Minutes of the Annual Meeting of Multi-State Project S1076

Fly Management in Animal Agriculture Systems and

Impacts on Animal Health and Food Safety (2019-2024)

January 11-13 2022 Virtual via Zoom

In attendance:

Name	Affiliation	Email
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Hanna Chu	U C Riverside	hchu036@ucr.edu
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2022 Meeting format

The 2022 meeting was held virtually hosted by Oklahoma State University in response to the ongoing COVID-19 pandemic. For this meeting, we adopted a new presentation style to combat "zoom fatigue" and increase discussion and engagement. Instead of the previously used 20-minute talk per presenter, the focus was on a 3-minute talk with the highlights of the project. Slide decks were limited to 4 slides. The emphasis was on discussion and collaboration.

Day 1:

Announcements:

- Justin Talley is taking over as Department Head at Oklahoma State University (Congratulations Justin!).
- Sonja Swiger has been promoted to Full Professor at Texas A&M (Congratulations Sonja!)
- Penn State is recruiting for a new vector biology faculty position.
- Texas A&M will be recruiting for two positions, one on insect microbiomes and one on global public health.
- University of Nebraska will be recruiting for a vector biology position.
- USDA Manhattan (Dana) is hiring 2 FYS; arbovirology and insect behavior.
- USDA-Kerrville (Kim) is looking for a screwworm SY who will rotate between Kerrville and Panama.
- All products containing chlorpyrifos are to be banned for use on animals (announced by Nancy)
- A new book is coming out titled "Pests and Parasites of Horses"; authors are Erika Machtinger, Chris Geden, Emma Weeks, and Erica Lacher.

Wes Watson led the discussion for **Objective 1, New technologies for management of biting and nuisance flies in organic and conventional systems**.

Gary Brewer reported on a grad student project involving a push-pull approach to stable fly management. The push was in the form of coconut fatty acids and the pull was SF traps. Permethrin treatments and water were positive and negative controls, respectively. Treatments were applied weekly over two seasons. SF populations were low in 2020. The push-pull treatment was effective as permethrin. There were discussions about: 1) the need for a better "pull" than sticky traps; 2) the desirability of a self-treatment device to dispense the coconut fatty acids; 3) Jerry Zhu said that he is looking at a water-based formulation and is working with a company on embedding attractants into trap adhesives.

Joe Argentine introduced Vedira fly bait, containing a new active ingredient broflanilide which is a non-repellent in IRAC group 30. The baits have multiple (proprietary) attractants and is effective against resistant house flies, phorids and fruit flies. The granules can be uses in bait stations or mixed with water to make a sprayable. Product launch is expected in a year or so, with a price point reflecting a premium product. The toxicant is long-lasting but slow-acting and there will need to be an education component to address expectations by end-users.

Dave Boxler reported on efficacy of daily cattle sprays with C8-10 fatty mixtures (product XPS-203) at different doses for horn fly control. Daily sprays kept fly numbers under the EIL. This would be labelled as an organic formulation. Dave will also be looking at this product on horses.

Wes Watson reported on ongoing work with *Beauveria bassiana* strains P89 and L90 (isolated from dairy farm house flies in New York) against house flies and face flies. Dust formulations (in flour) were more effective than 1 microliter topical applications of conidia in 0.01% Tween; the high rate tested was $3.3*10^6$. The two strains were similar in efficacy but conidiation on cadavers was stronger with P89.

Erika Machtinger looked at effects of horse (geldings, mares, foals) diet (forage, grain) on the suitability of the resulting manure for house fly development. Manure from geldings produced small numbers of very small pupae on both feeding treatments, especially at higher egg loading rates, and had low pupa-adult emergence rates. Flies grown on conventional fly larval diet produced pupae that were 2-10 times larger (20 mg) than pupae from any of the horse manures. Manure from grain-fed geldings produced larger pupae with higher emergence success than manure from pastured geldings.

Jeff Scott compared conventional UV light traps with the Mosclean trap that uses UV-LED lights. The Mosclean traps collected more flies, drew less power, were lighter, and had bulbs that lasted longer than those from conventional fluorescent UV traps.

Phil Kaufman led the discussion for **Objective 2, Insecticide resistance detection and management.**

Caleb Hubbard examined the stability of behavioral resistance of house flies to imidacloprid and found no evidence for waning of resistance after discontinuing the selection. Jeff Scott cautioned that if the selection had resulted in a population of homozygous resistant flies, then they would not be able to revert to susceptibility without new mutations or addition of susceptible alleles into the population.

