advisor about the keys you will need. If you are based in Marley, you will need to register a 4-digit pin to get into the building. To do this, send an email to Mike Riehle and he will send your email address to the Security company. You should then get a link that will enable you to set up your pin. Physical keys will be necessary for your laboratory and potentially office space.

Your advisor can tell the Entomology Dept. administration (currently Nirka Green) that you need a key to a particular room, and with the authorization you will receive, you can make the trek to the Key Desk north of Speedway to get keys.

Lab/Office Space

Your supervisor will assign you bench space in their laboratory. Students conducting research rotations may not be assigned individual bench space and instead may be assigned shared lab space for the duration of the rotation.

Your supervisor may also assign office space if there is some available. If your supervisor does not have adequate office space available, contact the **EIS Program Coordinator** for assistance.

University of Arizona Insect Collection (UAIC)

Over one million pinned and identified insects are curated in the University of Arizona Insect Collection (UAIC) located in Forbes building Room 410, next to the front offices of the Department of Entomology. The UAIC is a valuable resource for insect-related research projects and it is a great place to deposit voucher specimens resulting from your research.

Contact **Dr. Gene Hall** (Collection Manager) for more information about the UAIC.

Meeting rooms

The 7th Floor Meeting Room (Marley 741H), Entomology Classroom (Forbes 412) and Entomology Library (Forbes 403E) can be reserved by phoning the Entomology office staff (621-1151), or by emailing **Nirka Green.**

Seminars

Entomology & EIS: Fridays at 11:00 am in the Marley 230 Lecture Hall. Fall semester only.

Ecology & Evolutionary Biology: Mondays at 3:00 pm and Tuesdays 12:30 pm

Listservs

As an EIS graduate student, you are automatically subscribed to the EIS student listserv: **eis-students@list.arizona.edu**. You can email the address to send messages to all program students.

eis-faculty@list.arizona.edu is the listserv for all EIS faculty members.

ent@list.cals.arizona.edu is the listserv for all Entomology faculty and staff. Email **Nirka Green** to be added.

eeb@list.arizona.edu is the Department of Ecology and Evolutionary Biology. How to join: **instructions**

Graduate Student Learning Outcomes Assessment

As part of the accreditation process, and to measure whether students are achieving the learning outcomes desired, every academic program must have a "learning outcomes assessment." It is important to stress that this assessment is *not* used to grade or judge the student; instead, the responses are used by the Chair and Executive Committee to analyze patterns of strengths and challenge areas for students *across the program.* Based on the abstracted, anonymous data, the faculty may then make changes to the program to address any issues that need to be addressed through the curriculum. In 2023, upon consultation with the Office of Instruction and Assessment, the Executive Committee of the EIS Program revised the Assessment Rubric consistent with the goals of the program. Specifically, a quantitative 5-point scale for proficiency for learning outcomes was replaced by qualitative responses (by faculty) and self-reflection prompts (for students), more appropriate for a program with ~25-30 MS and PhD students.

MS Assessment

MS students will complete a self-reflection survey after:

Final thesis defense

PhD Assessment Activities

PhD students will complete a self-reflection survey after each of the following:

- Oral comprehensive exam
- Final dissertation defense

The EIS program has three learning outcomes. The first asks about the student understanding of insect biology (content learning outcome), the second asks about whether the student can think critically and creatively to perform and analyze research (the research learning outcome) and the third asks whether the student can communicate the research findings and the context for the research (the communication outcome). At a MS final defense, the student will be asked to reflect on their strengths and weaknesses with respect to all three learning outcomes. At a PhD oral comprehensive exam, the student will be asked to reflect on their mastery of discipline content (learning outcome 1). At the PhD final dissertation defense, the student will be asked to reflect on their research and communication skills (learning outcome 2 and 3).

Expected Student Learning Outcomes

1. **Discipline content:** The student demonstrates understanding of key concepts in insect biology as well as those underlying their general subject area (e.g. physiology, molecular biology, genomics, ecology, systematics, evolution or behavior).

2. **Research:** The student exhibits a) critical thinking skills to evaluate the scientific literature and articulates how their research fits into and advances the discipline. The student b) develops creative and innovative research ideas and approaches. The student c) uses multiple research approaches to collect scientific data related to their research area, and can interpret, analyze and critique their data.

3. **Communication:** The student communicates their research (importance, approaches taken, summary and interpretation of results) effectively through oral presentation and can express the potential impact of their work on society in lay terms.

Appendix 1: Student Appeals

All students of the EIS GIDP have the right to appeal decisions which impact their academic standing.

Graduation Requirements

Appeals for changes in the graduation requirements can be made to the Program Chair and will be considered at the next Executive Committee meeting.

Course Grades

University policy for grade appeals can be found under Grade Appeal in the **University's General Catalog**.

Unsatisfactory Academic Progress

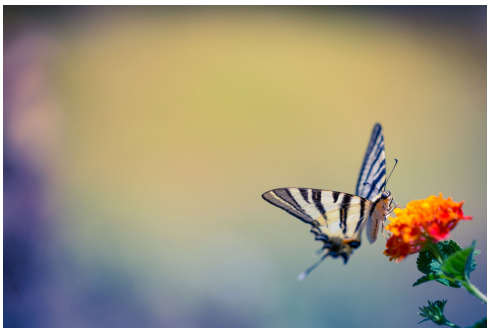
Students who receive notification of unsatisfactory progress from the Advisory committee will be given an opportunity to appeal the actions and/or deadlines required to prevent program termination as dictated by the committee. Appeals can be made to the Program Chair and will be considered at the next Executive Committee meeting.

In any case, should a student feel that there is a conflict of interest that may interfere with the objective review of their appeal, this issue should be raised with either the Program Chair or the Program Coordinator.

Grievance Policy

Should a graduate student feel he or she has been treated unfairly, there are a number of resources available. With few exceptions, students should first attempt to resolve difficulties informally by bringing those concerns directly to the person responsible for the action, or with the student's graduate advisor, the department head, or the immediate supervisor of the person responsible for the action. If the problem cannot be resolved informally, the student may be able to file a formal grievance.

For additional information: https://grad.arizona.edu/policies/academic-policies/grievance-policy#grievance-responsibility



Appendix 2: Progress Report Format

Note: Progress Report Format is subject to change – when completing your report, use the format provided by the Program Coordinator in the spring semester.

THE UNIVERSITY OF ARIZONA
Entomology & Insect Science
Graduate Interdisciplinary Program

MS Annual Progress Report 2022-2023

Graduate Student Name: Click or tap here to enter text. **Major Advisor Name:** Click or tap here to enter text.

Arrival term: Click or tap here to enter text. **Expected graduation term:** Click or tap here to enter text.

Your current grade point average: Click or tap here to enter text.

The names of the members of your graduate committee (if you have one)
Click or tap here to enter text.
Click or tap here to enter text.
Click or tap here to enter text.
Click or tap here to enter text.
Click or tap here to enter text.

The last time your graduate committee met (if they have met)
Click or tap here to enter text.

Do you have a committee meeting planned or scheduled?) ☐ Yes | ☐ No
If yes, when?
Click or tap here to enter text.

GradPath form progress
MS students have 4 required GradPath forms.

MS - Entomology & Insect Science (Active in Program)
Responsible Conduct of Research Statement (EISMS)
Plan of Study (EISMS)
Master's/Specialist Committee Appointment Form (EISMS)
Master's/Specialist Completion Confirmation (EISMS)

Have you completed your Plan of Study
☐ Yes | ☐ No

If yes, is it up to date?
☐ Yes | ☐ No

What is your next GradPath form to complete?
Click or tap here to enter text.

1. A paragraph summary of the thesis research project (even if preliminary). **Please write this for educated non-specialists (i.e. not just for your advisor).**

This section has been variable in quality - use this as an opportunity to really think about your research and how you'd describe it to a non-specialist.

Click or tap here to enter text.

MS Annual Progress Report (page 2)

2. Goals of the past calendar year (from last year's report), and a discussion of how those goals were met, or not met, and if the latter, why not.

If you are a first-year student, or haven't submitted one of these before, you may have to think back on what your goals were and do what you can to recreate them.

Click or tap here to enter text.

3. Goals for the next twelve months. These should be two to five concrete statements and should include research objectives as well as other aspects of progress in your program.

(Some hypothetical goals for different students could be: Form a committee and have a committee meeting, Collect a second season of field data on the influence of pollinators on nectar microbiome, Finish coursework requirements, or Submit draft of master's thesis to committee). Try to make them realistic, because these goals will be measured against your progress at the end of next year.

Click or tap here to enter text.

4. Other things that you think pertinent.

Click or tap here to enter text.

5. A current 2-page CV. Should include contact information, education, experience (academic work/research/teaching), awards and honors, service/activities, outreach, presentations, and publications.

There is no prescribed format - you can use the format you prefer. You may want to go over your CV with your advisor to make sure it's clear, concise and lists everything important.

When you're done, please highlight (with the Microsoft Word highlight function, with an asterisk or in bold) the awards, presentations, TAs, or publications *of the past year*.

THE UNIVERSITY OF ARIZONA
Entomology & Insect Science
Graduate Interdisciplinary Program

PhD Annual Progress Report 2022-2023

Graduate Student Name: Click or tap here to enter text. **Major Advisor Name:** Click or tap here to enter text.

Arrival term: Click or tap here to enter text. **Expected graduation term:** Click or tap here to enter text.

Your current grade point average: Click or tap here to enter text.

The names of the members of your graduate committee (if you have one)
Click or tap here to enter text.
Click or tap here to enter text.
Click or tap here to enter text.
Click or tap here to enter text.
Click or tap here to enter text.

The last time your graduate committee met (if they have met) Click or tap here to enter text.

Do you have a committee meeting planned or scheduled?) ☐ Yes | ☐ No
If yes, when? Click or tap here to enter text.

Number of Dissertation (EIS 920) units completed.
Click or tap here to enter text.

Have you met your speaking requirement?

☐ Yes | ☐ No Click or tap here to enter text.

PhD students are expected to give two research talks following completion of their comprehensive examination, at least one on campus.

Have you met your 1 semester teaching requirement, or equivalent?

☐ Yes | ☐ No Click or tap here to enter text.

PhD students must complete at least one semester of a Teaching Assistantship.

Note: Close to finishing students whose committee has not insisted on a teaching experience and/or speaking experiences may be exempt but let us know anyway.

GradPath form progress
PhD students have 9 required GradPath forms.

PHD - Entomology & Insect Science (Active in Program)
Responsible Conduct of Research Statement (EISPHD)
Plan of Study (EISPHD)
Comp Exam Committee Appointment Form (EISPHD)
Announcement of Doctoral Comprehensive Exam (EISPHD)
Results of Comprehensive Exam (EISPHD)
Doctoral Dissertation Committee Appointment (EISPHD)
Prospectus/Proposal Confirmation (EISPHD)
Announcement of Final Oral Defense (EISPHD)
Results of Final Oral Defense (EISPHD)

Have you completed your Plan of Study?
☐ Yes | ☐ No

If yes, is it up to date?
☐ Yes | ☐ No

Have you passed your comprehensive examinations?
☐ Yes | ☐ No

What is your next GradPath form to complete?

Click or tap here to enter text.

PhD Annual Progress Report (page 2)

1. A paragraph summary of the dissertation research project (even if preliminary). **Please write this for educated non-specialists (i.e. not just for your advisor).**

This section has been variable in quality - use this as an opportunity to really think about your research and how you'd describe it to a non-specialist.

Click or tap here to enter text.

2. Goals of the past calendar year (from last year's report), and a discussion of how those goals were met, or not met, and if the latter, why not.

If you are a first-year student, or haven't submitted one of these before, you may have to think back on what your goals were and do what you can to recreate them.

Click or tap here to enter text.

3. Goals for the next twelve months. These should be two to five concrete statements and should include research objectives as well as other aspects of progress in your program.

(Some hypothetical goals for different students could be: Form a committee and have a committee meeting, Collect a second season of field data on the influence of pollinators on nectar microbiome, Finish coursework requirements, or Submit draft of master's thesis to committee). Try to make them realistic, because these goals will be measured against your progress at the end of next year.

Click or tap here to enter text.

4. Other things that you think pertinent.

Click or tap here to enter text.

5. A current 2-page CV. Should include contact information, education, experience (academic work/research/teaching), awards and honors, service/activities, outreach, presentations, and publications.

There is no prescribed format - you can use the format you prefer. You may want to go over your CV with your advisor to make sure it's clear, concise and lists everything important.

When you're done, please highlight (with the Microsoft Word highlight function, with an asterisk or in bold) the awards, presentations, TAs, or publications *of the past year*.

Appendix J1. University of Arizona Insect Collection (UAIC)

The University of Arizona Insect Collection (UAIC) is one of the largest, oldest and most diverse arthropod museums for the Sonoran Desert Region. It houses over two million research specimens, 83% of which are identified to the species-level, representing an estimated 35,000 species, The UAIC has a rich history, is highly active, and has a bright future as an important provider of biodiversity data, well-curated specimens, and in-depth expertise for students, researchers, educators, and the public, as evidenced by our strong record and growing achievements in research, service, and education.

