**Minutes of the annual Multistate Project S-1076 meeting:**

**Fly Management in Animal Agriculture Systems & Impacts on Animal Health and Food Safety**

# Las Cruces, NM: January 16-17, 2019

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| **Present Affiliation** |
| Doug Ross | Control Solutions Inc. |
| Robert Gore | 4ry |
| Alec Gerry | University of California Riverside |
| Erika Machtinger | Pennsylvania State University |
| Chris Holderman | Central Life Sciences |
| Phil Kaufman | University of Florida |
| Nancy Hinkle | University of Georgia |
| Sonja Swiger | Texas AgriLife Extension Service |
| Jeff Scott | Cornell University |
| Xing Ping Hu | Auburn University |
| Mike Fletcher | Y-Tex |
| Barbara Hull | Y-Tex |
| Justin Talley | Oklahoma State University |
| Gary Brewer | University of Nebraska |
| Dave Boxler | University of Nebraska |
| Kelly Loftin | University of Arkansas |
| Brandon Smythe | New Mexico State University |
| Dave White | University of Tennessee |
| Becky Trout Fryxell | University of Tennessee |
| **Present via Remote**  |
| Kateryn Rochon | University of Manitoba |
| Wes Watson | North Carolina State University |
| Richard Meisel | University of Houston |
| **Absent from Meeting** |
| Edward Vargo | Texas AgriLife |
| Aaron Tarone | Texas AgriLife Research |
| Emma Weeks | University of Florida |
| John Stoffolano | University of Massachusetts |
| Lee Cohnstaedt | USDA-ARS ABADRU |
| Dana Nayduch | USDA-ARS ABADRU |
| Dave Taylor | USDA-ARS AMR |
| Chris Geden | USDA-ARS CMAVE |
| Kenneth Linthicum | USDA-ARS CMAVE |
| Jerry Hogsette | USDA-ARS CMAVE |
| Pia Olafson | USDA-ARS Kerrville |
| Beto Perez de Leon | USDA-ARS Kerrville |
| TC Crippen | USDA-ARS SPARC |
| Herbert Bolton | USDA NIFA |
| Bill Donahue | Sierra Research Laboratories, Inc.  |

**Opening session:**

Project chair **Becky Trout Fryxell** welcomed the meeting and congratulated the group with a successful transition to S1076. Becky reminded the group that the annual report is due 60 days after the meeting and that the final report is due in 12 months. Local arrangements coordinator **Brandon Smythe** provided information about the facility, wireless signal access, and registration. This was followed by a round of self-introductions.

Brandon Smythe then acknowledged the following companies for their support with the meeting: YTEX, Control Solutions, WellMark, 4RYS, New Mexico State University Center for Animal Health, and Sierra Life Sciences. Those in attendance agreed and thanked the companies for their support.

**Dave White,** the administrative advisor to S1076, introduced himself to the group (Veterinary microbiologist that began with North Dakota State University and then went to the FDA before starting at the University of Tennessee) and reminded us that the annual report is due 60 days after the meeting. Dave also discussed the situation in Washington and noted the federal shutdown will slow proposal opportunities and award announcements. [Note, at the time of the meeting the US federal government was shutdown.] Dave then shared the excellent news that the Farm Bill was passed. He reminded us about the Foundation for food and agriculture research (FFAR) and recommended the integration of private/public partnerships. He also mentioned the USDA has put $100,000,000 towards Sustainable Agricultural Systems and that for the next few years 10 grants worth $10,000,000 will be funded. Dave also reminded us about the opportunity to pursue workforce development grants and to work with *NIFA Listens.*

**Industry Perspective:**

Robert Gore shared his company’s spraying technology that electrifies a particle before it leaves the nozzle. He is evaluating it with different formulations and adaptations. Company website is [www.4rysprays.com](http://www.4rysprays.com).

Chris Holderman shared his company’s latest paper on house fly resistance and how to manage resistance. Company website is [www.CentralLifeSciences.com](http://www.CentralLifeSciences.com)

**Objective 1**. **New technologies for management of biting and nuisance flies in organic and conventional systems [Notes taken by Gary Brewer]**

**1a. Novel push-pull strategies**

 **Wes Watson** updated us on horn fly colonization of cattle following treatment with geraniol repellent (initial report last year and at ESA). Treatment with geraniol will flush horn flies off the treated cow. The flushed files will recolonize parts of the animal not treated with the repellent. A small portion of the flies (2.3 and 8%) moved upwind to colonize cattle in a pasture 0.28 km distant. Wind speed influenced percent of flies doing long-range colonization. Not known if a portion of flies distributed in other directions. Wes also evaluated horn fly dispersal (distance) using flight mills. Results showed that flight mills can potentially be used to test distance horn flies can fly; however, techniques to reduce fly-to-fly variation in distance flown are needed. *Comments* from the group included; 1) will fly behavior in other flight mill designs give the same results, 2) how can we standardize procedures, and 3) why not use wind tunnels instead of a flight mill.

*The group identified a research NEED to improve methodologies and standardize methods for dispersal, as well as developing radio transmitters for small creatures (horn flies) for field dispersal and using laboratory-controlled wind tunnel to control wind speed.*

 **Brandon Smythe** is evaluating repellents in Push-Pull system and noted that it is hard to frequently reapply repellents on distributed cattle. Intermediate lab-field trials done. Paired untreated, treated, mixed treated-untreated, and mineral oil carrier only treatments. Objective was to test if flies can be repelled long enough for fly starvation to occur. Observed that the mineral oil carrier is affecting results and needs to be accounted for. Flies “missing” after treatment confounded the results.