Jeff Scott thanked all the people that sent him flies to look at fluralaner cross-resistance and selection for resistance, all of the fly populations were already predisposed to fluralaner resistance, and three generations of selection led to high resistance levels.

Ted Burgess looked at fluralaner-resistant flies to see whether this insecticide can be synergized by PBO, TPP and DEM. Only PBO resulted in synergy, suggesting that that cytochrome P450's is involved in resistance.

Day 2:

Dana Nayduch then led the discussion on **Objective 3, Investigation of the microbial ecology, epithelial immunity, and vector competence of biting and nuisance flies**.

Dana led off with a discussion of how antimicrobial effector gene expression changes across life history stages, and that there is massive duplication of immune effector genes. For example, defensins have at least 12 gene copies, with the greatest expression in the larval stage. In contrast, the glycine-rich peptide superfamily is most commonly expressed in pupae, where they may function to neutralize microbes that survive larval-pupal metamorphosis. There was a discussion of what these antimicrobials actually do. Is there tissue specificity? Yes, some are limited to the larval gut, which is surprising because they are proteins and the gut is a tough neighborhood for proteins. It would be interesting to knock out defensins and see the effect on survival and fitness. **Rich Meisel** pointed out the need for better functional genetics tools for house fly, especially considering that RNAi does not work well in this species.

Danial Asgari has continued his work on constitutive expression of AMP's in Muscidae. He reported that house fly has vastly more gut defensins than horn fly or stable fly. He is also looking at microbial binding sites and trying to identify the switches that activate expression of AMPs. These binding sites are very different from those in blow fly larvae. The bacteria must be alive to induce AMPs, so there is more than just binding that's involved in the trigger

Cassandra Olds is following movement of house flies within confined cattle operations in Kansas using mark/release/recapture methods on a feedlot. Flies tended to move relatively little from their release point if there was sweet feed nearby. A long discussion followed about the challenges of marking and capturing flies and the attractiveness of different food items on farms.

Sara Neupane continues to examine prevalence of pathogenic bacteria in house flies collected from beef cattle operations. In 2019, flies were collected in NE, KS, and OK; 2020 collections were from TX and KS. Overall prevalence of pathogenic bacteria was very high in most collections, and species richness of bacteria on individual flies varied between collection sites. Prevalence was 40-60% for *Moraxella* and 45-100% for Shigella. A long discussion followed, including whether fly collections could be used as bioindicators of disease problems and antibiotic resistance in herds,

Tanya Purvis, also working with Dana, is examining antibiotic resistance in bacterial on houseflies collected from beef and dairy operations in Kansas. The work is a culture-based approach that involves growing coliforms on media containing antibiotics. Beef and dairy operations seem to have similar antibiotic resistance on bacteria collected from their associated house flies. Resistance to tetracycline and ampicillin is particularly prevalent, with some resistance to florfenicol. Producers do not keep detailed records of which antibiotics they're using. Rich Meisel suggested that LAMP (=loop-mediated isotheral amplification) might be useful for species monitoring in these kinds of studies.

Victoria Pickens is using a sequencing-based approach for looking at antibiotic-resistant bacteria on house flies from dairy and beef cattle operations. The project dovetails with Tanya's project, which provides the bacteria for the sequencing work. She is finding higher levels of multiple drug resistant phenotypes from bacteria from beef than from dairy farms, but overall AMR levels are similar. Resistance to tetracycline has three mechanisms. Many AMR genes are encoded in plasmids.

Paolo Moroni is examining variation in mastitis pathogens found on flies collected from New York dairies, mostly calf hutches, hospital pen, and milking parlor. There was a large difference in bacterial found on the surface of the flies compared with internal fly tissues. A total of 485 bacterial isolates collected from the flies were cultured, including several species associated with mastitis; *Mycoplasma arginini*, *Enterococcus* spp., and *Staphylococcus* spp.

Abby Orr screened mRNA databases associated with known species of flies to look for sequences matching bacteria and viruses associated with blow flies *Lucilia sericata* and *Chrysomaya rufufacies.* So far she has had virus hits for herpes, pox, and baculoviruses. Other hits include *Bacillus*, *Burkholderia, Wolbachia*, and bee pathogens.