The UAIC is administered by the Department of Entomology in the College of Agriculture and Life Sciences and is viewed as an integral part of this Land Grant University. It is secured by a long-term commitment of the University of Arizona and its many dedicated associated systematists. Today, the UAIC is fortunate to have an excellent team of dedicated personnel. We have nine "staff" members: the Curator (PI, W. Moore), Collection Manager (G. Hall), an IT specialist (R. Zimmerman), a photographer (C. Martinez), four graduate student curatorial assistants (D. Bergamaschi, C. Bradley, R. Ikagawa, J. Montoya), and three undergraduate research assistants (T. Bland, O. Husok, and J. Simon). The Curator is a tenured associate professor with a 50% research, 20% curation, 15% teaching, 15% service split. The Collection Manager is full-time staff with a 50% collection management, 50% extension split, The IT specialist is a volunteer, and the photographer is 0.49 FTE temporary position. Graduate students are not paid specifically to work in the UAIC but have volunteered large amounts of time for curation of particular groups, outreach programs, and assisting visiting researchers. Undergraduates serve crucial roles in maintaining the UAIC, including freezing drawers, preparing specimens, photographing specimens with their labels, and assisting with other maintenance duties. Further, we are extremely fortunate to have an endowment to offset expenses for visiting systematists to work in the UAIC on their specialty group during their sabbatical leave. This unique endowment helps to ensure the vitality and growth of the UAIC in perpetuity.

In addition to the regular "staff" noted above, several systematists are officially associated with the museum and the Department of Entomology and regularly help with the curation of particular groups. These include Drs. Kim Franklin (Formicidae), Michael Irwin (Therevidae), Tristan McKnight (Asilidae) and Ed Pfeiler (Lepidoptera), Over the past 15 years, over 40 other experts have volunteered their time and knowledge to help curate their specialty groups. These researchers continue a rich tradition of systematics that inspires students and all users of UAIC– extension agents, museum staff, researchers, and members of the public. Because our active community spans many generations, we provide an exceptionally rich environment for nurturing an understanding of the scale and importance of biological diversity.

The quality of the curation in terms of the percentage of specimens identified to the species level is high. The Smithsonian Institution's curation assessment method, known as the McGinley system (McGinley, 1993), works by assigning a numerical curation code (1-8) to the basic units used in insect collections. These are: Level 1- conservation problem; Level 2- unidentified unsorted material, sorted only to major groups (usually family); Level 3- unidentified material, sorted to "loan-able units" (usually genus); Level 4- material identified to species level but not incorporated into main collection; Level 5- identified and integrated material which is inadequately curated; Level 6-identified, integrated, and adequately curated; Level 7- physical curation complete, species-level inventory complete; and Level 8: physical curation complete, individual specimen label data captured, Overall, in 2011 at the time we submitted our last NSF CSBR proposal, 83% of the collection was curated at McGinley level 7. Post-renovation, **collection use has more than doubled** (*Table 1*) and the increase in the number of systematists living in southern Arizona who wish to deposit their collections in the UAIC has been overwhelming (*Table 2*) We have recently been offered several substantial, new donations which we anticipate will arrive within the next three years, largely of insect pollinators.

Table 1. Activity of the UAIC before and after 2012-14 renovations, A = number of visitors, B = number of specimens donated.

	A	B
Covid years		
2019	300	15K
2018	465	13K
2017	355	27K
2016	370	10K
2015	400	15K
2012-14 UAIC Renovations		
2011	176	5K
2010	215	17K
2009	175	3K
2008	180	3K
2007	154	3K

Table 2. Sizable donations already incorporated after 2012-14 renovations. A= name of donor and taxa donated, B= number of drawers, C= percent at McGinley Level 7 or greater. SASI=Sonoran Arthropod Studies Institute.

A	B	C
SASI, all	50	75%
Pape, all cave fauna	60	100%
McCleve, beetles	50	100%
Smith, beetles	24	100%
O'Brien, weevils (syn)	5	100%
Lingafelter, longhorn beetles	5	100%
Woodley, jewel beetles	5	100%
Botz, true bugs (syn)	5	100%
O'Brien, true bugs (syn)	1	100%
King, bees	5	100%
Menke, wasps (syn)	1	100%
ASDM, bees	10	100%
Watkinson, leps	40	100%
Melton, leps/bees	30	100%

The UAIC user community is diverse, ranging from outstanding undergraduate students to highly active emeritus insect systematists. Annually, we host thousands of visitors, ranging from resident researchers to individual walk-ins, campus tour groups, and vast numbers of people seeking information on the biology of the region. These visits illustrate the high profile and vibrant nature of UAIC, which complement our unique biological collections. The University of Arizona has one of the highest concentrations of insect scientists in the country and most of them use the UAIC in conjunction with research and outreach programs, Approximately 200 researchers, including faculty, staff, research associates, postdoctoral fellows and students distributed across 14 UA departments work on various aspects of insect science.

The UAIC Facilitates Collections-Based Research

The UAIC is a very active research collection. During the past ten years, it has averaged 10 loans to researchers annually, Prior to the 2012-14 renovations the UAIC received between 150 and 200 research & public visitors per year; since then, these numbers have doubled (see Table 1), This high rate of visitation is due in part to improved visitor resources following our last CSBR award and in part to our location in the megadiverse Sonoran Desert Region, which attracts researchers from around the world, Many researchers also visit the UAIC as they pass through Tucson to collect in the Madrean Sky Islands of the southwestern US and northern Mexico, and/or to participate in one of the intensive summer courses on insect systematics offered at the American Museum of Natural History's Southwest Research Station (SWRS) in Portal, Arizona each year, such as the Ant Course, the Bee Course, Beetle Course, and the Lepidoptera Course.

The deserts of the southwestern US and northwestern Mexico are fast becoming the research focus of many ecologists and conservation biologists because they are among the areas most impacted by climate change, population growth, and expanding human land (and water) use in North America (Sala et al. 2000; Smith et al. 2000), The University of Arizona is home to the USA National Phenology Network. Working under the motto that "changes in phenology are the "fingerprint" of climate change," the USA

National Phenology Network research team is particularly interested in tracking changes in the phenology of flowering plants and their insect pollinators (especially in agricultural settings). Pollination by native insects contributes more than $3 billion in agricultural crops each year. Metadata on specimens of insect pollinators provide a valuable window into the past to determine if and how much pollinator phenology has changed over the years.

Since 2013 we have digitized 130,733 UAIC specimens, Specimen-level data are captured in a two-step process. First, we photograph the specimen and all associated labels, including the unique UAIC specimen number, in a single shot using USB camera and 3D printed led dome light (designed and 3D printed by Charles Bradley, current Moore Lab PhD student), Each photograph is named with the unique UAIC specimen number. An associated Excel file tracks the unique specimen number, image, and taxonomic data associated with the specimen. Although our specimen-level data will be managed by Ecdysis, we will continue to share our data with SCAN, iDigBio, and GBIF. Fortunately, the Extended Specimen Network functions implemented in the new version of Symbiota that powers Ecdysis will allow us to easily link our pollinator specimen records to the Barcode of Life Database (BOLD) and to their host plant species (and host plant specimen when available) in SEINet thus making formal associations between these two large Symbiota database networks which will promote future digitalization and pollinator-plant research,

As part of our current NSF-funded project we are digitizing 44,200 additional specimens from UAIC holdings of insect pollinators, including 30,000 specimens of native bees (Hymenoptera: Apoidea: Anthophila), 1,100 hawk moths (Lepidoptera: Sphingidae), 3,100 brush-footed butterflies (Lepidoptera: Nymphalidae), 4,600 bee flies (Diptera: Bombylidae), 4,700 hover flies (Diptera: Syrphidae), and 700 thick-headed flies (Diptera: Conopidae).

The UAIC is the Cornerstone of Insect Diagnostics

The UAIC is an invaluable resource for Cooperative Extension, especially in support of our integrated pest management (IPM) programs. Accurate and timely arthropod identifications are critical to IPM decision-making in urban, agricultural, and natural settings. Statewide stakeholders who benefit from timely and accurate diagnostics include growers, pest control advisors, county extension agents, master gardeners, landscape professionals, park managers, turf managers, poison control, and homeowners, Collection manager Gene Hall is responsible for arthropod diagnostics in support of IPM at UA, Each year he responds to over 500 arthropod samples or electronic queries submitted by stakeholders to the UAIC.

Reliable, rapid, species-level identification of insect specimens is critical to making science-informed decisions aiding conservation efforts for our native pollinators, and much more. UAIC is obtaining and publishing sequence data that will allow for rapid DNA-based identification of all pollinators from the Sonoran Desert and Madrean Sky Island Regions and will house the associated voucher specimens in perpetuity. We are making sequences from our expertly-identified museum specimens publicly and freely available in the Barcode of Life Database (BOLD) to enable success of future biotic surveys and monitoring projects in the region. These data will also increase the resolving capacity and power of future research efforts using environmental DNA (eDNA), Unlike traditional biodiversity assessment methods, where captured or recorded individuals are used to determine presence or abundance, eDNA-based biodiversity assessment relies on our ability to capture the genetic signature left behind by organisms (shedding, excreting, decaying, feeding etc.). Several studies have already successfully shown that eDNA can be a highly accurate biomonitoring tool. However, this potential is dependent on our ability to accurately match the left-behind genetic signatures to the correct species, which is achieved by comparing the short sequences found in an environment with DNA from expertly-identified voucher specimens.

Once a barcode reference library for pollinators in the region is complete, researchers will be able to track pollinator health without the need for time-intensive manual inventories and even to molecularly identify which insects pollinate rare and endangered plants simply by sampling eDNA left on flowers themselves.

The UAIC Contributes to Formal Classroom Teaching

The UAIC is a key resource for several of our core courses, Students make their own insect collections in Insect Biology (ENTO 415), which is a required course for the minor in Entomology and the Undergraduate Certificate in Entomology, and in our upper division Insect Systematics course EIS 517. These courses as well as the Insect Discovery course make use of our extensive teaching collection of insects maintained by the UAIC.

TUCSON BEE COLLABORATIVE. In 2019 Curator Moore (UAIC), Dr. Kimberly Franklin (Conservation Scientist at the Arizona-Sonora Desert Museum, ASDM) and Jennifer Katcher (General Biology Instructor at Pima Community College) co-founded the Tucson Bee Collaborative (TBC). In 2021 the TBC was recognized by UA as a Vertically Integrated Project (VIP). VIP's are transformative approaches to enhancing higher education by engaging undergraduate and graduate students in ambitious, long-term, large-scale, multidisciplinary project teams led by faculty, Course-based undergraduate research experiences (CURE) are being developed and being offered through the Tucson Bee Collaborative. CURES allow students to conduct real research within the context of a formal course, through which they produce data that have broad scientific and societal relevance. They have a proven, positive impact on student learning and retention, problem-solving skills, solidification of their identities as scientists, and increase their likelihood of obtaining a college degree in a STEM discipline. The Tucson Bee Collaborative VIP and related CUREs can help to address several of the greatest challenges to human health and food security. All TBC CUREs center on specimen-based research on pollinators and the importance of natural history collections for studying biodiversity. Founded on the principle that well-curated natural history collections have always been, and will always be, the foundation of modern biology, the UAIC plays a central role in the Collaborative. Our students will learn cutting-edge skills in DNA analysis and digital imaging that will enable them to lead the 4th industrial revolution. Each student adopts a UAIC insect specimen, extracts DNA, sets up and runs a PCR, runs a gel, and learns to view, edit, and align DNA sequence data. This provides an experience-based understanding of the utility of DNA sequence data for identifying species and inferring evolutionary relationships as well as the opportunity to be a published scientist on the Barcode of Life Database (BOLD) and present their research to their peers and broader community in poster symposiums. The skills students learn in the process of DNA barcoding offer a unique foundation for a wide variety of jobs in biotechnology. A key Arizona Advantage of this project is that Arizona has the highest diversity of bees of any state in the US, which helps position UA as a global leader in documenting, understanding, and protecting pollinators. Building on our excellent track record of recruiting and retaining female and Hispanic-American students, we will continue to actively recruit students from groups that have been underrepresented in STEM. To date we have served over 340 PCC students and 25 UA students. All CURE students visit the UA campus to tour the UAIC and Dr. Moore's molecular laboratory (located in building next door to Forbes). Students are not only taught the importance of natural history museums in documenting the flora and fauna of the biodiversity hotspot in which they live, they are also provided an opportunity to engage in hands-on collections-based research themselves.

By involving college students in the process of obtaining and publishing the DNA barcode data, we are helping to train the future environmental workforce. Through our network of CUREs, undergraduate and graduate students build community connections, obtain biotechnology skills, and come to understand the importance of specimen-based research and natural history museums. We are thus documenting the morphological and genetic diversity of our native pollinators, while simultaneously building resources for rapid, reliable species-level identification and creating a standardized baseline for future monitoring of

changes in native bee diversity in the region, The project is also establishing a systematic and genetic foundation necessary for a myriad of hypothesis-driven research questions related to pollinators, food security, and effects of climate change in the Southwestern United States being addressed by students in the TBC-VIP,

Insect displays conceived and produced by Fall 2022 Insect Systematics students.

Insect specimens were collected, curated, and identified by students as part of the course's insect collection assignment. Students then arranged their specimens around original drawings (made by one of the students) that covered the bottom of a glass-covered insect display case. One display features pollinators of specific plants, and the other features habitats where various insects are found around the Las Milpitas farm. At the end of the semester, these displays were given to Las Milpitas de Cottonwood, a farm run by the community Food Bank of Southern Arizona.

