Minutes of the Annual Meeting of Multistate Project S-1076:

Arthropod Management in Animal Agriculture Systems and Impacts on Animal Health and Food Security

January 10-12, 2024

In-person (Las Cruces) and virtual via Zoom

NOTE: All events are in Mountain Standard Time

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Day 1

The meeting was called to order by **Erika Machtinger** at 8:30 AM. **Erika** reminded everyone that the forum is a hybrid of in-person and virtual (Zoom) participation and that the group is beginning a new project with the same number.

Next, Cliff Lamb, the S-1076 Administrative Advisor, spoke to the group via Zoom. He expressed his appreciation for the group's proactiveness and for getting the project proposal submitted. **Cliff** reported that with it being more of a project renewal than a new project proposal, it went through smoothly and did not require much review. The group was then reminded that there will be a mid-project review in 2 years and that the minutes and final report for the 2024 meeting are due within 30 days of this meeting. **Cliff** then encouraged the group to apply for the multistate award, as it is positioned well to be nominated again for a regional or national award. If so, the group will let Cliff know within the next couple of weeks to finish the nomination in time. In the meantime, if not already listed, all members were reminded to please list themselves in Appendix E of the NIMMS website for the S-1076 project by contacting Cliff. **Cliff** also provided answers to the group's following questions:

1. Are USDA employees already listed in Appendix E?
    a. Currently, some USDA employees are already listed, but very few are currently listed. New scientists can be added. Please send names and contact information to Cliff.
2. Can other USDA employees be listed in Appendix E besides the one official representative for each experiment station?
    a. Yes, as many people can be listed as the group desires.

Erika then reviewed the day's agenda and responsibilities of the objective leaders before introducing the current S1076 officers. The group was additionally informed that **Brandon Smythe** will be the Chair for the 2025 meeting. All members were reminded to contact objective leaders with questions about the project objectives.

This was followed by a discussion of the purpose of multistate projects, which is to bring together scientists from the State Agricultural Experiment Stations (SAES) to tackle problems of regional and national importance. Our group particularly excels in accomplishing these goals through the combination of both research and extension practices. **Erika** then gave a brief report on the project's current and past membership, which continues to increase yearly.

Brandon Smythe then handled announcements for **local arrangements**. He first apologized for the troubles with email updates, reaching USDA members for announcements regarding the 2024 meeting. The issue has hopefully been resolved, but members were encouraged to contact any of the officers if they have trouble receiving email announcements moving forward. Additionally, all members were reminded to add or update their email addresses to the signup sheet so that the officers can use this list to contact members moving forward. **Brandon** announced that lunches and breakfasts will be provided for both meeting days and that registration will be free to attendees.

Erika asked whether there were any announcements regarding job openings or transitions:

- UC Riverside: Assistant Professor/Assistant Entomologist in Genetics/Genomics of Arthropod Vectors of Human Diseases (job announcement)
- Texas A&M: Assistant Professor of Entomology in Agricultural Forensics (job announcement)
- Apex Bait Industries: Urban Entomologist/Chemical Ecologist (job announcement)
- University of Connecticut: Assistant or Associate Professor in One Health Approaches to Infectious Diseases (job announcement)
- Thermacell Repellents, Inc: Sr Scientist-Entomology Programs (job announcement)
- Vector-borne Disease Extension educator position will soon be available at the Ohio State University.

Cassandra Olds and **Phillip Shults** led the discussion for **Objective 1, Investigate the distribution, ecology and biology of arthropods of veterinary concern**.

Jeff Scott presented the new version of the house fly genome, which was published in late 2023. The group used long reads, making it a more contiguous genome. The genome is still incomplete, but it is far more contiguous than the genome assembled in 2014. Some noted benefits observed from the new genome include an improved sequence of genes (e.g., Vssc now on a single scaffold rather than needing to piece it together from five scaffolds) and better assemblies of loci containing gene families (e.g., immune genes). Emphasis was also given to closing gaps in the coding genes within antimicrobial peptide families. **Jeff** wished to thank **Rich Meisel** for performing much of the genome annotation. The new genome is currently available on NCBI.

We then briefly transitioned to **Michelle Colby,** who visited with us via Zoom to present the NIFA news and personnel updates, budget, events, funding opportunities, and FY 2023 success rates of the Animal Program Areas. Her complete report is available in **Appendix II** and the 2024 Las Cruces NM Google Drive. **Michelle** also provided answers to the group's following questions:

1. Years past, there were plant-based programs that could also be competitive for animal health entomologists. If there are areas that are more entomology-based, most often, they focus on plant-based, and livestock entomologists tend to get bounced back and forth between programs. Would it be beneficial for the group to receive a list of the plant-based system programs for consideration?
    a. Agreement that there is a lack of homes for entomological projects. Recommended proposals for A1181: Agricultural Biosecurity for additional consideration.
2. Are there any programs for One Health projects?

    a. The CDC has put out a call for One Health projects. However, NIFA does not have a One Health program at this time. The closest program fit would be Agricultural Biosecurity.
3. Is there a way for USDA applicants to apply through NIFA for EID since they cannot go through NSF?
    a. Recommended contacting the program lead for answers regarding whether USDA scientists can apply for EID. However, it was noted that the initial submission for EID is processed through NSF.
4. How do we handle conflicting information on a program application where the panel will tell us to apply for animal-focused programs, despite previously being told we could be considered for an alternative program?
    a. Recommended writing a brief paragraph of the planned project proposal and emailing the national program leader listed in the application request. It may be best to ask to set up a call with them for any further questions as well.