Ted Burgess then led the discussion of **Objective 4: Characterize population biology of biting and nuisance flies**.

Xinmi Zhang has been identifying *Culicoides* collected in the CA desert that are associated with hemorrhagic disease virus in bighorn sheep. The work has involved collected flies near Palm Springs and subjecting the same specimens to identification by morphological, non-destructive molecular, and full molecular methods. The CO1 gene can be used to distinguish morphologically similar species; data also indicate that some morphologically "difficult" species may be the same species. A discussion followed about the use of molecular methods to distinguish separate species. How "different" must they be to warrant species status?

Laura Harmon is looking at *Culicoides* distribution in the Western US. She is working with NEON (National Ecological Observatory Network) to get ecological data for the sites where collections are made. Flies are being collected and identified using morphology, non-destructive molecular, and full sequencing methods. The goal is to obtain improved mapping and modelling of species using Biomod2. This work is just getting underway.

Hanna Chu is looking at the distribution of blow flies in southern CA. Sampling is being conducted in 5 different ecological zones, and the fly distribution patterns reflect urbanization trends. She tested 12 different traps and chose the Rid-Max trap for the work, which is baited with aged pork liver. Traps are placed every other week from February-November, with traps being serviced twice a day.

Bethany McGergor has been studying larval habitats of *Culicoides* in NE Kansas. *Culicoides sonorensis* is well-known but other bluetongue disease vectors that don't occur on dairy farms have received little attention. This project is being done at Tallgrass Prairie National Preserve, which includes areas that are ungrazed or grazed by buffalo or cattle. She is finding different distributions by habitat, which includes pond, disturbed, spring, stream. *C. sonorensis* and *C. varipennis* are most common around streams associated with cattle but not buffalo.

Rich Meisel reported on continuing work on genetics and genomics to study sex-determination and thermal traits in house fly. HF has 2 sex-determining mechanisms: Ym (maleness alleles on chromosome Y, found in northern locations) and IIIm (maleness alleles on chromosome III, found in southern locations. Yet when mixed fly populations are raised at either hot or cold temperatures the proportion of IIIm males increases in both cases. Rich speculates that there is assortative mating whereby males benefit by mating with females from the population with the other, or "unfamiliar" sex-determining mechanism. A lively discussion followed about sex determination and thermal preference and tolerance. Is there a genetically linked allele that confers heat tolerance? If so, are heat shock proteins involved? Rich said that there is no evidence for differential expression of heat shock proteins.

Brandon Hall examined food preferences of male and female house flies using sugar, powdered milk, and powdered egg yolk that had been dyed different colors. Females consumed proportionally more milk, males preferred sugar, and neither sex consumed much powdered egg yolk.

At this point, discussion switched temporarily to discussion of **Objective 5, Objective 5. Extension and community engagement,** led by **Alec Gerry.**

Erika led off with an update on the 2019 grant that Penn State awarded S-1076 to do three things: 1) update the old "Lincoln document" that summarized research and extension needs for a variety of pests of veterinary importance, but focusing for now on the flies; 2) improvements to the Veterinary Entomology website, and 3) a set of training videos. Objective 1 was highly successful, with reviews of all of the major fly pests appearing in a Special Collection in late 2021. Objective 3 is mostly completed, with a series of Learn Now videos that have been made but not yet uploaded to the Veterinary Entomology website.

Alec began discussion of the website by first reminding the group of the funding opportunities from the regional IPM Centers. Each of the centers has somewhat different funding programs such as seed funds, outreach, workshops, crop profiles, and Pest Management Strategic Plans (PMSP). The discussion then turned to how to improve the website and use it (and S-1076) to leverage for funding. Suggestions included:

- Mention it in grants when asked to provide Extension goals and means
- As a tangible example of an Extension product
- A place to put new information for immediate impact
- Include it in grant budgets for content development (makes you seem serious about Extension)
- Erika and Becky, as Project Co-chairs, can write letters of support for the Extension portion of grants

Erika will be stepping down as webmaster, so there is an urgent need for someone to step up. A general discussion proceeded about the website (and related topics), including:

- How can it be strengthened?
- How can the content be built and managed?
- Who fixes broken links?
- How can it be kept fresh so that people have a reason to come back?
- Should we have a workshop just to discuss how to do a better job with the website?
- Phil suggested asking the Experiment Station Directors group to fund a Webmaster.
- Erika suggested S1076 having quarterly meeting meetings to discuss Extension items like the website and writing impact statements.