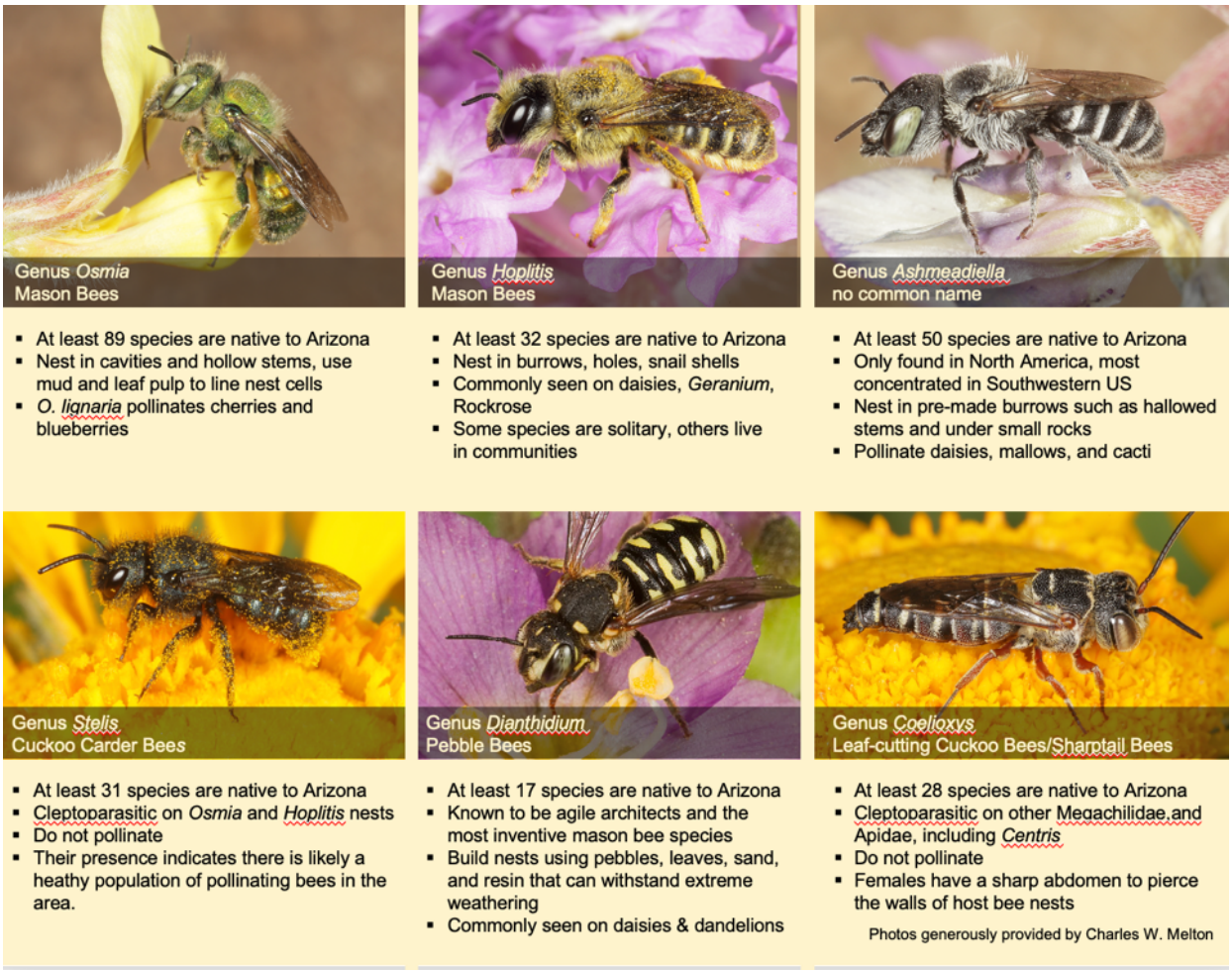

THE UNIVERSITY OF ARIZONA
COLLEGE OF AGRICULTURE & LIFE SCIENCES
Entomology
Insect Collection


Las Milpitas


Las Milpitas de Cottonwood
A COMMUNITY FARM
WELCOME!
Las Milpitas is a community farm that provides educational opportunities, capacity building, and a place for area residents and students to grow their own food. It also serves as a working demonstration ...te in desert food production, composting, ecological restoration, and permaculture for the greater Tucson community.
¡BIENVENIDOS!
Las Milpitas es un espacio comunitario el cual provee oportunidades educativas, incrementa la capacidad comunitaria de autogestión, y es un lugar en donde los residentes locales y estudiantes pueden cultivar sus propios alimentos. También sirve como espacio de demostración sobre la producción de alimentos, compost, restauración ecológica, y permacultura en beneficio de la comunidad de Tucson.
Community Food Bank of Southern Arizona
CITY
APOYAMOS
¡JUSTICIA PARA TODOS!

Outreach flyer conceived and produced by Spring 2023 Discovering Biodiversity (CURE) students.

Our students' course-based research projects focused on several genera of leaf cutter bees (family Megachilidae). In the process of researching them, the students discovered the importance of native pollinators such as wild bees. They produced this trifold flyer as a product of the course. We passed these out to the public at various outreach events, including at the Arizona-Sonora Desert Museum's "Insect Mania" night July 8, 2023.



The UAIC Contributes to other Outreach Initiatives of the Entomology Department

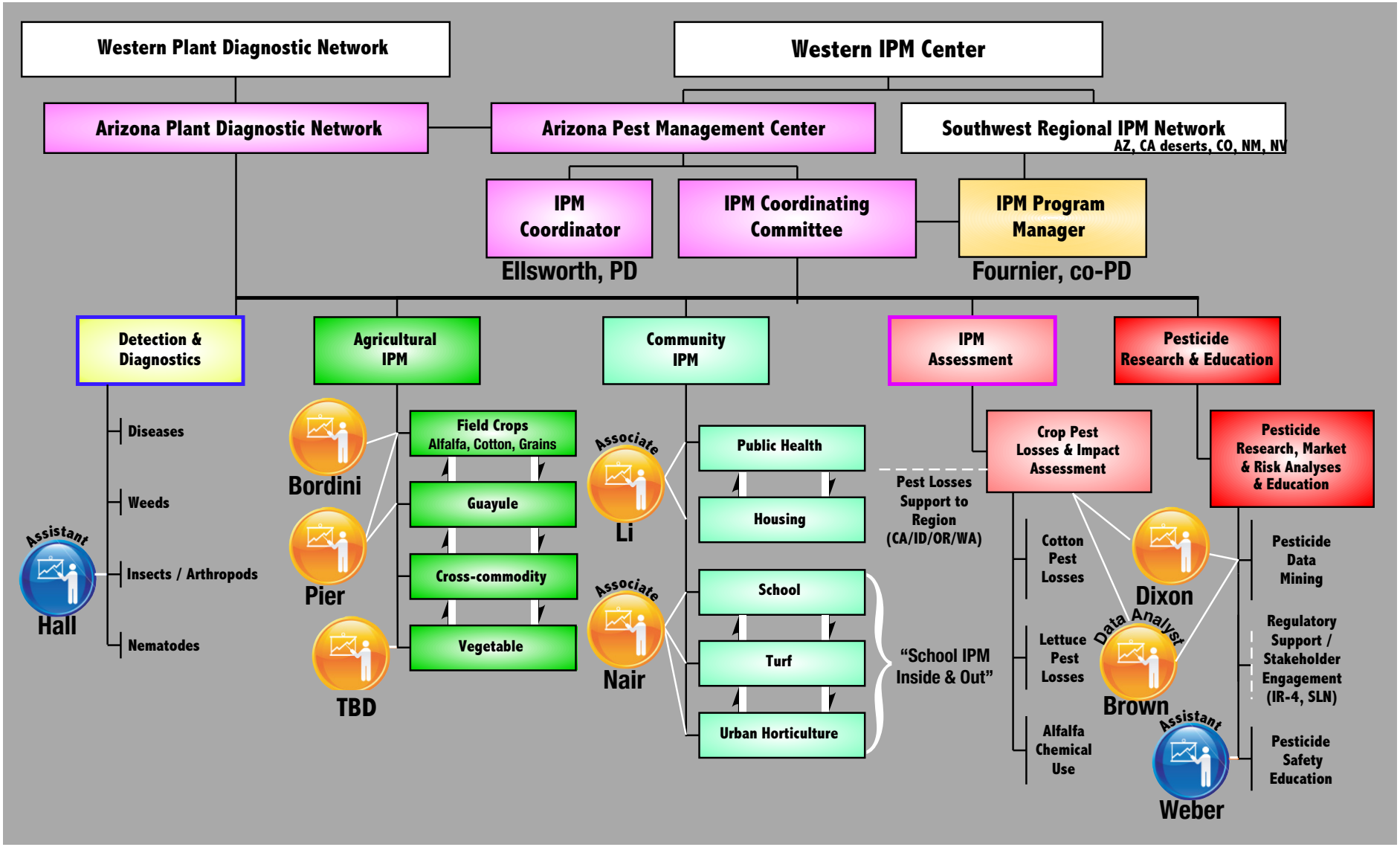
The UAIC serves as an important resource for interactions between the Department of Entomology, EIS students and the public, Students and staff create artful, educational displays of specimens shown at the annual Arizona Insect Festival, in the Insect Discovery Program and in other classroom visits to both Tucson area schools and UA classrooms. EIS students are involved in the frequent tours of the UAIC, for example during the Festival of Books, for the Undergraduate Biology Research Program (UBRP) students, and for community groups. EIS students are also involved with UAIC staff in helping to provide the public and agencies with identifications of arthropods associated with homes, gardens, crops, livestock, forensics, and venomous attacks,

THE INSECT DISCOVERY PROGRAM. In Arizona, state science teaching standards recommend that insects be a component of the elementary school science curriculum. In the Tucson Unified School District insects are the central focus of the second-grade life sciences curriculum. The UA Insect Discovery Program provides classroom visits and UA campus workshops to help teachers make the most of their students' fascination with insects. Last year Insect Discovery completed its 16th year of activities, during which it served over 3000 K-12 students from 30 local schools, well over half of which are Title 1 schools, many of which have over 50% minority enrollment. UAIC graduate and undergraduate students participate in classroom visits and workshops and in return they receive course credit as well as training

and experience in communicating science. Each visit and workshop use pinned insect collections for activities that explore insect diversity and classification. Since young children handle these fragile, dried insect collections, the UAIC supplies Insect Discovery with fresh, pinned specimens each year.

THE ARIZONA INSECT FESTIVAL, In 2011 the UAIC organized and helped sponsor the first Arizona Insect Festival, which took place in the center of the University of Arizona campus. Now in its 11th year, the festival delights over 5000 visitors from the Tucson community who attend the festival annually. In addition to contributing its own booth, the UAIC provides many outreach displays for many of the other booths at the Arizona Insect Festival each year.

Appendix J2. University of Arizona IPM Program Organization



Appendix J2. University of Arizona IPM Program Organization

*Blue text denotes current Entomology faculty

1. Western IPM Center (WIPMC)
Funded (1 of 4) by USDA-NIFA
Administered by UC-Davis, Baur, Director
Ellsworth, one of four Co-Directors

2. Southwest Regional IPM Network
Information network funded through WIPMC Signature Program (2012 – 2026)
Competitive grant subaward – Ellsworth & Fournier (co-PIs)
Fournier, Network Coordinator
Scope: AZ, CO, NM, NV and arid desert region of CA

3. Arizona Pest Management Center (APMC)
Founded in 2003 by UA-IPM (3-d) as proposed by Ellsworth, Palumbo, Baker & seeded by UA-Cooperative Extension Statewide Initiative. Since 2009, has thrived on a series of competitive institutional USDA-NIFA grants (Ellsworth & Fournier, CoPIs). The APMC synergizes the full set of University of Arizona research and Extension resources involved in IPM in Arizona. Base funding is highly leveraged and provides foundational capacity for stakeholder engagement, IPM program delivery and measurement of outcomes.