Rich then resumed **Objective 1**, announcing that there will soon be a new house fly reference genome at the chromosome level, having all 5 major chromosomes resolved to single scaffolds. The group was encouraged to continue using the 2023 house fly genome but cautioned not to try to attempt to improve it due to plans for the release of this new chromosome-level genome assembly soon. Also, **Rich** announced that the stable fly chromosome-level genome assembly is now available in the Darwin Tree of Life Data Portal.

Alec Gerry reported on the graduate work performed by **Xinmi Zhang** looking at seasonal variation in host-seeking activity of *Culicoides sonorensis* in CA. **Xinmi's** first study looked at the diel host-seeking activity. Trapping was conducted over three years every other week using a time-segregated rotation trap baited with CO_2. Major findings were that peak host-seeking activities before, during, or after sunset varied between different months of the year, which could impact surveillance trapping. For midge host-seeking activities during the winter, they collected midges using 16 CO2-baited CDC traps from November to April every other week (on the warmest day). The group noted that midges were active throughout the winter each year and that there was no evidence for adult diapause. Additionally, the adult midge survival during this period was estimated at <1 month, leading the group to conclude that ongoing Blue Tongue Virus transmission during the winter is necessary for BTV to persist locally. The overwintering study is published for reference.

Lauren Beebe presented stable fly feeding choices from a drive-thru exotic wildlife park with surrounding Brazos County, TX cattle farms. Following weekly collections of flies from May 2022-May 2023, 15 host species were identified in stable fly blood meals. Nine flies had mixed host results. The highest number of flies were positive for cattle/zebu (47), yak (14), cattle (12), mixed (9), and banteng (9). Other hosts included humans, horses, elk, deer, pigs, and bushbuck. Bushbuck was not present on site, so it was suspected to be from a nearby site. This raised the question of using positive controls for the hosts, which has been done for some but not all host species (i.e. Zebu). The group then discussed the difficulties in obtaining blood from some animal host species to have a positive control in studies.

Cassandra Olds reported on horn fly populations of stocker cattle grazing in seasonally burned pastures (spring, summer, fall) in Flint Hills, KS. Flies were enumerated from photos of 40 randomly selected cattle in each pasture treatment taken weekly while cattle were on pasture May-August 2023. High variability in the number of flies on each animal was observed. Still, overall, the cattle on spring pastures had lower numbers of horn flies, though not always significantly different for each week. However, the impact of spring burning on horn flies may still be beneficial, as it does not affect the forage quality in these pastures and cattle on spring burned pastures had significantly higher weight

gains. **Cassandra** also noted that, after surveying dung beetle populations in treated fields, there was no difference in the number of dung beetle species. Additionally, although not presented, surveillance of tick populations in these pastures during the same year found that burning significantly reduces ticks for all burn treatments compared to not burning. Spring burning was observed to be the optimal season for tick management. Some considerations for the group expressed were to reevaluate the economic injury level for horn potentially flies on cattle in pastures, the need for automated fly enumeration from photos, and the potential of pasture burning as an integrative pest management approach for multiple arthropod pests of livestock since many control methods are currently not effective.

Becky Trout Fryxell reported Asian longhorned tick, *Haemaphysalis longicornis*, surveillance and potential management as it has progressed in eastern Tennessee. Eastern Tennessee has a lot of submissions from sources, and additionally collected samples via drag from 3 different cattle farms confirmed to have infestations. The group Started collecting based on producer feedback of where ticks are, where cattle are dying, etc. and continued collecting weekly (2019-2020), then monthly (2021). This helped to answer many of the questions developed based on producers' questions: 1)When can you find it? : Late February to late October/early November; 2) Where can you find it? : Throughout the entire farm, but primarily at edge habitats; 3) Who are the hosts? : Cattle, companion animals, wildlife, particularly medium mammals; 4) How can you manage it? : Provide producers USDA information for management strategies, closed herd, watch for other ticks (more abundant with other species), and combined management in pastures (bush-hog monthly) and cattle (acaracide application), which additionally helps manage wildlife infestations. The Tick Blitz will be starting in June. The next steps are regional, welfare, and economic studies to help improve integrative pest management and guideline development. The current need is to integrate tick surveillance data, particularly in areas not covered by the CDC, which focuses on public areas like parks.

Rich Meisel presented data on wild-caught house flies previously submitted by S-1076 members from various states. The study aimed to determine the frequencies of male and female-determining alleles. Flies underwent multiple generations of rearing in the lab to assess the allele frequency of sex-determining genes. A PCR assay was employed to identify the Y^M chromosome in male flies and tra^D and Mdmd in female flies. Prediction simulations of Y^M, III^M, and tra^D were conducted for each state's population to ascertain the frequencies required to produce the PCR results. The correlation between male and female frequencies increased proportionately. It was discovered that Y^M exhibits cold adaptation while III^M demonstrates warmth adaptation. Y^M frequency decreases with increasing daily temperature ranges, while III^M frequency rises with increasing daily temperature ranges. Moreover, the variance in temperatures also predicts the frequency. However, a challenge with the data lies in the indirect measurement of the frequency.