We then returned to complete Objective 4, led by **Dana.**

Edward Bird is examining whether bluetongue and vesicular stomatitis viruses affect the vectors, since both viruses infect the eyes. In one study, BTV was found to affect response of the flies to UV. Edward looked at the transcriptome of VSV-infected flies and found that there were 37 downregulated genes involved in sensory functions.

Caitlin Taylor collected 828 blow flies from Florida beaches where red-tide outbreaks led to large numbers of dead fish being washed up onto the beach. Most of the flies developing in the killed fish were *Chrysomyia megacephala* and *Cochliomyia macelleria*. Samples of the fly larval tissues showed large amounts of red tide brevetoxin. The amount of toxin in the larvae would be more than enough kill insectivorous vertebrates that consumed them.

Meeting adjourned for the day.

Day 3:

Industry reports

Barbara Hull said that Y-Tex will pull back their Warrier eartags because of the chlorpyrifos cancellation. The company's replacement will be the diazinon Max40. A discussion followed about how to get the word out to stakeholders about chlorpyrifos and whether existing inventories can be used until they're gone.

Chris Holderman announced a 4% novaluron (IGR, similar to diflubenzuron) granule product for uses in places like hay rings. The granules can be used as is or mixed with water. Frequent applications may be needed because rain will dilute the product below the point of effectiveness. Chris also reported on a study to incorporate garlic into a mineral block for cattle. The public likes the idea of garlic for insect control and the cattle liked the taste of the garlicky mineral, but there was no effect on horn flies. A discussion followed where several other members reported disappointing results with garlic.

Business Meeting

- The meeting began with a discussion of whether to self-nominate the project for an award as we did in 2015 and 2016. The group decided to wait until the end of the current project.
- The LIWC meeting is still scheduled for Texas, June 5-8. There will be no talks on Sunday.
- Orlando was chosen as the 2023 meeting site, with a possible extra half-day for discussion about the website.
- After a long discussion about choosing chairs for the new project new chairs, the group decided to wait until 2023. The group will elect two co-chairs, one of which is primary chair for the first 3 years, after which the 2nd co-chair takes the primary role for the remaining 2 years.
- We all wished Dave Taylor well as he takes over the helm as editor in chief for the Journal of Medical Entomology
- Effective immediately, Cassandra Olds replaces Dana Nayduch as leader of Objective 4 for the remainder of the project.

Project Re-write: Initial Discussion

There was broad support for expanding the project to include ticks and to shift focus from taxa-specific items to a broader animal health focus. The new project will add probably add poultry as a commodity and include ticks.

Ideas for project names and objective titles were suggested. Dave White cautioned that we need to watch out for perceived overlap with other projects if we go broader.

Becky captured the ideas for titles and objectives, and we agreed to develop them more via email after the meeting.

Meeting adjourned 2 PM EST

APPENDIX 1. AGENDA

Multistate Project S-1076 Virtual Meeting:
Fly Management in Animal Agriculture Systems and
Impacts on Animal Health and Food Safety (2019-2024)

January 11-13th, 2022

S1076 Google Drive:
https://drive.google.com/drive/folders/1p409NO-ZdJrjZc9aM7jue3YvteYRwtHN

Day 1 January 11 (11am – 2pm EST)

Welcome and Introductions Erika Machtinger (Chair)

S-1076 Officer Reports:
Erika Machtinger (Chair)
Becky Trout-Fryxell (Past Chair)
Chris Geden (Secretary)
Justin Talley (2022 Local Arrangements Chair)

Advisor Reports / Program Leader:
Dave White (S-1076 Administrative Advisor)
- AI in Ag Meeting being held at Auburn in March. https://aaes.auburn.edu/ai-driven-innovations-in-agriculture/

****NEW:** Kathe Bjork and Robert Smith (NIFA Representatives)** (welcome Dr. Bjork and Dr. Smith!)
USDA NIFA National Program Leaders (email sent/attached)