4. IPM Coordinator
Nominated by IPM Coordinating Committee, appointed by UA Extension Director, currently Ellsworth
IPM Coordinating Committee Chair
Representative to WERA-069, the regional coordinating committee for IPM in the West
Reporting requirement to USDA-NIFA

5. IPM Coordinating Committee
20-member committee with broad representation of IPM interests in Arizona
Oversight of IPM Programs
Approve APMC budgets
Baur (ex-officio), Birkemeyer (stakeholder), Dias, Ellsworth (Committee Chair, team leader), Evans, J. (stakeholder), Evans L. (stakeholder), Farrar (stakeholder), Frisvold, Gouge (team leader), Hu, Johnson (ex-officio), Montoya (stakeholder), Mostafa, Norton, Orr (ex-officio), Palumbo (team leader), Peterson (stakeholder), Poudel-Ward, Richardson (stakeholder), Schuch, IPM Program Manager & Associate Director, APMC (Fournier)

6. IPM Program Manager
Al Fournier
Associate Specialist, non-continuing (80% Extension, 10% Research, 10% Service)
Stationed at Maricopa Ag Center; supported by EIP, state funds, and grants
Supports IPM programs & faculty (evaluation, needs assessment, grant support, coordination)

7. Program Focus: Agricultural IPM (Ellsworth & Palumbo, focus leaders)

Consists of programmatic teams of County, Departmental and Ag. Center faculty

a. Cotton & Guayule – Ellsworth (team leader), Bordini & Pier (staff)
b. Cross-commodity Research & Outreach Program – Ellsworth / Palumbo (team leaders)
c. Vegetables – Palumbo (team leader), staff position vacant

8. Program Focus: Community IPM (Gouge, focus leader)

Supporting needs of diverse and underserved communities, including issues of public health, food safety and resilience

a. Public Health & Housing
- Food Safety – Rock (team leader), Li (staff)
- Vector Management – Gouge & Walker (team leaders), Li (staff)
- Housing – Gouge (team leader), Li (staff)

b. School IPM Inside & Out (includes buildings, turf & landscape) – Gouge (team leader), Nair (staff)

9. Program Focus: IPM Assessment (Fournier, focus leader)

Continuing need of all IPM programs & priorities identified by Federal IPM Roadmap

a. Crop Pest Losses & Impact Assessment

Funded by WIPMC Signature Program to Ellsworth & Fournier + leveraged resources
- Cotton Pest Losses – Ellsworth (leader), Pier & Bordini (staff)
- Lettuce Pest Losses – Palumbo (leader)
- Regional outreach on diverse crops – Ellsworth (leader) Fournier (support)

10. Program Focus: Pesticide Research & Education (Fournier, focus leader)

Consists of pesticide-related programs of research and outreach, including work impacting public policy

a. Pesticide Research, Marketing & Risk Analyses, & Education
- Pesticide Data Mining – Fournier (team leader), Dixon & Brown (staff)
- Regulatory Support / Stakeholder Engagement
  - IR-4 (registration support for specialty crops) – Palumbo (state liaison)
  - Pesticide Registration Review – Fournier (leader), Dixon (staff)
- Pesticide Safety Education – Weber (leader)

11. Western Plant Diagnostic Network (WPDN)

Funded (1 of 5) by USDA-NIFA to facilitate coordination of diagnostics activities between USDA, land grant institutions, and state departments of agriculture
Administered by UC-Davis, McRoberts & Brenes-Arguedas, Co-Directors

12. Arizona Plant Diagnostic Network (AzPDN)

Facilitates coordination of in-state diagnostic activities related to regulation and early detection and links local diagnostic labs to regional and national networks (Hu, leader)

13. Program Focus: Diagnostics and Detection

Consists of diagnostics labs and Specialists throughout the state that provide pest diagnostic services to facilitate IPM decision making in urban, agriculture and natural environments

a. Plant disease diagnostics – Hu (Plant Sciences) & Poudel-Ward (Yuma CE)

b. Weed diagnostics – Dias (Plant Sciences)

c. Insect diagnostics – Hall (Entomology), Coordinator, UA Insect Collection (Moore & Gouge, co-leaders)

d. Nematode diagnostics – un-filled

(rev. 8/2023)

Appendix J3

IPM Coordinating Committee Membership
September 2023

Name	Dept. / Affiliation	Location
Peter Ellsworth, Chair & IPM Coordinator, Specialist & Professor	Entomology	Maricopa Agricultural Center Maricopa, AZ
Matt Baur, Director (ex-officio, WIPMC)	Western IPM Center	University of California Davis, CA
Keith Birkemeyer (stakeholder)	ProBest, LLC	Gilbert, AZ
José Dias (weed scientist) Assistant Specialist & Assistant Professor	Plant Sciences	Maricopa Agricultural Center Maricopa, AZ
Junior Evans (stakeholder)	Corteva	Yuma, AZ
Lin Evans (stakeholder)	Lin Evans Enterprises	Phoenix, AZ
Jim Farrar (stakeholder)	UC Statewide IPM	University of California, Davis, CA
George Frisvold Specialist & Professor	Ag & Resource Economics	UA Main Campus Tucson, AZ
Dawn Gouge, Specialist & Professor	Entomology	Maricopa Agricultural Center Maricopa, AZ
Alex Hu, Assoc. Specialist & Associate Professor	Plant Sciences	UA Main Campus Tucson, AZ
Ken Johnson, Director (ex-officio, MAC)		Maricopa Agricultural Center Maricopa, AZ
Tom Montoya (stakeholder)	Independent PCA	Gilbert, AZ
Ayman Mostafa, Area Extension Agent & Interim Director	Maricopa Co Cooperative Extension	Phoenix, AZ
Randy Norton, Area Extension Agent & Director	Safford Ag Center, Graham, Greenlee, Cochise Co Cooperative Extension	Safford, AZ
Ethan Orr, Assoc. Director, ANR Programs (ex-officio, UACE)	School of Government & Public Policy, Cooperative Extension Administration	UA Main Campus Tucson, AZ
John Palumbo, Specialist, Professor & Endowed Chair	Entomology	Yuma Agricultural Center Yuma, AZ
Jack Peterson (stakeholder)	Arizona Dept. of Agriculture	Phoenix, AZ
Bindu Poudel-Ward (plant pathologist, diagnostician)	Yuma Co. Cooperative Extension	Yuma, AZ
Jesse Richardson (stakeholder)	Corteva	Mesa, AZ
Ursula Schuch, Associate Specialist	Plant Sciences	UA Campus Tucson, AZ

Appendix J4. IPM Program Leverage of EIP Dollars (2017–2020)

The USDA-NIFA Extension Implementation Program (EIP) grant administered by the Arizona Pest Management Center of the University of Arizona was invested in two primary program areas and two secondary program areas over the last grant cycle. Over a 4-year period, those investments were leveraged 5-fold by funding secured or enabled by our IPM staff in more than 70 grants, gifts and contracts. That leveraged activity in research and Extension expenditures greatly increases the value of EIP investments made in Arizona and the scope and number of outcomes and impacts achieved by our IPM programs.

Team	Leverage	Investment	N-fold
Veg IPM	$ 1,633,536	$ 390,173	4.19
Ag IPM	$ 2,022,930	$ 339,335	5.96
School IPM, Public Health IPM, PSEP	$ 1,768,302	$ 354,452	4.99
	$ 5,424,768	$ 1,083,961	5.00

rev. 3/5/21

1. Bordini, I. & Ellsworth, P. Being Selective in IPM: Investigating Insecticide Safety to Natural Enemies and Biological Control in Cotton. 2019 Western SARE Professional Development State Program – AZ. $7,000. 5/2020 – 12/2020.
2. Bordini, I., Ellsworth, P., Fournier, A., Naranjo., S. Empowering producers to effectively integrate chemical and biological controls through research and outreach on selective chemistries and impacts on natural enemies. Western SARE graduate student grant program. $25,000. 5/2018 – 4/2019.
3. Bordini, I., Ellsworth, P., Fournier, A., Naranjo., S. Enhancing IPM by integration of chemical and biological controls through assessment of selectivity of chemistries and function of biocontrol. Western IPM Center grants program (USDA-NIFA). $30,000. 3/2018 – 3/2019.
4. Bordini, I., Ellsworth, P., Fournier, A., Naranjo., S., Richardson, J., Grettenberger, I. Being Selective in IPM: Novel Research to Reduce Risk and Advance Integration of Chemical and Biological Control. Western IPM Center grants program (USDA-NIFA). $30,000. 3/2021 – 2/2022.
5. Bordini, I., N. Dayoob. 2020. Making the Right Decisions with Predator Thresholds for Whitefly Management in Cotton (production of 2 videos). United States Department of Agriculture, Western Sustainable Agriculture Research & Extension (SARE), AZ State SARE support. $7,500. 2020.
6. Dayoob, N., P.C. Ellsworth, A. Fournier. 2020. Guayule Insect Pest Management During Stand Establishment. USDA-AMS, Specialty Crop Block Grant (AZ). $57,333. 2020-2021.
7. Dixon, W.A. & A.J. Fournier. 2019. Arizona Crop Information Site Migration Supports Arizona Agriculture. University of Arizona Cooperative Extension, Extension Strategic Initiative Program. $42,332. 3/2019 – 1/2020.
8. Ellsworth, P.C. 2014. A Western IPM Center Led by California, Arizona and Oregon. USDA-NIFA, Crop Protection and Pest Management, Regional Centers Program, subaward: Crop Pest Losses and Impact Assessment. $324,375. 1/2015 – 12/2018.
9. Ellsworth, P.C. 2014. Building Capacity for Sustainable Pesticide Safety Education in

Arizona. Crop Life America, Pesticide Safety Education Program Improvement & Modernization Initiative. $75,000. 7/2014 – 6/2017.

10. Ellsworth, P.C. 2014. Conduct Field Evaluation of Transgenic Cotton for Pest Resistance and Alfatoxin Contamination. USDA-ARS, Specific Cooperative Agreement. $50,000. 2014-2019.
11. Ellsworth, P.C. I. Bordini, N. Dayoob. Insecticide Impacts on non-target organisms in cotton. 2017 Gifts. $7,500. 2017-2018.
12. Ellsworth, P.C., A. Fournier. 2018. A Western IPM Center Led by California, Arizona, and Oregon (FY18); Signature Program Area: Crop Pest Losses & Impact Assessment; Regional IPM Information Network. USDA-NIFA CPPM Regional Coordination Program (Subaward from UC-ANR, 4 million). $335,174. 09/2018-08/2022.
13. Ellsworth, P.C., I. Bordini, N. Dayoob. 2017. Managing Insect Threats to Stand Establishing Guayule. Bridgestone. $46,000. 2017-2021.
14. Ellsworth, P.C., I. Bordini, N. Dayoob. 2018. Non-target effects of 'Lygus Bt' cotton - Functional effects of 'Lygus Bt' cotton on biocontrol services. Monsanto Company. $51,622. 2018-2019
15. Ellsworth, P.C., I. Bordini, N. Dayoob. Chemical Controls of Lygus Bugs and Whiteflies in Cotton. 2017 – 2020 Gifts. $256,600. 01/2017 – 12/2020.
16. Ellsworth, P.C., I. Bordini, N. Dayoob. Chemical Controls of sugarcane aphid in forage sorghum. 2017 Gifts. $8,000. 2017 – 2018.
17. Ellsworth, P.C., J. Palumbo, Y. Carriere, A. Fournier, W. Dixon, L. Brown, S. Castle, N. Prabhaker. “Prospective” Resistance Management: Empowering Growers to Understand and Exploit Refugia. Monsanto Insect Knowledge Management Program (competitive). $424,325. 07/2015 – 6/2018.
18. Ellsworth, P.C., S. Naranjo. 2018. Non-target and functional effects of 'Lygus Bt' cotton biocontrol services. United States Department of Agriculture, RSA contract. $104,169. 2018-2020.
19. Ellsworth, P.C., S. Naranjo. 2019. Longitudinal study of non-target and target effects of cotton insecticides in AZ & CA. United States Department of Agriculture, RSA contract. $60,000. 2019.
20. Ellsworth, P.C., S. Naranjo. 2021. Improving Insect Management Strategies in Arizona Cotton. Arizona Cotton Research & Protection Council. $20,000. 01/2021-12/2021.
21. Ellsworth, P.C., S.E. Naranjo, A.J. Fournier. 2017. Designing & Evaluating Sustainable Cotton Systems with Reduced Pest & Pesticide Risks. Cotton Incorporated. $135,000. 1/2017 – 12/2019.
22. Ellsworth, P.C., S.E. Naranjo, A.J. Fournier. 2020. Selectivity of Cotton Insecticides Drive Ecotoxicological Gains and Improve Arizona Cotton IPM. $45,000. 1/2020 – 12/2020.
23. Ellsworth, P.C., S.E. Naranjo, I. Bordini, & N. Pier. 2017. Improving Insect Management Strategies in Arizona Cotton. Arizona Cotton Growers Association. $71,717. 1/01/2017 – 12/31/2020.
24. Fournier, A., P. Ellsworth, W. Dixon, J. Peterson. 2019. Influencing Pesticide Registration Decisions for Specialty Crops. USDA-AMS, Specialty Crops Block Grant Program (AZ). $54,483. 10/01/2019-12/31/2020.
25. Fournier, A., P. Ellsworth, W. Dixon, J. Peterson. 2020. Improving Transparency of Pesticide Registration Review for Specialty Crops. USDA-AMS, Specialty Crops Block Grant Program (AZ). $55,138. 10/2020-09/2021.