Brandon Lyons shared his work determining the predilection of larval and nymph life stages of Cattle Fever ticks, *Rhipicephalus* (*Boophilus*) *microplus*. The two goals of the study were to evaluate tick scratcher's ability to find immatures on live *Bos taurus* cattle and identify where the immatures congregate on the cattle. Two groups of cattle (3 cattle per group) were inoculated with ~5,000 larvae and remained on cattle ~10 days. A tick scratcher searched each animal thoroughly before culling animals, and then hides from euthanized cattle were later searched manually to generate a map of tick attachment sites. Hide maps were then reassembled into predilection maps and used to generate a heat map. The tick scratchers found no larvae for live animal counts and only recovered <2.5% of nymphs. Larval density was similar to adult for the host congregation, being greatest in thigh and rear leg, shoulder and front leg, chest, udder, thigh, and rear leg. Nymphs appear to have more migration, moving into the Dewlap in addition to the shoulder and front leg, thigh, and rear leg. It was commented that this methodology might be great for assessing the recovery of ticks from animal

hosts. Additionally, the conversation turned towards the dilemma that tick scratchers only search animals for 30 seconds-1 minute when performing inspections.

Ted Burgess presented work on a pilot project on the expression, activity, and biochemical inhibition of α- and β-glucosidases in different life stages of *Culex quinquefasciatus.* This study aims to identify alternative target sites for mosquitoes looking outside of the typical neurotoxic sites. **Ted** shared their interest in glucosidases as target for control, as they are typically expressed in gut tissues, which is ideal for entry and metabolism. The project involved performing enzyme activity assays of all life stages using model substrates with p-nitrophenol moiety, *In vivo* inhibition of α-glucosidases in adult mosquitoes and β-glucosidases in mosquito larvae, and relative expression of putative glucosidase genes. Enzyme activity differed by life stage, with β-glucosidase activity high in larval, but much lower in later stages, and α-glucosidase present throughout all life stages. Noted, but not shown, was that notable expression was potentially not a good indicator of activity for inhibition study results. Additionally, carbose caused hyperphagia of sugar meal, which could affect physiology.

Dave Boxler and **Gary Brewer** led the discussion for **Objective 2, Develop and implement pest management systems to protect animal health, welfare, and productivity.**

Aaron Tarone shared work examining whether eBeam might be an alternative to the sterile insect technique for *Cochliomyia macellaria* because of national concerns about using cobalt and cesium methods. Early testing of the eBeam at several different amounts indicated low energy eBeam seemed to be sufficient, but that initial observation has been rejected after further replication. Dose delivery is highly variable with the high-energy eBeam, but 140 KeV has lower variability and looks more promising than 120 KeV. Research has been underway testing for polyploidy/genetic damage in *C. macellaria*. They are also receiving *C. hominivorax* from Panama treated with known doses to compare the presence of polyploidy to eBeam irradiated *C. macellaria*. Results found that treated males have testes with higher ploidy than untreated testes. Additionally, when looking at the ovarian dose response of *C. macellaria* with high-energy eBeam, no developed ovaries were found in flies treated with >40 Gy. If any S-1076 members are interested in looking over a review article on the SIT program and possible alternatives, please let **Aaron** know.

Erika Machtinger shared work with **Karen Poh** on whether permethrin is an effective blacklegged tick repellent for horses. The group investigated what levels of permethrin on horses repel ticks and how much permethrin the horses can tolerate. Fluorescent paint-marked adult females (n=5) were added to the legs of horses treated with horses 0%, 1.5%, 5%, and 10% permethrin and water solutions and measured whether they were “repelled” or “not repelled” by crossing into different zone designations on the leg. The same concentrations were added to the necks of horses, and the skin was scored for redness and edema, followed by a skin biopsy. The solution was removed at a certain point if welfare concern for both experiments. The 5-10% permethrin was effective for 1.5-2 days, but it was hard on horses. All horses had to be withdrawn by day 8 for the 10% permethrin. For the 1.5% permethrin, <50% of ticks were repelled. This study has been published for review. A future project is working on a citizen science project looking at treated horse coverings to help reduce tick bites. Contact **Erika** if you are interested in collaborating.

Amy Murillo presented the major ectoparasites of poultry and the environments that they typically favor. Northern fowl mites are an issue in cage-free poultry, the chicken body louse an issue in pasture/outdoor access poultry continually, bed bugs are a big problem in broilers and are expanding into egg layers, and poultry red mites do not have many solutions, and needs clear documentation in poultry. It was emphasized that there are not currently a lot of control methods for these ectoparasites, and that treatment in conventional ways is complicated for large populations. Results were then shared on an *in vivo* mite control study with essential oils. While essential oils reduced mite levels, it

was pointed out that their application is not practical due to high dosages and having to spray individual birds. **Amy** then appealed to the group: 1) Where can we go for poultry ectoparasite prevention? 2) Is the material or the application material important?

Hannah Tiffin shared the current direction for the development of tools for monitoring and control of bed bug infestations in poultry. Unfortunately, issues for bed bugs are considered a stigma for these facilities and producers don't really want to share details that could help inform researchers, resulting in many unknowns. To help determine how it's getting on the farm, there are plans to conduct genetic analysis of bed bugs from multiple states in the northeast. Investigations are also planned to figure out whether bed bugs present similar health concerns to people through histamine production and effects. There is additionally a need to understand the extent of the problem and associated challenges, which may be possible through focus groups and site visits. Finally, tool development for monitoring and control is another avenue which needs to be pursued. Potential tool development tactics include natural insecticides, treated fabric, novel trap design, and repurposing red poultry mite tools. **Hannah** concluded with a call for help to address ectoparasite management in poultry.

After lunch, **Nancy Hinkle** opened the floor by asking the group to consider what should an extension agent recommend about managing bed bugs in poultry for open discussion. The group discussed the following points regarding the potential solutions and barriers facing bed bug management in poultry:

- One alternative solution is that heat treatments may be a possible management solution, but barn structure is fundamental in determining effective management strategies.
- Insights were shared on methods of application and efficacy of currently known products. Some products that may be used for bed bugs are not necessarily labeled for use against bed bugs.
- There was a general consensus that it is hard to jump to control recommendations when we don't have much monitoring and surveillance. There is a need to understand the resistance levels of bed bugs to recommend products. Folks with contacts who can provide samples would be beneficial for looking at population genetics and resistance levels.