Announcements
Promotions
Justin Talley now Department Head of OSU Entomol. & Plant Pathol.
Sonja Swiger promoted to Full Professor
Upcoming Positions
Penn State vector biology / ecology - tick focus
Post doc position at OSU with Talley
Texas A&M Tenure Track insect microbiome
Glen Scoles / ARS / Rutgers - post doc position with ALT
Univ Neb Linc - vector biologist (animal or plant)
Dana Nayduch / ARS – recruiting, positions to open soon, insect behavior/physiology, arbovirol
Kim L./ARS - screwworm ecology rotating between Panama/Tx labs
Other
Pests and parasites of horses by Machtinger, Weeks, Geden, and Lacher (Wageningen AP)
Nancy Hinkle received Lifetime Achievement Award Friends of IPM Awards, Southern IPM

Objective 1. New technologies for the management of biting and nuisance flies in organic and conventional systems (*Led by Watson*)
- Novel push-pull strategies (NE, NC, USDA-NE, USDA-FL)
  - Brewer
- Evaluation of improved monitoring systems (USDA-NE, CA, TN, NM)
- Novel toxicants, biopesticides, & delivery systems (FL, PA, NE, NM, TX, USDA-FL, USDA-NE)
  - Joe Argentine
  - Watson
  - Boxler

- Non-pesticide management options (mechanical) (AU, FL, NC, NE, PA, TN, USDA-NE, USDA-FL, USDA-TX)
    - Machtinger
    - Scott

Objective 2. Insecticide resistance detection and management *(Led by Kaufman and Scott)*

- Assessment of insecticide resistance (TX, NY, USDA)
- Leveraging the *Stomoxys* and *Musca* genomes for novel control measures (NY, USDA)

Either email objective leader or sign up at the link here:
https://docs.google.com/spreadsheets/d/1fM_WbCpV8nA3lHXn8K2AfRbV44FP4RuAgSaFE-zbifw/edit#gid=1966139455

Day 2 January 12 (11am – 5pm EST)

Welcome and Introductions Erika Machtinger (Chair)

Objective 3. Investigation of the microbial ecology, epithelial immunity, and vector competence of biting and nuisance flies *(Led by Nayduch)*

- Identification of the key bacterial strains and their metabolites playing a major role in oviposition and larval development of stable flies (TX, KS, USDA)
- Investigation of the innate immune response of filth flies (KS, USDA)
- Consequences of fly-bacteria interactions: selection effects and evolutionary outcomes (USDA, TX)
- Animal and human pathogen acquisition, dispersal, and deposition by muscid flies (AU, NC, MA, KS)

Objective 4. Characterize population biology of biting and nuisance flies *(led by Burgess)*

- Characterize effects of climate and landscape features on dispersal (KS, TX, USDA-NE)
- Phenology of biting and nuisance flies (AU, FL, KS, TN, USDA-NE)
- Genetic structure of biting and nuisance fly populations (TN, TX, USDA-NE)

Objective 5. Extension and community engagement *(Led by Gerry)*

- Improve project website to maximize extension and community engagement
- Demonstrate research value to stakeholders and funding decision-makers
- Seek funding to support these extension/outreach efforts by developing proposals that will be submitted to various granting agencies including our Regional IPM Centers.

Either email objective leaders identified above or sign up at the link here:
https://docs.google.com/spreadsheets/d/1fM_WbCpV8nA3lHXn8K2AfRbV44FP4RuAgSaFE-zbifw/edit#gid=1966139455

Day 3 January 13 (11am– 2pmEST)

Welcome and Introductions Erika Machtinger (Chair)

Industry perspectives *(Led by Machtinger and admin/industry representatives)*

Project Coordination

As a group, identify and develop collaborative efforts related to objective goals.

Business Meeting

- **Old business**
- **New Business**
    1. **Vice-chair**
    2. **Selection of 2023 meeting location**

5-year plan

- **Identify and develop collaborative projects that will advance sub-objectives**
- **Assess funding opportunities**

APPENDIX 2 – NIFA UPDATE

National Institute of Food and Agriculture UpdateS1076 Fly Management in Animal Agriculture