26. Fournier, A., P.C. Ellsworth, J. Palumbo. 2017. Pesticide Use Data Benefits Specialty Crops. USDA-AMS, Specialty Crops Block Grant Program (AZ). $97,402. 10/2017-09/2019
27. Gouge, D. H., S. Li, S. Nair. 2020. Tribal Emergency Preparedness for Pest Outbreak Workshop. Inter-Tribal Council of Arizona, Inc. (ITCA) - Bureau of Indian Affairs Tribal Resilience Program Grant. $15,000. 2020.
28. Gouge, D. H., S. Li, S. Nair. 2019. Reducing Pests and Pest Management Related Hazards in Low-income Multiunit Public Housing – A Family and Consumer Science Application. Cooperative Extension, University of Arizona. $18,658. 03/2019 – 2/2020
29. Gouge, D. H., S. Li, S. Nair. 2021. Tribal Emergency Preparedness for Pest Outbreak Workshop. Inter-Tribal Council of Arizona, Inc. (ITCA) - Bureau of Indian Affairs Tribal Resilience Program Grant. $15,000. 2021.
30. Gouge, D. H., S. Li, S. Nair.2020. Fendona CS efficacy assessment on bark scorpions from direct contact and residual control under controlled (lab) conditions. BASF Corporation. $6,000. 07/2020 – 10/2020
31. Hall, W., P.C. Ellsworth, N. Pier, L. Abrell. 2017. Blister Beetle Impact on Specialty Crops. USDA-AMS, Specialty Crop Block Grant (AZ). $19,870. 10/2017-9/2022.
32. Hall, W., L. Abrell, D. Diaz, P.C. Ellsworth, N. Pier. 2018. Blister Beetle Risks to Specialty Crops. USDA-AMS, Specialty Crop Block Grant (AZ). $36,239. 10/2018-9/2022.
33. Huseth, A.S., G.G. Kennedy, S.E. Naranjo, & P.C. Ellsworth. 2018. Understanding the potential for resistance and biological control impacts of thrips and plant bug active Bt deployment. USDA-NIFA, BRAG. $498,993. 2018 – 2021.
34. Jeffery, B. 2019. Backcountry Preservation Plan, Casa Grande Ruins National Monument. US Department of the Interior, National Park Service. $80,000. 07/2019 – 07/2020.
35. Jeffery, B. 2017. Backcountry Preservation Plan, Casa Grande Ruins National Monument. US Department of the Interior, National Park Service. $80,000. 07/2017 – 07/2018.
36. Li, S. 2019. Development of three IPM guides for property manager: bed bugs, cockroaches, and house mice. Housing and Urban Development. Stop Pests in Housing. Northeastern IPM Center / Cornell University. $6,000. 01/2019 – 06/2019.
37. Li, S. and S. Nair. 2019. Navajo Nation Integrated Pest Management Workshop, Inter Tribal Council of Arizona, Inc. $5,400. 2019.
38. Li, S. and S. Nair. National IPM Training for Tribal Communities. Inter Tribal Council of Arizona, Inc. $8,660. 2019.
39. Li, S., D. H. Gouge, K. Walker, A. J. Fournier, S. Nair, M. Brophy, J. Weber, N. Dayoob. 2020. Emergency Preparedness through Integrated Pest Management Education and Tribal Partnerships in Arizona. U.S. Environmental Protection Agency, Border 2020 Program. $99,974. 02/2020 – 08/2021.
40. Li, S., D.H. Gouge, K.R. Walker, K.C. Ernst, P. Rivadeneira, P.C. Ellsworth. 2019. Public Health IPM Education in American Indian Communities. Cooperative Extension, University of Arizona. $31,895. 03/2019 – 2/2020.
41. MacLean, M.F., A.J. Fournier, P. Beamer, A.F. Arellano, E.J. Bedrick. 2020. Prenatal Exposure to Pesticide Mixtures and Childhood ADHD. National Institute of Environmental Health Sciences. $746,964. 9/2020 – 8/2023.

42. Murray, K., P. Jepson & A.J. Fournier. (Oregon State University lead) 2016. IPMSPs: Bringing "Integration" to Pest Management Strategic Plans. USDA-NIFA, Crop Protection and Pest Management, Applied Research and Development Program. $215,460. 9/2016 – 8/2021.
43. Palumbo, J. C. 2017. Enhancing Vegetable IPM Education in Arizona. USDA-AMS, Specialty Crops Block Grant Program (AZ). $82,638. 10/2015- 9/2017.
44. Palumbo, J. C. 2018. Insect Management in Organic Vegetables Crops. USDA-AMS, Specialty Crops Block Grant Program (AZ). $68,194. 10/2016-9/2018.
45. Palumbo, J. C. 2019. Diamondback Moth Management in Arizona Vegetables. USDA-AMS, Specialty Crops Block Grant Program (AZ). $67,990. 10/2017- 9/2019.
46. Palumbo, J. C. 2019. Enhancing IPM for Arizona Vegetables. USDA-AMS. Specialty Crops Block Grant Program (AZ). $92,722. 10/2017- 9/2019.
47. Palumbo, J. C. 2020. Enhancing IPM Education for Arizona Vegetable Industry. USDA-AMS, Specialty Crops Block Grant Program (AZ). $92,588. 10/2019- 9/2021.
48. Palumbo, J. C. 2020. Monitoring Diamondback Moth Activity and Insecticide Resistance in Arizona Vegetables. USDA-AMS. Specialty Crops Block Grant Program (AZ). $57,045. 10/2019- 9/2021
49. Palumbo, J.C. 2017. Evaluation of Insecticide Alternatives for Whiteflies and CYSDV in Melons. California Melon Research Board. $20,396. 3/2017-2/2018.
50. Palumbo, J.C. 2017. Evaluation of New Insecticides for Insect Management in Desert Head Lettuce. Arizona Iceberg Lettuce Research Council. $23,050. 9/2017- 8/2018.
51. Palumbo, J.C. 2017. Monitoring for Lettuce Insects in Yuma County. Arizona Iceberg Lettuce Research Council. $4,755. 9/2017- 8/2018.
52. Palumbo, J.C. 2018. Evaluation of Insecticide Alternatives for Whiteflies and CYSDV in Melons. California Melon Research Board. $21,616. 3/2018-2/2019.
53. Palumbo J.C. 2018. Evaluation of New Insecticides for Insect Management in Desert Head Lettuce. Arizona Iceberg Lettuce Research Council. $19,994. 9/2018- 8/2019.
54. Palumbo, J.C. 2018. Monitoring for Lettuce Insects in Yuma County. Arizona Iceberg Lettuce Research Council. $3,720. 9/2018- 8/2019.
55. Palumbo, J.C. 2019. Evaluation of Insecticide Alternatives for Whiteflies and CYSDV in Melons, California Melon Research Board. $16,698. 3/2019-2/2020.
56. Palumbo, J.C. 2019. Evaluation of New Insecticides for Insect Management in Desert Head Lettuce. Arizona Iceberg Lettuce Research Council. $19,518. 9/2019- 8/2020.
57. Palumbo, J.C. 2019. Monitoring for Lettuce Insects in Yuma County. Arizona Iceberg Lettuce Research Council. $4,905. 9/2019-8/2020.
58. Palumbo, J.C. 2019. Profiling Western flower Thrips Activity in Leafy Vegetables, Syngenta Crop Protection. $47,880. 7/2018-6/2019.
59. Palumbo, J.C. 2020. Evaluation of Insecticide Alternatives for Whiteflies and CYSDV in Melons, California Melon Research Board. $14,931. 3/2020-2/2021.
60. Palumbo, J.C. 2020. Insect Management in Desert Head Lettuce. Arizona Iceberg Lettuce

Research Council. $19,774. 9/2020- 8/2021.

61. Palumbo, J.C. 2020. Monitoring for Lettuce Insects in Yuma County. Arizona Iceberg Lettuce Research Council. $6,389. 9/2020- 8/2021.
62. Palumbo, J.C. 2020. Experimental Insecticides on Leafy Vegetables. BASF Corporation $20,700. 5/2020 -4/2021.
63. Palumbo, J.C. 2020. Profiling Lepidopterous Larvae Activity in Leafy Vegetables. Syngenta Crop Protection. $24,000. 7/2019-6/2020.
64. Palumbo, J.C. 2020. Profiling Western flower Thrips Activity in Leafy Vegetables. Syngenta Crop Protection. $17,000. 7/2019-6/2020.
65. Palumbo, J.C. 2021. Insecticide Alternatives Insect Management in Melons. California Melon Research Board. $14,058. 3/21-2/22.
66. Pratt, J., M. Logvin. 2015. Project Puente – Expand the bioscience pipeline from middle and high schools to colleges and universities. USDA-NIFA, Hispanic Serving Institutions Education Grants. $274,692. 10/01/2015-09/30/2018.
67. Schuch, U.K., D.H. Gouge, K. Umeda. IPM and Strategic Plant Use for Human Health in Health Care Facilities. 2019. Cooperative Extension, University of Arizona. $18,172. 03/2019 – 2/2020.
68. Sutherland, A., D-H. Chow, C. Foss, D. H. Gouge, S. Li, S. Nair, A. Romero, H. Spafford. 2017. Work Group: Developing effective bed bug outreach programs for diverse clientele in the West. Western Region IPM Center, USDA-NIFA. $30,000. 03/2017-02/2018.
69. Umeda, K. 2017. New groundcover and native grass species when replacing turfgrass. Horticultural Research Institute. $17,500.00. 01/2017 – 03/2018.
70. Walker, K., M. Riehle, K. Ernst, D.H. Gouge. 2017. Impacts of targeted larviciding and ULV adulticiding on the abundance and age structure of Aedes aegypti in south-central Arizona. Centers for Disease Control and Prevention. $1,250,000. 07/2017 – 06/2021.

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COOPERATIVE EXTENSION

Cotton Insecticide Use Guide

Knowing and Balancing Risks

Isadora Bordini[1], Alfred Fournier[1], Steven Naranjo[2], Naomi Pier[1], Peter C. Ellsworth[1]; [1]University of Arizona, [2]USDA-ARS

Many factors must be considered when choosing an insecticide, such as cost, efficacy, risk of resistance, and safety to non-target organisms. This ***Cotton Insecticide Use Guide*** summarizes the diverse risks of insecticides used to control three pests, helping you make well informed pest management decisions.

Product Risks to Arthropod Natural Enemies

Beneficial predators like *Orius* pirate bugs, *Geocoris* big-eyed bugs, crab spiders, *Collops* beetles, lacewing larvae, and *Drapetis* flies provide free biological control. Check product selectivity or compatibility with these natural enemies by looking at the background colors.

Fully Selective	**GREEN: LOW risk to natural enemies**
Partially Selective	**YELLOW: MODERATE risk to natural enemies**
Not selective	**RED: HIGH risk to natural enemies**

Product Efficacy

Consider efficacy of products against the target pest, based on the number of stars. Check whether insecticides provide control of specific life stages by checking letters next to stars.

Product Name	Common Name	IRAC No.[1]	Chemical Group	Silverleaf Whitefly
Courier	buprofezin	16	Chitin inhibitor	★★★★ (N)

★★★★ excellent ★★★ good ★★ fair ★ suppression E,N = efficacy against eggs & nymphs only, respectively

Resistance Management

Resistance can erode the efficacy of any product, but levels vary geographically and seasonally. Comments indicate resistance levels of whiteflies to products. Where resistance has not yet been detected in Arizona's populations, the cell is left blank.

SWF, Risk of Resistance
under investigation
mild–moderate

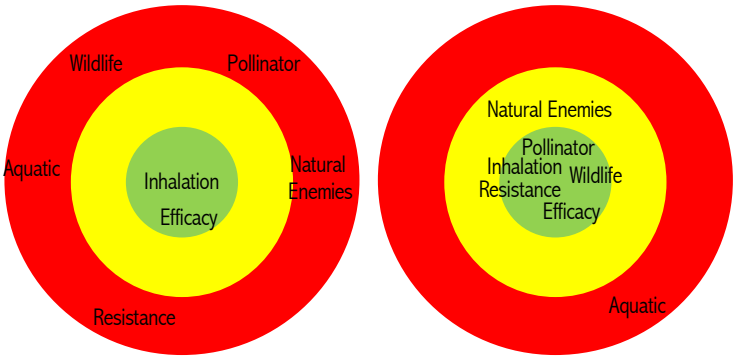
Risk to Human Health & the Environment

Identification of risk is based on scientific assessment. Check level of risk to bystanders, pollinators, and aquatic and terrestrial wildlife. "Yes" indicates a **significant risk of concern** has been identified. A blank cell does not indicate lack of any risk. Some risk is associated with the use of any product, especially to pesticide applicators, who should follow all personal protective equipment and other requirements for applying pesticides safely.

Risk to Aquatic Life (fish, algae)	Risk to Wildlife (mammals, birds)	Risk to Pollinators (bees)	Inhalation Risk (human bystanders)
Yes		Yes	
Yes	Yes	Yes	

Choosing Products Wisely = Minimizing Risks

Perhaps the worst product a grower could choose is the one that doesn't work. Risks are minimized by choosing insecticides that are effective against pests, while providing safety to natural enemies and other non-target organisms, and to human health.



Insecticide A **Insecticide B**

Each insecticide decision carries with it a variable combination of risks. The ***Cotton Insecticide Use Guide*** identifies 7 different risk factors (selectivity towards natural enemies, target pest efficacy, aquatic life, terrestrial wildlife, pollinators, bystander inhalation, and insecticide resistance in whitefly populations). Where possible, a grower should target products that minimize these risks. While "Insecticide A" has excellent target pest efficacy and very low risks to bystander health, it poses high risks to natural enemies, pollinators, aquatic and terrestrial wildlife, and higher risks for resistance development in whiteflies. "Insecticide B" poses a low risk to all factors, except for natural enemies (moderate risk) and aquatic life (high risk). The ultimate goal is to aim for excellent efficacy while minimizing risks as much as possible. In this example, "Insecticide B" fulfills this criteria better than "Insecticide A".

Each decision and every product has risk. Even when risk is not shown on the table, some level of risk will be present. Minimizing these risks conserves biocontrol and avoids catastrophic ecological effects that can increase the need for future sprays to control primary pests that resurge (e.g., whiteflies) or secondary pests that break out (e.g., mites).

Economic risks are important, too! Consider product cost and value alongside factors shown in the table. A lower-priced insecticide that slightly increases other risks may sometimes be the best choice. However, growers should consider the broad set of risks associated with insecticide use and avoid the false economy of always choosing the "cheapest" insecticide. The IPM goal should be to identify, balance and prioritize all insecticide risks, considering them on a case-by-case basis, for each grower and system.

8/4/22

ARIZONA PEST MANAGEMENT CENTER

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***Cotton Insecticide Use Guide*.** Insecticides have been screened for efficacy against target pests, *Lygus hesperus*, *Bemisia argentifolii* (MEAM1; silverleaf whitefly, SWF), and *Euschistus servus* (brown stink bug); as well as for their impact on non-target beneficial arthropods including >20 predators common in Arizona cotton. Those insecticides with full selectivity or safety towards these beneficial predators are in green; those that are partially selective or safe are in yellow; broad spectrum insecticides are in red. Some insecticides pose environmental and human health risks that require mitigations such as buffer zones and additional personal protective equipment (PPE). IRAC group numbers are provided to facilitate rotation of chemistry and SWF resistance risks are presented.