Amanda Warner then presented her research determining the genetic parameters of horn fly abundance and tolerance in beef cattle. To do so, a combination of subjective and image-based counts of horn flies were collected on cattle, in addition to collecting biological factors (blood, skin biopsy, growth, and reproduction) for looking into various cattle phenotypes. **Amanda** also reported developing a model for the automated counting of flies from images. It was reported that the photograph analysis only had a 60% correlation to horn fly levels, and that the still images may not be the most accurate estimation of the actual fly burden on a host due to limitations for field of view using 2-D images. Horn fly levels decreased 22% in cattle with higher thrombin levels, an important phenotype to consider given that the heritability of thrombin is 0.38-0.39. As for reproduction, lack of horn fly control greatly affected conception rates and calving in cows, but not heifers. Future goals are to improve the horn fly count automation, perform sequencing, investigate various hair/skin phenotypes, and improve estimation for the onset of economic injury.

Jerry Zhu announced his work on alternative repellents against biting flies, ticks, and bed bugs. Two companies are working with him to look at the potential of coconut fatty acids. They've found that it works as well as or better than DEET. In particular, the solution spray has been observed to be effective for more than 5 days against stable fly populations, and horn fly populations collapsed within a few hours. Contact **Jerry** if you wish to collaborate on further testing these products.

Jerry also announced that **John Wang**, a faculty member at the University of Nebraska experienced with toxicology and molecular entomology, is looking for collaborators.

Ted Burgess and **Alden Estep** then led the discussion of **Objective 3, Develop and strengthen insecticide resistance surveillance of arthropod pests of veterinary concern and associated arthropod-transmitted pathogens.**

Jeff Scott announced a project in collaboration with **Ted** to understand the decreased penetration resistance mechanism in house flies against fluralaner. Using a 10,000-fold resistant strain of house flies started from flies sent in through S-1076 collaborators, the goal is to isolate the chromosome 3 resistance factor. Efforts to understand the penetration mechanism through cuticle analysis currently underway.

Alec Gerry assessed whether permethrin resistance in *Culex tarsalis* differed for two regions (Coachella vs Inland Valley) in southern California. Mosquitoes were collected from 5 locations and the F_0 population tested for resistance to permethrin with the standard CDC bottle bioassay. Mosquitoes captured in the Coachella region did have higher survivorship than Inland Valley, which is expected to be due to differences in regional permethrin usage as the Coachella region has history of usage for mosquito control near Salton Sea and agricultural purposes. The Bakersfield strain lab susceptible colony was additionally tested to determine the effects of mosquito sex and age on permethrin resistance. No significant difference was observed in survival of males and females, but there was a slight difference in survival for different ages to where younger mosquitoes survived longer than older ones (**Ted Burgess** commented the same trend has been observed for other mosquito species). This study led to an in-depth discussion on the implications involved with using the CDC bottle assay versus other methods practiced by entomologists for resistance surveillance. Major points included that the CDC method is most often used by public health agencies for resistance surveillance and is more feasible for those agencies; however, it may affect the accuracy of resistance surveillance efforts.

Amy Murillo reported **Caleb Hubbard**'s recent research investigating behavioral resistance of house flies to imidacloprid. In the first study, wildtype strain and behaviorally resistant strains were evaluated for behavioral resistance across generations after colonization in the lab without imidacloprid exposure. No significant difference in survival was observed across 30 generations of the behaviorally resistant strain, even in the absence of selective pressure. There are follow up questions on whether there is a fitness effect, however, it's suspected to be unlikely due to its stability. Their second study evaluated the inheritance and dominance of this behavioral resistance. Using the F_1 male backcross method, it was found that it's a polygenic trait inherited differently between male and female flies. A feeding preference assay for imidacloprid-specific response in the presence or absence of other neonicotinoids additionally found that there was no significant difference in the percent mortality of behaviorally resistant flies in the absence of other choices, but significantly lower percent mortality of flies when given other choices. Both studies have been published for review.

Pia Olafson presented her work with **Xinyue Huang** looking at whether there are mutations in glutamate-gated chloride (GluCl) genes that associate with ivermectin resistance for the Cattle Fever tick, *Rhipicephalus* (*Boophilus*) *microplus*. Currently, ivermectin resistance has not been detected in US, but the group hopes to develop tools to improve surveillance for ivermectin resistance. First, tick larvae were immersed in serially diluted ivermectin, then survivors were selected and fed on cattle. This was repeated for multiple generations to pressure susceptible strains to develop a resistant strain. In the meantime, a susceptible tick strain and an archived (frozen) 'ivermectin resistant' strain underwent plasmid cloning to select for, amplify, and sequence the GluCl channel gene coding region. At this stage, no mutations associated with the archived ivermectin-resistant phenotype have been found, but plans are to perform the same process with the lab colony currently being selected for resistance. They did find alternative splicing that can also be found in *A. gambiae*, which are able to express different isoforms that affect ivermectin sensitivity. The hope is to identify polymorphisms

associated with the phenotype potentially and in the future look at differential expression of susceptible and resistant larvae once resistance is better established.