January 11, 2022

I. News and Personnel Updates (https://nifa.usda.gov/newsroom)

A. NIFA relocated to Kansas City on September 30, 2019 and lost about 75% of its staff. NIFA now has ~250 employees and all mission critical functions have continued.
B. On Jan 4, 2021 Dr. Carrie Castille was appointed as the NIFA Director.
C. Dr. Robert Godfrey joined NIFA in September 2021 as Director, Division of Animal Systems. Previously he was Director of the Agricultural Experiment Station at the University of the Virgin Islands, St. Croix.
D. National Program Leader News:
- Dr. Andres Cibils (Rangeland Ecology and Grazing Management) joined NIFA in February 2021 after 17 years at New Mexico State University where he was Professor, Department of Animal and Range Sciences.
- Dr. Angelica Van Goor (Animal Genomics and Health) joined NIFA on July 2021 after a postdoctoral fellowship with the ARS in Beltsville, MD.
- Dr. Joel Caton (Ruminant Nutrition and Developmental Programming) joined NIFA in July 2021. Joel is on sabbatical leave from North Dakota State University.
- Dr. Kamilah Grant (Animal Reproduction) joined NIFA in November 2021 after 6 years on the faculty of Alcorn State University and Tuskegee University.

E. Program Specialists News:
- Rekia Salter joined NIFA in January 2021. Rekia has a B.S. in Animal Science from Tuskegee University andan M.S. in Dairy Science from the University of Wisconsin.

II. NIFA Budget

Congress passed the FY 2021 Omnibus Appropriations Bill that provided a ~3.5% increase in funding for NIFAcompared with FY 2020. NIFA awaits passage of FY2022 Agricultural Appropriations Bill. NIFA's comparative budget table will be posted at https://nifa.usda.gov/budget.

III. Competitive Programs

A. Three AFRI Requests for Applications (RFAs) will be released for FY 2022. See https://nifa.usda.gov/afri-request-applications.
1. Sustainable Agricultural Systems (RFA for FY 2022 is pending)
2. Education and Workforce Development (RFA for FY 2021-2022) will be updated for FY 2022 on February 3. Includes pre- and postdoctoral fellowships, undergraduate experiential learning, and K-14 educational programs.
3. Foundational and Applied Sciences (RFA for FY 2021-2022) will be updated for FY 2022 in January 2022.
   a. Animal Health and Production and Animal Products. Next application submission deadline is August 11,2022.
   b. Crosscutting Programs
      - Critical Agricultural Research and Extension (CARE)
      - Data Science for Food and Agricultural Systems (DSFAS)
      - Inter-Disciplinary Engagement in Animal Systems (IDEAS)
      - Tactical Sciences for Agricultural Biosecurity
   c. Agricultural Innovation through Gene Editing has been sunset

B. Other competitive grant programs with opportunities for animal science research, extension and/or education
1. Organic Agriculture Research and Extension Initiative (OREI); Organic Transitions
2. Beginning Farmers and Ranchers Development Program
3. Biotechnology Risk Assessment Grants (BRAG)
4. Special Research Grants Program - Aquaculture Research
5. Small Business Innovation Research (SBIR); 8.3 Animal Production & Protection; 8.7 Aquaculture
6. AFRI Small and Medium-Sized Farms (see Ag Economics & Rural Communities in AFRI Foundational RFA)
7. AFRI Engineering Products and Processes (see Ag Systems & Technology in AFRI Foundational RFA)
8. Farm of the Future: FY2021 appropriations provided $4 million for a competitive grant to an institution in the land-grant university system to establish a Farm of the Future testbed and demonstration site. https://nifa.usda.gov/program/farm-future. Application submission deadline was October 15, 2021.

C. Interagency Funding Opportunities

1. **Ecology and Evolution of Infectious Disease** – NIFA partners with the National Science Foundation (NSF),NIH and the U.K. Biotechnology and Biological Sciences Research Council. Applications are submitted to and reviewed at NSF with NIFA, NIH & U.K. participation. NIFA plans to invest $5 million in FY2022.

D. Program outcomes for AFRI Foundational Programs in FY 2021.

Animal Health and Production and Animal Products ($5**5.7** million total program funds)				
Program Area	**Program Contacts for FY 2021**	**Funding ($ million)**[1,2]	**# Standard Awards**[3]	**Success Rate**
Animal Breeding, Genetics, and Genomics	Frank Siewerdt & Angelica van Goor	$4.7	8	27%
Animal Reproduction	Mark Mirando	$6.5	15	25%
Diseases of Agricultural Animals	Tim Sullivan & Kathe Bjork	$13.0	33	26%
Animal Nutrition, Growth, and Lactation	Andres Cibils, Joel Caton, Angelica van Goor & Steve Smith	$9.3	21	24%
Well-Being and Welfare of Agricultural Animals	Frank Siewerdt & Mark Mirando	$4.0	9	31%
Inter-Disciplinary Engagement in Animal Systems (IDEAS)[4]	Andres Cibils, Steve Smith, Joel Caton & Angelica van Goor	$4.0	11	34%

[1] Excludes contributions to AFRI cross-cutting program in Tactical Science for Biosecurity and Extension, Education & USDA Climate HubsPartnership program area priorities or the Ecology & Evolution of Infectious Disease interagency program.