Product Name	Common Name	IRAC No.[1]	Chemical Group	Lygus Bug	Silverleaf Whitefly	Brown Stink Bug	Risk to Aquatic Life	Risk to Wildlife	Risk to Pollinators	Inhalation Risk	SWF, Risk of Resistance
Carbine	flonicamid	29	Feeding inhibitor	★★★★							
Courier	buprofezin	16	Chitin inhibitor		★★★★ (N)						under investigation
Exirel / Benevia	cyantraniliprole	28	Diamide		★★★★						
Knack / Farewell	pyriproxyfen	7C	Juvenoid		★★★★ (E,N)						mild–moderate
Oberon[2]	spiromesifen	23	Lipid synthesis inhibitor		★★★★ (N)						under investigation
PQZ	pyrifluquinazon	9B	Pyridine azomethine		★★★★						
Sefina Inscalis	*afidopyropen*	*9D*	*Pyropene*		★★★						
Sivanto prime	flupyradifurone	4D	Butenolide		★★★★						
Transform	sulfoxaflor	4C	Sulfoxamine	★★★★	★						
Assail / Intruder[3]	acetamiprid	4A	Neonicotinoid		★★★★		Yes				moderate–severe
Belay	clothianidin[4]	4A	Neonicotinoid	★★	★★		Yes		Yes		
Centric	thiamethoxam[4]	4A	Neonicotinoid		★★		Yes		Yes		
Venom	dinotefuran	4A	Neonicotinoid		★★★		Yes		Yes		
Acephate	acephate	1B	Organophosphate	★★★		★		Yes	Yes		
Bidrin	dicrotophos[5]	1B	Organophosphate	★		★	Yes	Yes	Yes	Yes	
Cormoran	novaluron + acetamiprid	15 + 4A	Chitin inhibitor	★★ (N)	★★	★ (N)	Yes				
Diamond / Mayhem	novaluron	15	Chitin inhibitor	★ (N)	★	★ (N)	Yes				
Synergized pyrethroids	various[6]	3A + 1B	Pyrethroid + organophosphate		★★		Yes	Yes	Yes		moderate–severe
Vydate C-LV	oxamyl[5]	1A	Carbamate	★★★★			Yes	Yes	Yes	Yes	

Background color: **Green** = Fully selective and safe to beneficials; **Yellow** = Partially selective or safe to beneficials; **Red** = broad spectrum, not safe to beneficials; ***Italics*** = based on preliminary testing. Risks as calculated from ipmPRiME (Jepson et al. 2014); 'Yes' indicates moderate to high risk for the given category.

★★★★, Excellent control; ★★★, Good control; ★★, Fair control; ★, Suppression only; **E, N** = Efficacy against eggs or nymphs only, respectively.

[1] The Insecticide Resistance Action Committee (IRAC) assigns numbers for each unique mode of action or class of chemistry. Many appear on U.S. insecticide labels and are helpful for resistance management.

[2] At 0.125–0.156 lbs ai / A only; higher rates are more destructive of natural enemies.

[3] The State of Arizona has approved a Special Local Needs (SLN) increase in acetamiprid use rates by up to +50% against difficult-to-control whiteflies. Impact to beneficials is more severe at these higher rates.

[4] This active ingredient can significantly affect bee populations, other pollinators and birds, can persist for years in soils, and can leach into waterways and groundwater.

[5] This active ingredient is considered highly hazardous by the Word Health Organization (WHO Ib), a restricted use pesticide with signal words DANGER and POISON, requiring posting, additional PPE, and closed systems. Avoid if possible.

[6] Beta-cyfluthrin[ab], bifenthrin[b] and lambda-cyhalothrin[b] are considered highly hazardous by the [a]WHO (Ib) or in the [b]Globally Harmonized System of Classification and Labelling of Chemicals (GHS Category 2). Avoid if possible.

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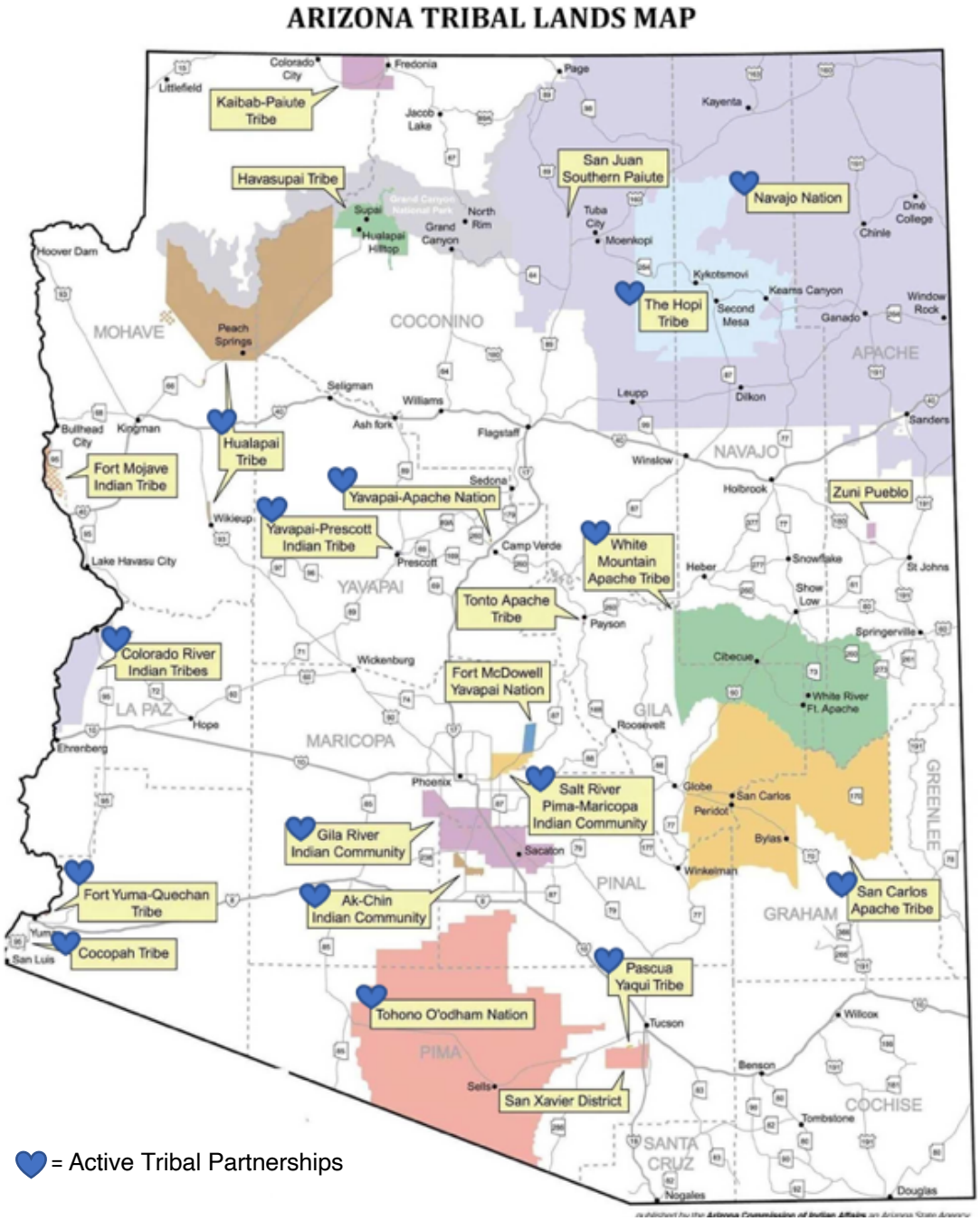

Appendix J6. Tribal Partnerships. The UA Public Health IPM Team has cultivated trusting relationships with tribal leaders, experts and professionals with 15 Arizona tribes (blue hearts) to address critical health issues through IPM research and outreach. Tribal collaborators include environmental health and vector control professionals, health care/services, tribal housing authorities, council members, animal control officers, pest management professionals, school personnel, veterinary technicians, first responders, and more. Our Agricultural IPM program engages four of these tribes as well, each managing individual and large tribal farms (Colorado River Indian Tribes, Gila River Indian Community, Ak-Chin Indian Community, Salt River Pima-Maricopa Indian Community).

Appendix J7
529 Selected Extension Publications & Other Outputs, 2016 - 2022

Extension Publications (72)

1. Arizona Pest Management Center (APMC). 2018. National Institute of Food and Agriculture's Crop Protection and Pest Management Program Saves Lives, Dollars & the Environment in Arizona. University of Arizona, Arizona Pest Management Center. Link
2. Bordini I., A. Fournier, S. Naranjo, N. Pier, P.C. Ellsworth. 2020. Cotton Insecticide Use Guide – Knowing and Balancing Risks. IPM Short. University of Arizona, Arizona Pest Management Center. Link
3. Ellsworth P.C., N. Pier, A.J. Fournier, S.E. Naranjo. 2019. Making Use of Predators in Cotton. IPM Short. University of Arizona, Arizona Pest Management Center. Link
4. Ellsworth P.C., N. Pier, A.J. Fournier, S.E. Naranjo. 2019. Utilizando los Predatores en Algodon. IPM Short. University of Arizona, Arizona Pest Management Center. Link
5. Ellsworth, P.C., I. Bordini, N. Pier. 2021. ThryvOn™ Cotton, Frequently Asked Questions. IPM Short. University of Arizona, Arizona Pest Management Center. Link
6. Ellsworth, P.C., I. Bordini, N. Pier. 2021. Tips on How to Manage Lygus Efficiently in ThryvOnTM Cotton. Presentation Handout. University of Arizona, Arizona Pest Management Center. Link
7. Ellsworth, P.C., N. Pier, W.E. Hall. 2021. Potential Pest of Arizona Pecans: Rapid Communication. IPM Short. University of Arizona, Arizona Pest Management Center. Link
8. Ellsworth, P.C., N. Pier. 2022. First Foliar Insecticide Special Local Needs Registrations for Palestriped Flea Beetle Control During Guayule Stand Establishment. IPM Short. University of Arizona, Arizona Pest Management Center. Link
9. Ellsworth, P.C., N.M. Pier, A.J. Fournier, S.E. Naranjo, 2020. Utilización de Depredadores en Algodón. IPM Short. University of Arizona, Arizona Pest Management Center. Link
10. Ellsworth, P.C., Pier N., A.J. Fournier, S.E. Naranjo, T. Vandervoet. 2019.Whitefly Predator "Thresholds" in Cotton IPM Short. University of Arizona, Arizona Pest Management Center. Link
11. Evancho, B., W. McCloskey, N. Pier, K. Caffrey. 2021. Resistant Palmer Amaranth Control – Best Management Practices. IPM Short. University of Arizona, Arizona Pest Management Center. Link
12. Fournier, A.J., N. Pier, P.C. Ellsworth. 2020. Your Voice Matters: Influencing Pesticide Registration Review. University of Arizona Cooperative Extension. Publication no. AZ1811. Link
13. Fournier, A.J., P.C. Ellsworth, N. Pier, W. Dixon II. 2016. Pesticide Use Data – Why Getting it Right Matters. IPM Short. University of Arizona, Arizona Pest Management Center. Link
14. Gouge D.H., P. Rivadeneira, S. Li. 2018. Roof Rats: Pathogens and Parasites. University of Arizona Cooperative Extension. Publication no. AZ1784-2018. Link
15. Gouge D.H., S. Li, C. Bibbs, S. Nair. 2018. Scorpions of the Desert Southwest United States. Extension Publication. University of Arizona Cooperative Extension. Publication no. AZ1768 Link
16. Gouge D.H., S. Li, K.R. Walker, C. Sumner, S. Nair, C. Olson, F.B. Ramberg. 2019 (revised). Mosquitoes: Biology and Integrated Mosquito Management. University of Arizona Cooperative Extension. Publication no. AZ1706. Link