Dana Nayduch gave an overview of using house flies for pathogen and AMR surveillance. Thus far, projects using 16S sequencing approaches by **Sara Neupane** and culture-based approaches by **Victoria Pickens** of whole flies have demonstrated the utility of house flies for xenosurveillance of microbial threats to human and animal health. 16S sequencing of whole flies from different environments and months provided by members of the multistate project reveal that microbial communities in house flies can give a "snapshot" of the environment and date of collection. Additionally, house flies are carrying important human and animal pathogens, regardless of location. Culture based methods have also revealed various species of bacteria possessing a wide range of AMR phenotypes. Future plans include using house flies to help monitor existing threats, discover cryptic threats and prevent outbreaks. **Dana** additionally announced that the subobjective of next CRIS will be mining the metagenome of flies collected from different states and hopes to take a integrated approach in using these projects to look at pesticide resistance genotypes of house flies at the multistate level as well.

Oshneil Baker reported his work investigating the effects of pyrethroid resistance genes on the negative temperature coefficient of pyrethroids in house flies. To investigate, a diagnostic dose of permethrin was formulated for each of four congenic strains of house flies differing in the 3rd chromosome for pyrethroid resistance. The four house fly strains were: aabys (wild type and genetic background of all other strains); alkdr (L1014F); jp super (M918T + L1014F); ob js (T9291 + L1014F). This was followed by a laboratory assay assessing responses of 10 female flies per strain at three different temperatures (19°C, 25°C, 31°C), performed in 25 replicates per temperature. The wildtype strain had a negative temperature coefficient, but it disappeared for the alkdr and ob js strains. For the jp super strain, the negative temperature coefficient reappeared. The key takeaway was that the temperature coefficient of permethrin may not only be dependent on the chemical nature but additionally on the resistance genotype of house flies.

Abby Orr presented her work on xenosurveillance using blow flies. A comparison of *Cochliomya macellaria* samples representing 3 library types, small RNA (n=39), ribosomal depletion (n=29), and mRNA (n=101) revealed that the recovered microbiome from the samples will be affected by the type of library preparation used. When looking at the bacterial taxa identified, it was found that only 11 taxa were shared amongst all library types. The ribosomal depletion yielded the greatest number of microbial taxa identified for the least number of library preps, which was stated to be best if looking for a wide net of what's present in the environment. Sixteen viruses were identified in the blow fly samples. Seven plant pathogens were found, suggesting that if blow flies encounter diseases and rotten plants before pollination, they may participate in the mechanical transmission of viruses. Five viruses identified are associated with bacteria hosts and one virus identified, *Choristoneura fumiferana granulovirus*, is known to be used for insect control. Three viruses were additionally gut-associated viruses shed in fecal matter from vertebrates. **Abby** soon plans to look through the proportion of fly samples for each library prep type that possesses the viruses identified.

After a 10-minute break, **Pia Olafson** and **Becky Trout Fryxell** led the discussion of **Objective 4, Develop precision innovations for economically beneficial management of arthropods of veterinary concern.**

Becky Trout Fryxell presented work with **Katy Smith,** developing and validating a S.M.A.R.T. surveillance platform for fly and tick detection on beef cattle. The goal is for the platform to provide a rapid, accurate and safer detection method that will ideally be used by producers too. Two rounds of training and testing the model for tick detection have been performed from images provided by producers and collaborators and compared to manual counts. The first test found that the model had a

20% mean tick detection from the 76 training images. After the second round, 203 training images resulted in 38.9% mean tick detection. Currently, the computer does a better job with lower densities of ticks on the animal, but people better detect ticks for animals with higher densities. **Katy** and **Becky** emphasized that they need more images to help further develop the model. Members were asked to please provide any pictures of ticks and flies, in any format and on any host or structure (except people). Form to sign up to contribute pictures Https://tiny.utk.edu/CattlePestImageSurvey

Alec Gerry shared findings on two studies looking at attractive toxic bait options for control of mosquitoes and flies. Preliminary lab experiments found that fermented guava juice was highly attractive to both flies and mosquitoes compared to other sugar attractants. First, the group investigated use of this sugar attractant for controlling mosquitoes where pesticides cannot easily be applied. Liquid sugar baits with 1% boric acid both with and without (control) the sugar attractant in storm drains of a residential area in CA. The result was that more mosquitoes were collected in the treated area than control. However, some untreated traps did have mosquitoes engorged on boric acid treatment, suggesting the need for something faster acting. In a second study, dry granular sugar bait (Quikstrike) was combined with the sugar attractant with the hope to increase fly mortality. To assess efficacy for catching flies in a pepper field, paired groups of control and treated buckets were arranged in each row, repeated over a series of days. Similarly, a circular arrangement of control and treated bait traps were placed at a dairy. For both field trials, the attractant resulted in a significantly higher number of flies in the trap than baited traps without the sugar attractant. However, the trap does not seem to be particularly efficient in control of flies overall, as many flies were observed to pass by the traps.

Alec Gerry and **Erika Machtinger** then led the discussion of **Objective 5, Develop and deliver science-based educational materials focused on the management of arthropods of veterinary concern.**

Alec began by reviewing each of the subobjectives and reminded the group of the emphasis on extension for this objective. He then asked that for any member who thinks they fit into a subobjective, please sign up. Anything ranging from providing extension material, working on the website, connecting with producers, etc. They are also looking for new ideas for activities that fit this objective.

Next, **Alec** provided an overview and status update for the extension website and VetPestX, a searchable pesticide database to look up info on pesticides registered for use in certain animals, pests and states. Historically there has been particular focus on livestock pests, but urban pesticides have begun to be added to the database as well. **Alec** has been working with pesticide companies, who have been providing lists for updates. All members were asked to please notify **Alec** of any products currently being used in research, or that are in development for usage in other systems, that is not present in the database to help contribute to and expand the database.