[2] Funding from FY2021 appropriation only. Programs will also use ~50% of FY2022 appropriations to fund proposals submitted in FY2021.

[3] Budgets ≤ $650,000 (including indirect costs) for up to 5 years; excludes seed, sabbatical, equipment & conference awards.

[4] Funding excludes $3 million contribution from other AFRI Program Areas (BNRE, AERC, AST).

IV. Contact Information for the Division of Animal Systems

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APPENDIX 3 – Publications from the S1076 group

Special Collection: IPM of fly pests in animal agriculture.

1. **Machtinger, E. T., A. C. Gerry, A. C. Murillo, J. L. Talley. 2021.** Filth fly impacts to animal production in the United States and associated research an Extension needs. J. of Integrated Pest Management. 12(1): 41, https://doi.org/10.1093/jipm/pmab026
2. **Geden, C. J., D. Nayduch, J. G. Scott, E. R. Burgess IV, A. C. Gerry, P. E. Kaufman, J. Thomson, V. Pickens, E. T. Machtinger. 2021.** House fly (Diptera: Muscidae): Biology, pest status, current management prospects, and research needs. J. of Integrated Pest Management. 12(1): 39. https://doi.org/10.1093/jipm/pmaa021
3. **Murillo, A. C., C. B. Hubbard, N. C. Hinkle, A. C. Gerry. 2021.** Big problems with little house fly (Diptera: Fanniidae). J. of Integrated Pest Management. 12(1): 42. https://doi.org/10.1093/jipm/pmaa023
4. **Brewer, G. J., D. J. Boxler, L. D. Domingues, R. T. Trout Fryxell, C. Holderman, K. M. Loftin, E. Machtinger, B. Smythe, J. L. Talley, W. Watson. 2021.** Horn fly (Diptera: Muscidae) Biology, management, and future research directions. J. Integrated Pest Management. 12(1): 42. https://doi.org/10.1093/jipm/pmab019
5. **Rochon, K., J. A. Hogsette, P. E. Kaufman, P. U. Olafson, S. L. Swiger, and D. B. Taylor. 2021.** Stable fly (Diptera: Muscidae) Biology, management, and research needs. J. of Integrated Pest Management. 12(1): 38. https://doi.org/10.1093/jipm/pmab029
6. **Trout Fryxell, R. T., R. D. Moon, D. J. Boxler, and D. W. Watson. 2021.** Face fly (Diptera: Muscidae) Biology, pest status, current management prospects, and research needs. J. Integrated Pest Management. 12(1): 5. https://doi.org/10.1093/jipm/pmaa020

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9. **Burgess, E. R., IV, E. E. Taylor, A. Acevedo, M. Tworek, D. Nayduch, N. Khurana, J. S. Miller, and C. J. Geden. 2021.** Diets of erythritol, xylitol and sucrose affect the digestive activity and gut bacterial community in adult house flies. Entomologia Experimentalis et Applicata, 169: 878-887.
10. **Butler, R. A., J. G. Chandler, K. M. Vail, C. J. Holderman, and R. T. Trout Fryxell. 2021.** Spray and pour-on acarcides killed Tennessee (United States) field-collected *Haemaphysalis longicornis* nymphs (Acari: Ixodidae) in laboratory bioassays. Journal of Medical Entomology. 58(6): 2514-2518. https://doi.org/10.1093/jme/tjab115. Highlighted in *Entomology Today;* https://entomologytoday.org/2021/08/05/acaricides-effective-invasive-asian-longhorned-tick/
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21. **Hinkle, N.C. 2021**. "Beef Cattle External Parasite and Grub Control." 2021 Georgia Pest Management Handbook, pp. 54-70.
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34. **Hinkle, N. C, and J. A. Hogsette. 2021.** A Review of Alternative Controls for House Flies. Insects 12:1042. https:// doi.org/10.3390/insects12111042.
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