17. Gouge D.H., S. Li, S. Nair, K.R. Walker, C. Bibbs. 2018. Mosquito and Tick Repellents. Extension Publication. University of Arizona Cooperative Extension. Publication no. AZ1761 Link
18. Gouge, D. H., T. Stock. 2021. Integrated Pest Management for Bed Bugs in Schools. Oregon State University PNW 757. Link
19. Gouge, D.H., H. Venkat. 2021. Rabies Risk Reduction. University of Arizona Cooperative Extension. Publication no. AZ1874. Link
20. Gouge, D.H., S. Li, S. Nair, M. Brophy, K. Walker, C Sumner, F. Ramberg. 2021. Mosquitoes and Disease Concerns. University of Arizona Cooperative Extension. Publication no. AZ1912. Link
21. Gouge, D.H., S. Li, S. Nair, M. Brophy, K. Walker, P.A. Andrade-Sanchez. 2021. Mosquitos. Quick Read Brochure in Spanish. University of Arizona Cooperative Extension. Publication no. AZ1873S. Link
22. Gouge, D.H., T. Stock. 2021. Bed Bugs in the Classroom. Pacific Northwest Extension Publishing. PNW 756 Link
23. Hall, W.E., J.D. Sherman, W. Moore, P.C. Ellsworth, N. Pier. 2021. First Detection of Pecan Bud Moth in Arizona. IPM Short. University of Arizona, Arizona Pest Management Center. Link
24. Hall, W.E., N. Pier, P.C. Ellsworth. 2019. Blister Beetle Basics. IPM Short. University of Arizona, Arizona Pest Management Center. Link
25. Hall, W.E., N. Pier, P.C. Ellsworth. 2019. Blister Beetles in Food? IPM Short. University of Arizona, Arizona Pest Management Center. Link
26. Li S., D.H. Gouge, A.J. Fournier. 2019. Practical Methods of Controlling Bed Bugs at Home (revision). University of Arizona Cooperative Extension. Publication no. AZ1642. Link
27. Li S., D.H. Gouge, K.R. Walker, A.J. Fournier, S. Nair, M.R. Wierda, J. Hurley. 2016. The Zika Virus. IPM Short. University of Arizona, Arizona Pest Management Center.
28. Link
29. Li S., D.H. Gouge, K.R. Walker, A.J. Fournier. 2019. Longhorned Tick a New Invasive Tick in the United States. University of Arizona Cooperative Extension. Publication no. AZ1792. Link
30. Li S., D.H. Gouge, S. Nair, A.J. Fournier, W.E. Hall. 2019. Arizona Kissing Bugs. University of Arizona Cooperative Extension. Publication no. AZ1787. Link
31. Li S., D.H. Gouge, S. Nair, K.R. Walker, A.J. Fournier. 2018. What you should know about mosquito and tick repellents. IPM Short. University of Arizona, Arizona Pest Management Center. Link
32. Li, S., D.H. Gouge, I. Ruberto, S. Nair, A.J. Fournier, W.E. Hall. 2022. What You Should Know About Kissing Bugs. University of Arizona Cooperative Extension. Publication no. AZ1992. Link
33. Li, S., D.H. Gouge, M. Brophy, S. Nair, K. Walker, P. Andrade-Sanchez. 2021. Garrapatas Marrones del Perro y Fiebre Maculosa de las Montañas Rocosas (Brown dog ticks and Rocky Mountain spotted fever in Spanish). Publication no. AZ1935S. Link
34. Li, S., D.H. Gouge, M. Brophy, S. Nair, K. Walker, P. Andrade-Sanchez. 2021. Brown Dog Ticks and Rocky Mountain Spotted Fever. IPM Brochure. University of Arizona Cooperative Extension. Publication no. AZ1935. Link
35. Li, S., D.H. Gouge, S. Nair, A.J. Fournier. 2021 (revised from 2015). Head Lice: Identification, Biology, and Integrated Pest Management. University of Arizona Cooperative Extension. Publication no. AZ1687. Link

36. Li, S., D.H. Gouge, S. Nair, K. Walker, M. Brophy. October 2021. Brown Dog Ticks. Brochure. University of Arizona Cooperative Extension. Publication no. AZ1871. Link
37. Li, S., D.H. Gouge, S. Nair, L. Graham, A.J. Fournier, K. Umeda. 2021. Beware of Fire Ant Stings. University of Arizona Cooperative Extension. Publication no. AZ1954. Link
38. Li, S., J. Weber. 2020. Protecting Your Flocks from External Parasites – Mites and Lice. University of Arizona Cooperative Extension. Publication no. AZ1858. Link
39. McCloskey W., P.C. Ellsworth, K. Umeda. 2017. Auxin Herbicides in Arizona Cotton: Avoiding Off-target Movement. IPM Short. University of Arizona, Arizona Pest Management Center. Link
40. McCloskey, W., B. Evancho, N. Pier. 2021. Guayule Weed Management During Establishment in Arizona – December 2021. IPM Short. University of Arizona, Arizona Pest Management Center. Link
41. McCloskey, W., N. Pier. 2019. Avoiding 2,4-D and Dicamba Off-Target Movement from Cotton. IPM Short. University of Arizona, Arizona Pest Management Center. Link
42. McCloskey, W., N. Pier. 2019. Spray Legally: Summary of EnlistTM, Engenia® and Xtendimax® Application Use Requirements on Cotton. IPM Short. University of Arizona, Arizona Pest Management Center. Link
43. Murray, K., I. Sandlin, P. Ellsworth, P. Jepson, A. Fournier, H. Luh, D. Walenta. 2021. Measuring the Economic Impact of Pests and Pest Management on Oregon Peppermint. Oregon State University Extension Service. Publication number EM-9303. Link
44. Murray, K., I. Sandlin, P.C. Ellsworth, P. Jepson, A.J. Fournier, H. Luh and S. Reitz. 2022. The Economic Impact of Onion Pests in the Treasure Valley: A Look at Pests and Associated Pest Management Practices, 2018 – 2019. Oregon State University Extension Service, Oregon State University. Publication EM 9347. Link
45. Nair S., D.H. Gouge, S. Li, P.C. Ellsworth, M.R. Wierda, A.J. Fournier. 2016. Why Pesticide Application Notifications in Schools are Important. IPM Short. University of Arizona, Arizona Pest Management Center. Link
46. Nair S., D.H. Gouge, S. Li, P.L. Warren, A.J. Fournier, M.R. Wierda, K. Umeda, D.M. Kopec. 2016. Honey Bees in Community Environments – Identification and Biology. IPM Short. University of Arizona, Arizona Pest Management Center. Link
47. Nair S., D.H. Gouge, S. Li. 2018. Something's Biting Me But I Can't See it. IPM Short. University of Arizona, Arizona Pest Management Center. Link
48. Nair S., D.H. Gouge, S. Li. 2019. Bed Bugs: What Home Care Providers and Welfare Workers Need to Know. University of Arizona Cooperative Extension. Publication no. AZ1804. Link
49. Nair S., K. Umeda, W.B. McCloskey, D.H. Gouge, P.C. Ellsworth. 2018. Weed Control Choices for Turf and Landscapes. IPM Short. University of Arizona, Arizona Pest Management Center. Link
50. Nair S., S. Li, D.H. Gouge. 2018. Head Lice in Schools. IPM Short. University of Arizona, Arizona Pest Management Center. Link
51. Nair, S., D.H. Gouge, A. Mostafa, S. Li, K. Umeda, H. Li-Byarlay. 2020. Wild Honey Bees in Community Environments – Identification, Biology, and Reducing Risks. University of Arizona Cooperative Extension. Publication no. AZ1846. Link
52. Nair, S., D.H. Gouge, and A.C. Murillo. 2021. Backyard Chickens and Ectoparasites: Introduction and Management. University of Arizona Cooperative Extension. Publication no. AZ1878-2021. Link

53. Nair, S., D.H. Gouge, S. Li. 2021. Chinches: lo que los proveedores de cuidados en el hogar y los trabajadores sociales deben saber. (Trifold brochure-Spanish). University of Arizona Cooperative Extension. publication AZ 1804S. Link
54. Nair, S., D.H. Gouge, S. Li., K. Walker. 2021. Personal Repellents. IPM Brochure Trifold – (Quick read-English). University of Arizona Cooperative Extension. Publication no. AZ1955. Link
55. Nair, S., D.H. Gouge, S. Li., K. Walker. 2021. Repelentes de Mosquitos y Garrapatas. IPM Brochure Trifold – (Quick read-Spanish). University of Arizona Cooperative Extension. Publication no. AZ 1955S. Link
56. Nair, S., D.H. Gouge, S. Li., K. Walker. 2021. Use of Personal Repellents for Protection Against Mosquitoes and Ticks. IPM Brochure. University of Arizona Cooperative Extension. Publication no. AZ1913. Link
57. Pier N., A.J. Fournier, P.C. Ellsworth. 2018. Risky Business: What is Risk? IPM Short. University of Arizona, Arizona Pest Management Center. Link
58. Pier N., P.C. Ellsworth. 2020. Cotton Fleahoppers in Cotton. IPM Short. University of Arizona, Arizona Pest Management Center. Link
59. Pier N., W.E. Hall, P.C. Ellsworth. 2020. False Chinch Bugs in Cotton. IPM Short. University of Arizona, Arizona Pest Management Center. Link
60. Pier, N., L. Brown, P.C. Ellsworth, J.C. Palumbo, Y Carriere, A.J. Fournier, S. Castle N. Prabhaker. 2016. Maps Provide Directions for Resistance! IPM Short. University of Arizona, Arizona Pest Management Center. Link
61. Reese, S, S. Li, D.H. Gouge. 2020. Integrated Pest Management for Bed Bugs – A Guide for Property Managers. Stop Pests in Housing. University of Arizona Cooperative Extension and the Northeastern IPM Center. Link
62. Reese, S, S. Li, D.H. Gouge. 2020. Integrated Pest Management for German Cockroaches – A Guide for Property Managers. Stop Pests in Housing. University of Arizona Cooperative Extension and the Northeastern IPM Center. Link
63. Reese, S., D.H. Gouge, T. Stock, R. Corrigan, S. Li, and S. Nair. 2021. House Mice: A Guide for Property Managers. Stop Pests in Housing. University of Arizona Cooperative Extension and the Northeastern IPM Center. Link
64. Stock, T., D.H. Gouge. 2021. Ants in the Classroom. Pacific Northwest Extension Publishing. PNW762. 2pp. Link
65. Stock, T., D.H. Gouge. 2021. Integrated Pest Management for Ants in Schools. Oregon State University PNW761. Link
66. Umeda, K., D. Kopec, and S. Nair. 2021. Annual Bluegrass (Poa Annua) Control in Non-overseeded Bermudagrass and Winter Overseeded Turfgrasses in Low Desert Arizona. University of Arizona Cooperative Extension. Publication no. AZ1885-2021. Link
67. Umeda, K., S. Nair, and M. Chamberland. 2021. Clear Up the Confusion: Know How to Select the Appropriate Herbicide to Control Weeds. University of Arizona Cooperative Extension. Publication no. AZ1914-2021. Link
68. Vandervoet T., P.C. Ellsworth, L.M. Brown, A.J. Fournier, S.E. Naranjo. 2019. Making Whitefly and Predator Counts. IPM Short. University of Arizona Cooperative Extension. Publication no. AZ1813. Link
69. Walker, K.R., H. Yaglom, D.H. Gouge, M. Brophy, M. Casal, O. Encinas. 2018. The Brown Dog Tick and Epidemic Rocky Mountain spotted fever in Arizona and northwestern Mexico. University of Arizona Cooperative Extension. Publication no. AZ1769 Link

70. Weber, J. S. Li. 2020. Protecting Your Flocks from External Parasites – Mites and Lice (Control de Parasitos Externos en Aves de Corral). (In Spanish) University of Arizona Cooperative Extension. Publication no. AZ1858S Link
71. Wierda M.R., A.J. Fournier, W.B. McCloskey, K. Umeda. 2017. Water Soluble Packaging WSP: Mixer/Loader Exposures Best Practices and Labeling Changes. IPM Short. University of Arizona, Arizona Pest Management Center. Link
72. Wierda M.R., D.H. Gouge. 2017. Tick & Flea Collars Integrated Pest Management and Your Safety. IPM Short. University of Arizona, Arizona Pest Management Center. Link

Digital Publications, Videos, and Other Media (43)

Presentations & Videos (YouTube) (24)

1. Bordini, I. It's All About Size: Are we Doing Research at the Right Scale? UArizona Cooperative Extension Field Crops Clinics. 01/20/22. 20 views. Link
2. Ellsworth, P.C. 2020 Cotton Insecticide Screening Trials for Lygus and Whiteflies. Play list of 10 short videos recorded in the field. 11/4/2020. 43 views. Link
3. Ellsworth, P.C. 2021 Cotton Pest Control in Review. Arizona Cotton Symposium. University of Arizona Cooperative Extension. 02/10/22. 30 views. Link
4. Ellsworth, P.C. Predator Thresholds for Whitefly Control: Even more helpful than you think! UArizona Cooperative Extension Field Crops Clinics. 01/20/22. 39 views. Link
5. Ellsworth, P.C., I. Bordini, N. Pier. 2021. Frequently Asked Questions about ThryvOn Cotton in Arizona. 8th Annual New technologies Workshop for Field Crops. 06/21/2021. 35 views. Link
6. Ellsworth, P.C., I. Bordini, N. Pier. 2021. Tips on How to Manage Lygus Efficiently in ThryvOn Cotton. UArizona Cooperative Extension Cotton "Tent Talks". 07/11/2021. 62 views. Link
7. Ellsworth, P.C., N. Pier, I. Bordini 2021 Trends in Cotton Insect Management & What's Next? UArizona Cooperative Extension Field Crops Clinics. 01/27/21. 45 views. Link
8. Ellsworth, P.C., N. Pier, I. Bordini. 2020. Virtual Tour & Discussion of Cotton Insect Management Research Plots. 10th Annual Central Arizona Farmer Field Day. 10/28/2020. 61 views. Link
9. Fournier, A.J. Pesticide Registration Review Update. UArizona Cooperative Extension Field Crops Clinics. 02/04/2021. 93 views. Link
10. Gouge, D.H. 2020 Mosquito Surveillance. University of Arizona Cooperative Extension. 8/10/20. 73 views. Link
11. Harrington, K. 2021 Preparing for 2022: Alfalfa Weevil Pest Management. UArizona Cooperative Extension Alfalfa and Forage "Tent Talks" 07/17/2021 21 views. Link
12. Harrington, K. First Year with Weevil Threshold APP: Let's Use it and Use it Wisely. UArizona Cooperative Extension Field Crops Clinics. 01/20/22. 12 views. Link
13. Li, S., 2021. Creepy Crawly Backyard Bugs. University of Arizona Cooperative Extension 10/19/21. 83 views. Link
14. Li, S., 2021. Engaging Tribal Stakeholders to Address Public Health Pests. University of Arizona Cooperative Extension. 10/5/21. 144 views. Link
15. Li, S.J, K.A. Smith. 2020 Integrated Mosquito Management. University of Arizona Cooperative Extension. 8/13/20. 62 views. Link