Erika then presented on the needs assessments for veterinary professionals for VectorED Network. The intention is to work with the veterinary community to educate them on family and pet protection against arthropod pests. The group is still working on needs assessments for what's most important to do regarding extension and education. Penn State Survey Research Center will work on this once they identify which groups are in need via focus groups, surveys, and interviews. The goals are to learn knowledge gaps and training needs, communication strategies and preferences, and collaboration and training the trainer opportunities, primarily related to ticks.

Erika and **Karen Poh** collaborated on a recent study examining knowledge and perception of ticks and tick-borne diseases of U.S. equine veterinarians, which has been accepted for publication.

Moving forward, the group is ideally looking to recruit veterinarians to participate. **Erika** will be sending information to S-1076 members to share information for recruitment. The estimated time investment for focus groups and interviews is about an hour. Working with veterinary schools has been challenging, but members are encouraged to discuss with their own contacts if desired.

S-1076 members were also asked to capture lectures given to veterinary communities in department courses, seminars and conferences.

The discussion then turned towards how the group may wish to accomplish the goals of **Objective** 5. It was suggested that it might be worthwhile to get together a couple of times a year to do a 1-hour review virtually over Zoom, maybe twice a year, to discuss likes/dislikes regarding objective goals and create a report. Objective leaders intend to move forward with a potential time in the spring and fall to discuss where we might be going as a group regarding objective goals.

It was additionally expressed that there is interest in educating veterinary technicians seeking information on arthropod pests of animals, but don't know where to get it from. This further led to a discussion for identifying or developing resources to recruit and educate veterinarians.

The meeting adjourned at 4:15 PM.

Day 2

At 8:32 am, **Erika Machtinger** welcomed everyone and provided an overview of the second day's agenda.

Brandon Smythe then gave a series of announcements for local arrangements during the rest of the meeting. A big thank you was expressed to the local arrangement chairs and graduate students who volunteered to help with the meeting.

Attendees were additionally reminded that **Brandon** will be the Chair for the 2025 meeting.

A call was made for new officer announcements. There was none to report.

Erika made two additional job announcements, which were added to the list provided in **Day 1.**

Erika then led the **business meeting**. Attendees were reminded that the plan for 2025 was to meet in Stillwater, OK (hosted by **Justin Talley**), to which all approved moving forward with these plans. **Justin** expressed intentions to provide attendees the option to tour the Oklahoma State University Tick Rearing Facility.

Justin additionally announced that his former role as Extension Specialist for Livestock Entomology at OSU will soon be filled by **Jonathan Kemeck**.

Afterwards, further discussion continued of potential options for future meetings of the group:

- **Becky Trout Fryxell** proposed alternating between hybrid and in-person meetings each year to help promote after-meeting conversations that help foster further collaboration. It was agreed that the 2025 meeting will be hybrid, and the decision for the 2026 meeting tabled until next year.
- The group was then reminded that some members wished to consider the time zone differences of membership, particularly for zoom attendees during the hybrid meetings. It was recommended that the selected location be further east for years of hybrid meetings at least. This decision was tabled for discussion until deciding arrangements next year for the 2026 meeting.

Erika then transitioned the meeting to the **selection of a new secretary and vice chair** by starting with the responsibilities and terms of each position. **Phillip Shults** was nominated by **Karen Poh** to serve as the next vice chair but, after careful consideration by **Phillip** and the group, opted to instead nominate himself for the role of secretary. The group unanimously approved **Phillip** serving as secretary. **Cassandra Olds** was then nominated to serve as vice chair, which was unanimously approved. Both will be assuming their position for the 2025 meeting.

Before beginning the next section of the meeting, **Nancy Hinkle** and **Pia Olafson** announced that the Livestock Insect Workers Conference will be June 23-26, 2024 in Coco Beach, FL. **Becky** also expressed gratitude to the group members who contributed letters for the LIWC awards granting graduate student travel to the meeting.

The group started the **planning session** with starting work on the multistate award application. **Erika** informed the group that a folder (2024 S1076 Award Application) had been made in the 2024 Meeting Google Drive shared with the group via email, which included resources for further award information and the working documents for the award application. Work had already begun since Cliff Lamb's recommendation last year to apply, though it was decided to wait a year to apply due to prioritizing the new project. **Erika** emphasized three areas which needed assistance from project members:

1) Funding
2) Impact statements and outputs
3) Synergistic activities

A shared document was created for each of these in the 2024 S1076 Award Application folder on Google Drive and shared with members. Time was set aside for meeting attendees to begin working. All members were asked to leave comments, citations, or other information in bullet point form. Additional documents added for reference included last year's final report (S1076 Final Report Outputs) and an example of a successful nomination (Example of Successful Nomination_20221208).

While members were working, **Karen** made the announcement that the Entomological Society of America Medical, Urban, and Veterinary Entomology (MUVE) Section's Communication Committee is looking for Veterinary Entomologists to highlight in the MUVE Newsletter. Members were invited to send recommendations to **Karen** or **Bethany McGregor**.

At this point, **Erika** opened the floor for members to discuss the future of the upcoming project, particularly next steps and recruitment. Starting with recruitment, it was brought up that with the change in the new project to include non-Dipteran arthropods affecting animal health, it would be beneficial to expand the group to include more members working on other arthropods. **Phillip Kaufman** emphasized that, considering research faculty of land grant universities are sometimes expected to participate in multistate projects, the group could extend more invitations to departments of land grant institutions in the hopes they would have higher interest to participate in the project. Another potential avenue mentioned for recruitment was the ESA MUVE Newsletter. However, **Ted Burgess** then asked current members to consider whether the group is content with how the meetings are currently run and/or if the structure would need to change if membership further expanded. A few points presented were:

- Potentially shift the meetings to talking more about things the group wants to do versus what has already been done. Previous meetings broke into groups for these sorts of discussions, and it was voiced that it could better provide opportunities to collaborate on tasks that members can't accomplish alone.
- It may not be conducive to have so many individual talks to help with opening up more time in the meeting. Instead, perhaps representatives from each institution could present a summary of their members' work.
- The new presentation format of the meeting talks to be both shorter and include an emphasis on how the group can help both concerns, as it both prompts collaboration and opens up time for more speakers and conversation.
- Having a larger meeting could result in needing more days to accommodate presentations and business meetings. This may make it more difficult for project members to attend meetings, particularly in person, as it will increase expense and time commitment.

After further discussion, there was a consensus from the group to keep the meeting somewhat smaller but move forward with targeted recruitment of underrepresented areas in the group, particularly parasitologists and veterinarians. Project members wishing to recruit more members were encouraged to invite them first to LIWC to learn more about the multistate project and meet current members.

This then transitioned into discussion around the group's needs and collaborations. It was agreed to compile a list of members' needs and collaboration ideas for planned projects in the next year in a shared document (2024 Needs) in the 2024 Meeting Google Drive. Members were encouraged to continue adding to the list which was to be distributed to members after the meeting via email. Items in the list could include need for samples, skill sets, advice, etc.

Before concluding the meeting, **Erika** gave a final reminder of the needs for the project's award application. All members were encouraged to add their input on the funding, impact

statements/outputs, and synergistic activities in each document of the 2024 S1076 Award Application folder, and asked to leave comments, citations, or other information in bullet point form. The deadline to do so is January 31st, and final submission of the application is due February 2nd. Additionally, members were reminded to list themselves in the NIMSS appendix E for the project if not already listed.

Meeting adjourned at 10:20 AM.

APPENDIX I: MEETING AGENDA

Annual Meeting of the Multistate Project S-1076:

Arthropod Management in Animal Agriculture Systems and

Impacts on Animal Health and Food Security

January 10-12, 2024
Zoom link Thursday: https://nmsu.zoom.us/j/84693556407
Zoom Link Friday: https://nmsu.zoom.us/j/84404482316

NOTE: The agenda is in Mountain Standard Time

Carpool spreadsheet click here

Attendance verification here

Courtyard by Marriott Las Cruces at NMSU

456 E University Ave, Las Cruces, NM 88005

575-5261722

Wednesday Session (arrival)

1600: Optional Tour of Veterinary Entomology Laboratory (1 of 3 options) (Smythe) Sign up here

Thursday Session (0830-1700)

0700 Breakfast: Provided by hotel

0830 Welcome (Machtinger)

0845 Update from Cliff Lamb (S-1076 Administrative Advisor) (Virtual)

0900 Local Arrangements (Smythe)

0915 S1076 Officer Reports, Job announcements, Job celebrations

0930 Update from Michelle Colby (USDA) (virtual)

1000 Objective Activities:

1. **Investigate the distribution, ecology and biology of arthropods of veterinary concern (Olds, Shults)**
    a. **Determine life history and ecology patterns of arthropod pests**
    b. **-Omics of arthropod pests**
    c. **Investigate arthropod-microbe interactions and their impact on food security**
    d. **Quantify arthropod physiological and behavioral responses to a changing environment**
2. **Develop and implement Pest Management Systems to Protect Animal Health, Welfare, and Productivity (Brewer, Boxler)**

a. **Developing new IPM tactics and tools such as competitive exclusion to reduce pest population development in larval habitats, selection for virulence in entomopathogens, improving fly trap efficacy, and integration into IPM systems.**
b. **Provide IPM solutions for production systems, commodities, and species management, including invasive species.**
c. **Determine baseline efficacy for novel pesticides and monitor pesticide resistance levels for key pests and currently used pesticides.**

3. **Develop and strengthen insecticide resistance surveillance of arthropod pests of veterinary concern and associated arthropod-transmitted pathogens**

1200: Tentative break for lunch

3. Develop and strengthen insecticide resistance surveillance of arthropod pests of veterinary concern and associated arthropod-transmitted pathogens (Burgess, Estep)

a. **Insecticide resistance detection and management**
b. **Xenosurveillance**
c. **Ecological epidemiology**

4. Develop precision innovations for economically beneficial management of arthropods of veterinary concern (Trout Fryxell, Olafson)

d. **a. New/developing approaches to managing pests**
e. **Vaccination technologies including anti-tick vaccines**
f. **Automation and precision in monitoring (Technology, automation, and remote sensing of arthropods)**
g. **Improved economic modeling (Identify successful models of producer behavior change and technology adoption emphasizing the critical decision drivers and thresholds)**
h. **E.T.s / EILs**
i. **Animal Response to pest pressure**
j. **Production expenditures and losses/costs**
k. **Modeling economic impacts of arthropod pests.**

5. Develop and deliver science-based educational materials focused on the management of arthropods of veterinary concern (Gerry, Loftin, Machtinger)

l. **Professional development for multi-state members and stakeholders.**
m. **Website workshop**
n. **Assessment Coordinator**
o. **Impact speakers**
p. **Connecting with veterinarian groups**
q. **Education of Stakeholders, Sells/Co-op, Extension, next generation of livestock entomologists**

- TBD- Optional Tour of Veterinary Entomology Laboratory (2 of 3 options) (Smythe) Sign up here

Friday Morning Session (0800-1300)