16. Li, S.J, K.A. Smith. 2020 Mosquito Surveillance. University of Arizona Cooperative Extension. 8/7/20. 192 views. Link
17. Li, S.J. 2021 Cockroaches: More than a Nuisance. University of Arizona Cooperative Extension. 4/15/21. 71 views. Link
18. Li, S.J. 2021 Itchy Bugs and Updates on New Products. University of Arizona Cooperative Extension. 4/13/21. 235 views. Link
19. Mostafa, A. Management Approaches for Alfalfa Pests. UArizona Cooperative Extension Field Crops Clinics. 02/02/2021. 47 views. Link
20. Mostafa, A. Management of Aphids and Balanced Nutrients in Alfalfa. UArizona Cooperative Extension Field Crops Clinics. 01/20/2022. 33 views. Link
21. Mostafa, A. Pest Management Practices for Arizona Forage Crops. Annual UA Alfalfa & Forage Workshop. 04/21/22. 15 views. Link
22. Mostafa, A., K. Harrington, W. Burayu. 2020. 2019 & 2020 Sugarcane Aphid Management on Forage Sorghum Research Trials at MAC. 10/28/20. 29 views. Link
23. Mostafa, A., K. Harrington, W. Burayu. 2021 Chemistries for Pest Management of Forage Crops. 8th Annual New technologies Workshop for Field Crops. 06/20/2021. 54 views. Link
24. Mostafa, A., K. Harrington, W. Burayu. 2021 Pest Management for Forage Crops07/16/2021. 18 views. Link

Presentations (PDF) (10)

1. Bordini, I., N. Pier, P.C. Ellsworth. 2020. Biocontrol Informed Thresholds, Insecticide Selectivity, and Risk Reduction in Whitefly Management. UA Cooperative Extension January Field Crops Clinics. 1/10/20. (Virtual Presentation) Link
2. Ellsworth, P.C. 2016. Fulfilling Our Mission. Campus Administrative Team In-Service, Maricopa Ag Center Campus Administrative Team In-Service, Maricopa Ag Center. 11/1/16. (Presentation). Link
3. Ellsworth, P.C., N. Pier, I. Bordini, S.E. Naranjo. 2020. Making the Right Decisions with Predator Thresholds for Whitefly Management in Cotton. UA Cooperative Extension Virtual Tent Talk. (Presentation) Link
4. Ellsworth, P.C., N. Pier, I. Bordini. 2020. Push-Pull-Control: Securing Guayule's Future. UA Cooperative Extension Tent Talk. (Virtual Presentation) 6/3/20. Link
5. Ellsworth, P.C., S.E. Naranjo, I. Bordini, N. Pier. 2020. Latest Arizona Research on ThryvOn Cotton Trait Technology. Desert Agriculture Conference. 4/28/20. (Virtual Presentation) Link
6. Fournier, A.J., W.A. Dixon II, P.C. Ellsworth. 2017. Helena Desert Agronomy Meeting. 2/15/17. (Presentation) Link
7. Hall, E.W., P.C. Ellsworth, L. Abrell, N. Pier, D. Diaz. 2019. Blister Beetles: A Challenge for Arizona's Growers. UA Cooperative Extension Conference, Tucson, AZ August 2019. (Poster) Link
8. Hong, Z., A.J. Fournier. 2022. Comments from Western Stakeholders influence EPA Pesticide Registration Decisions. UA Cooperative Extension Annual Conference. 8/11/22. (Poster) Link
9. Li, S., D.H. Gouge, A.J., Fournier, S. Nair, A. Dorame-Avalos, S.K. Reese, M Brophy, K. Walker, K.C. Ernst, T. Teegerstrom, P.C. Ellsworth. 2020. Honoring and Empowering Tribal Nations and Indigenous Peoples Through IPM Education and Emergency Preparedness. 2020 UA Cooperative Extension Virtual Conference. 10/8/20. (Poster & Presentation). Link

10. Nair, S., D.H. Gouge, K. Umeda, Li, S., Fournier, A.J., Schuch, U. 2020. Implementing IPM in schools without IPM legislation: Experiences from Arizona. 2020 Arizona Cooperative Extension Virtual Conference. 1/6/20. (Poster) Link

Online Courses/Presentations for Continuing Education Credits (9)
These courses, recorded live, include presentations on a variety of IPM topics. Only courses with involvement of Entomology faculty members are shown.

1. Dinwiddie, D., R. Masson. 2022 Southwest Ag Summit online on-demand workshop. "Integrated Pest Management in Vegetables". CEUs offered: 2.0 AZDA, CA-DPR, and CCA. (Jun 2022). 100% effort. On-demand link
2. Dinwiddie, D., R. Masson. 2022 Southwest Ag Summit online on-demand workshop. "IPM Regulatory Update". CEUs offered: 1.0 AZDA, CA-DPR, and 2.0 CCA. (Jun 2022). 100% effort. On-demand link
3. Dinwiddie, D., R. Masson. 2022 Southwest Ag Summit online on-demand workshop. "Cotton Management: Insects, Nutrients and Weeds". CEUs offered: 1.0 AZDA, CA-DPR, and 2.0 CCA. (Jun 2022). On-demand link
4. Keith, M., Dinwiddie, D., Masson, R. 2022. Maximizing the Fundamentals of IPM, an Organic Approach to IPM. Online on-demand CEUs offered: 1.0 CCA. 60 min. (Sept 2022). On-demand link
5. Masson, R. 2019. End of Year Desert IPM Seminar. 6 Speakers. 30 attendees. live. CEUs offered: 3.0 AZDA and CA-DPR. Yuma, AZ. (Dec 2019). Course removed from on-demand circulation.
6. Masson, R. 2022. Yuma Fall IPM Seminar. 13 speakers, live in-person and zoom, converted to on-demand. CEUs offered: 5.0 AZDA, CA-DPR, and CCA. 46 in-person attendance, 48 zoom, and 11 on-demand. Yuma, AZ. (Aug 2022). On-demand link
7. Masson, R. End of Year Desert IPM Seminar. 8 Speakers. Zoom. 30 attendees. CEUs offered: 3 AZDA and CA-DPR. Yuma, AZ. (Dec 2020). Course removed from on-demand circulation.
8. Masson, R., D. Dinwiddie. 2022. A Day in the Life of a Pest Control Advisor, Interactive Iceberg Lettuce IPM Video. CEUs offered: 2.0 AZDA, CA-DPR, CCA. 108 min. (Jun 2022). 100% effort. Casual View (no-CEUs) CEU version
9. Masson, R., J. Leon. 2021 Southwest Ag Summit online on-demand workshop. "Vegetable IPM". CEUs offered: 2.0 AZDA, CA-DPR, and CCA. (Jun 2021). Course removed from on-demand circulation.

Newsletter Articles (192)

Community IPM Newsletters (38)
Community IPM Newsletters cover Integrated Pest Management in schools, homes and communities. Topics range from insect and rodent management to turf and landscapes and public health IPM. A selection is included below. All newsletters can be found online. Link.

1. Brandt, R., W.E. Hall, 2021. Bug Bonanza: 7 Big, Colorful Critters to Try to Spot This Monsoon Season. UA School and Home IPM Newsletter. Aug 2021.

2. Gouge, D. H., J. Weber, S. Li, S. Nair. 2020. People Unite Against the Threat of COVID-19. UA School and Home IPM Newsletter. Apr 2020.
3. Gouge, D. H., S. Li, S. Nair. 2019. Mosquitoes. UA School and Home IPM Newsletter. Sept 2019.
4. Gouge, D. H., S. Nair, S. Li. 2020. Bee Informed: Warming and Swarming. UA School and Home IPM Newsletter. Mar 2020.
5. Gouge, D. H., S. Nair, S. Li. 2020. Unfortunate Facts about Flu. UA School and Home IPM Newsletter. Jan 2020.
6. Gouge, D., C. Rock. 2018. IPM for Microorganisms with a Focus on Flu Part 2. School & Home IPM Newsletter. Feb 2018
7. Gouge, D., S. Li. 2018. Flea borne Typhus. 2018. UA School and Home IPM Newsletter. Oct 2018.
8. Gouge, D.H., S. Nair, L. Rose, M. Nelson, J.A. Hurley, T. Stock, S. Li, V. McGregor. 2021. What You Need to Know About Disinfectant Wipes. UA School and Home IPM Newsletter. Apr 2021.
9. Gouge, D.H., T. Stock, S. Reese, R. Corrigan, S. Li, S. Nair, S. 2022. House Mice: Signs of Uninvited Four-legged Visitors. UA School and Home IPM Newsletter. Jan 2022.
10. Li S., D.H. Gouge, S. Nair, A.J. Fournier, U.K. Schuch, D.M. Kopec, P.L. Warren, M.R. Wierda. 2016. Wild Honey Bees UA School and Home IPM Newsletter. May 2016.
11. Li S., D.H. Gouge, S. Nair, A.J. Fournier, U.K. Schuch, D.M. Kopec, P.L. Warren, M.R. Wierda. 2016. Kissing Bugs UA School and Home IPM Newsletter. Sept 2021. January 2016.
12. Li S., D.H. Gouge, S. Nair, A.J. Fournier, U.K. Schuch, D.M. Kopec, P.L. Warren, M.R. Wierda. 2016. Zika and IPM Weed Control UA School and Home IPM Newsletter. Apr 2016.
13. Li S., D.H. Gouge, S. Nair, A.J. Fournier, U.K. Schuch, D.M. Kopec, P.L. Warren, M.R. Wierda. 2016. Pesticide Application Notification in Schools and Zika Virus UA School and Home IPM Newsletter. Feb 2016.
14. Li S., D.H. Gouge, S. Nair, A.J. Fournier, U.K. Schuch, K. Umeda, D.M. Kopec, M.R. Wierda. 2018. School Preparation Guidance for Summer Management Teams. UA School and Home IPM Newsletter. May 2018.
15. Li S., D.H. Gouge, S. Nair, A.J. Fournier, U.K. Schuch, K. Umeda, D.M. Kopec, M.R. Wierda. 2018. Spring Preemergence Weed Control in Lawns. UA School and Home IPM Newsletter. Mar 2018.
16. Li S., D.H. Gouge, S. Nair, A.J. Fournier, U.K. Schuch, K. Umeda, D.M. Kopec, M.R. Wierda. 2018. IPM for Microorganisms – Focus on Flu Part 2. UA School and Home IPM Newsletter. Feb 2018.
17. Li S., D.H. Gouge, S. Nair, A.J. Fournier, U.K. Schuch, K. Umeda, D.M. Kopec, M.R. Wierda. 2018. IPM for Microorganisms: Cleaning Disinfecting and Sanitizing. UA School and Home IPM Newsletter. Jan 2018.
18. Li S., D.H. Gouge, S. Nair, A.J. Fournier, U.K. Schuch, K. Umeda, D.M. Kopec, M.R. Wierda, M.R. Wierda. 2017. Increase in Rabies Cases in Animals School and Home Integrated Pest Management. UA School and Home IPM Newsletter. Sept 2017
19. Li S., D.H. Gouge, S. Nair, A.J. Fournier, U.K. Schuch, K. Umeda, D.M. Kopec, P.L. Warren, M.R. Wierda. 2017. Stop School Pests. UA School and Home IPM Newsletter. Feb 2017.
20. Li S., D.H. Gouge, S. Nair, A.J. Fournier, U.K. Schuch, K. Umeda, D.M. Kopec, P.L. Warren, M.R. Wierda. 2017. CDC Online Classes UA School and Home IPM Newsletter. Jan 2017.

21. Li S., D.H. Gouge, S. Nair, A.J. Fournier, U.K. Schuch, K. Umeda, D.M. Kopec, P.L. Warren, M.R. Wierda. 2016. Ants UA School and Home IPM Newsletter. Sept 2016.
22. Li S., D.H. Gouge, S. Nair, A.J. Fournier, U.K. Schuch, K. Umeda, D.M. Kopec, P.L. Warren, M.R. Wierda. 2016. Pesticide Safety and IPM Weed Control UA School and Home IPM Newsletter. Mar 2016.
23. Li, S., D.H. Gouge, I. Ruberto, S. Nair, A.J. Fournier, W.E. Hall. 2021. What You Should Know About Kissing Bugs. UA School and Home IPM Newsletter. June 2021.
24. Li, S., D.H. Gouge, J. Weber, S.A. Kells, J.A. Hurley, A.J. Fournier, S. Nair, K. Buhl. 2020. What You Should Know About N95 Respirators and Face Masks. UA School and Home IPM Newsletter. Apr 2020.
25. Li, S., D.H. Gouge, S. Nair, A.J. Fournier, K. Umeda. 2018. Beware of Fire Ant Stings. 2018. Ed. Li, S. School & Home IPM Newsletter. UA School and Home IPM Newsletter. Aug 2018.
26. Li, S., D.H. Gouge, S. Nair, L. Graham, A.J. Fournier, K. Umeda. 2021. Beware of Fire Ant Stings. UA School and Home IPM Newsletter. Mar 2021.
27. Li, S., M. Brophy, D.H. Gouge, S. Nair, K. Walker. September 2020. Brown Dog Ticks and Repellents. UA School and Home IPM Newsletter. Sept 2020.
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