0700 Breakfast: Provided by hotel

0830 Welcome and plan for the day (Machtinger)

0845 Local Arrangements (Smythe)

0900 Business Meeting:

- Selection of 2024 meeting location
- Selection of new secretary
- Selection of new Vice Chair
- New Business

1030 Planning session

- How are we going to move this forward (what is the next step)
- Recruitment
- Award
    - Award application
    - Guidelines
    - Working documents
        - Outputs document
        - Funding document
        - Synergistic activities document

1200: Tentative break for lunch

1300 Closing: Smythe (Local Arrangements Chairs) Machtinger (Chair)

TBD - Optional Tour of Veterinary Entomology Laboratory (3 of 3 options) (Smythe) Sign up here

APPENDIX II -NIFA UPDATE

National Institute of Food and Agriculture Update

S1076 - Arthropod Management in Animal Agriculture Systems and Impacts on Animal Health and Food Security

Las Cruces, NM - January 11, 2024

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

A. NIFA has now ~350 employees and is fully staffed.

B. Dr. Manjit Misra was appointed NIFA Director effective May 8, 2023. Dr. Misra comes to NIFA from Iowa State University where he was Professor of Agricultural and Biosystems Engineering and served for more than 30 years as Director of the university's Seed Science Center.

C. Dr. Dionne Toombs has transitioned into her permanent role as Associate Director for Programs from her previous role as NIFA Acting Director in which she served since April 2022.

D. Dr. Frank Siewerdt, National Program Leader, departed NIFA on April 21 to become Chair of the Department of Poultry Science at North Carolina State University.

E. Dr. Debora Hamernik retired from NIFA effective August 30. Dr. Venu "Kal" Kalavacharla is now serving as acting Deputy Director of the Institute of Food Production and Sustainability.

II. NIFA Budget

For FY2024, NIFA is currently operating under a Continuing Resolution that funds the Federal Government through January 19. In FY2023, NIFA received just over $1.708 billion in discretionary appropriations. This was an increase of $48 million above the FY2022 enacted level and $115 million below the FY2023 President's Budget. Mandatory funding was $231 million, which was $26 million above the FY2022 enacted level. NIFA's budget information is available to the public at https://nifa.usda.gov/budget.

III. NIFA Events

A. For announcements of technical assistance webinars, application deadlines, informational webinars and other items of interest see: https://www.nifa.usda.gov/events

B. NIFA Listens: Stakeholder input opportunity in November 2022, report is available here: https://www.nifa.usda.gov/nifa-listens

IV. Competitive Programs

A. In FY2024, three AFRI Requests for Applications (RFAs) will again be released. See https://nifa.usda.gov/afri-request-applications:

1. The Foundational and Applied Science RFA (AFRI-FAS) is expected to be published on December 15, 2023. There will be multiple deadlines for applications depending on the program area. 2. The Sustainable Agricultural Systems RFA (AFRI-SAS) is expected to be published on February 1, 2024. Funding of $70 million will be allocated to the program, with 7 awards anticipated. 3. The Education and Workforce Development RFA (AFRI-EWD) is expected to be published February 1, 2024.

B. Other competitive programs with opportunities for animal science research, extension and/or education. See NIFA Request for Application Calendar: https://www.nifa.usda.gov/grants/upcoming-request applications-calendar

1. Equipment Grants Program

2. Small Business Innovation Research (SBIR); 8.3 Animal Production & Protection (includes diagnostics)

3. Laying Hen and Turkey Research Program (LHT)

4. AFRI Foundational and Applied Science program area priorities:

a. Critical Agriculture Research and Extension (CARE) – A1701

b. Rapid Response to Extreme Weather Events Across Food and Agricultural Systems – A1712 c. Data Science for Food and Agricultural Systems (DSFAS) – A1541

d. Small and Medium-Sized Farms – A1601

C. Interagency Funding Opportunities

2. 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 FY2024.

D. Program outcomes for AFRI Foundational Programs in **FY2022**. Outcomes or FY2023 are pending.

Animal Health and Production and Animal Products ($55.75 million total program funds)				
Program Area	**Program Contacts (for FY23-24)**	**Funding ($ million)[1]**	**Standard Awards[2]**	**Success Rate**
Animal Breeding, Genetics, and Genomics	Angelica van Goor & Tim Sullivan	$5.4	10	34%
Animal Reproduction	Mark Mirando & Kamilah Grant	$6.5	15	25%
Diseases of Agricultural Animals[3]	Tim Sullivan & Kathe Bjork	$13.0	31	23%
Animal Nutrition, Growth, and Lactation	Steve Smith & Mark Mirando	$9.3	20	26%
Welfare of Agricultural Animals	Kamilah Grant & Mark Mirando	$4.9	10	50%
Inter-Disciplinary Engagement in Animal Systems (IDEAS)[4]	Angelica van Goor	$4.0	9	35%
Agricultural Biosecurity[3,5]	Michelle Colby & Amer Fayad	$2.8	6	30%

[1] Funding allocation from FY23 appropriation only. Programs also used the remaining 50% of FY22 appropriation to fund proposals submitted in FY22 as the 2nd part of the approach to use 3 years of appropriations to fund 2 years of submission and get AFRI back on track to be almost fully expended within the same year that funds are appropriated.

[2] Budgets not exceeding $650,000 (including indirect costs) for up to 5 years; excludes seed, sabbatical, equipment & conference awards. [3] Excludes proposals and awards for COVID-19 related work supported through the USDA Animal and Plant Health Inspection Service from ARPA funds.

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

[5] Funding excludes $2.4 million contribution from Plant Health and Production and Plant Products.

IV. Contact Information for the Division of Animal Systems

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