*The group identified a research NEED to determine a common definition for fly repellency and methods for measuring or assessing it.*

**1b. Evaluation of improved monitoring systems**

 **Becky Trout Fryxell** is working with UNL (Psota) to develop an automated neural-network to improve computer processing of digital images of horn flies on cattle. This is an unfunded project and they are looking for opportunities to get this project funded and complete. There is some difficulty is in identifying flies from a flat image of an animal as the animal has natural curves, shading, and differences in hair coat color increase the difficulty in identifying flies from a 2-dimensonal image. Network also has trouble separating flies closely spaced, but sometimes correctly found flies missed by human observer. Ultimate goal is to use the algorithm in a dynamic web page where producers can upload images and get a count (an assessment). Network has capacity to identify by species. Becky is requesting help with images (good quality) from other regions. Will send a request for help.

 **Erika Machtinger** is evaluating fly management options in poultry houses that preserves natural enemy populations. Sanitation is about the only option, but it is difficult to identify breeding hotspots. She is using FLIR technology to locate heat signatures of developing maggots and finds the technology promising. FLIR is an attachment to the cell phone and *may* be able to identify larval density differences, location, and depth. This is based on temperature ranges, but still needs validation.

 **Justin Talley** is (1) evaluating the economic impact of horn flies and (2) integrating these into extension demonstration trials. With an AgEconomist they assessed the profitability of insecticides for horn fly control in a stocker cattle system. Treatments were Corathon ear tag, Long Range, and a control. Long range gave a higher but not significantly different daily weight gain than the Corathon treatment. Also considered were treatment and application costs. While Long Range performed better because it has a higher product cost the ear tag was more profitable. Justin then addresses questions from the public such as, *When should I tag cattle for horn fly control?* Ear tags were placed on cattle in April, May, or June. Found that by the end of the fly season in Oklahoma, numbers of horn flies per animal were all about the same regardless of when the tags were attached. Because of changes in cattle genetics and production practices, thinks the 200 EIL for horn flies is too low for Oklahoma (and probably elsewhere).

**1c. Novel toxicants, biopesticides, & delivery systems**

 **Erika Machtinger** is working with *Beauveria* in poultry houses to manage flies. Objective was to find promising isolates from poultry houses and breed for improved efficacy and to develop auto-dissemination technology. Five isolates were found, and one was very effective, giving 100% mortality in 5 days. Next questions include compatibility with natural enemies, autodissemination devices, etc.

 **Phil Kauffman** is also identifying and breeding *Beauveria* strains for improved efficacy.

 **Dave Boxler** is evaluating different products for horn fly management. Warrior Y-Tek ear tag was effective through week 11-12. With Long Range, horn fly numbers exceeded 200 per animal by week 6 and kept increasing thereafter. The horn fly control reported in some locations has not been seen in Nebraska. C8910, originally developed as a repellent, is also a toxicant for flies directly exposed to a spray of C8910. Flies are not killed by exposure to dry C8910.

 **Alec Gerry** tested Vesteron Spider Venom as a fog application to control house flies and it was not effective. He will publish in AMT (Arthropod Management Tests). Two concentrations were evaluated with surfactant against permethrin and control; as mentioned house flies were not controlled with the spider venom, but were with the permethrin treatment. This research is important as more virulent (previously exotic) new castle disease is occurring in California and elsewhere; both commercial and backyard poultries are testing positive.

 *Group Suggestion: others consider submitting results to Arthropod Management Tests or J of IPM to preserve in the public domain as it is valuable information.*

 **Sonja Swiger** tested a BASF bait product for control of flies in homes and structures for horn fly and stable fly control (Y-Tek PT Alpine Pressurized Fly Bait). Application of the bait to non-porous surfaces was efficacious in tube trials, but needs to be evaluated in field trials.

 *Research Need: how to record death (mortality) in field trials*

**1d. Non-pesticide management options (mechanical)**

 **Dave Boxler** evaluated Knight Stick Traps and found them very effective, but probably too expensive for Central Nebraska producers as it will take many traps to control fly populations. He noted that a roll will hold ~1000 stable flies and will work in areas where cattle are not present. He attempted to make traps using locally made wraps coated with tangle foot, and these were not as effective as the traps with Knight Stick wraps. Why the original traps are more effective is unknown. Traps were placed near water tanks, mineral feed, loafing area, etc. Perhaps traps may be used with a push-pull system.

*Comment. Knight Stick Traps were also effective in Texas.*

 **Phil Kaufman** is evaluating various trap designs in Florida with counts taken every evening for 5-6 days. Some days traps captured lots of stable flies and few flies were on cattle, other days very little flies were in the traps. This daily variation in fly behavior leads Phil to the conclusion that on any given day fly populations will vary because days vary; thus, days need to be considered similarly as environments. Potential day-variables include where cattle are located relative to traps, wind direction, temperature, sunny/cloudy, etc.

 **Becky Trout Fryxell** with **Pia Olafson** is assessing horn fly resistance and determining if it is heritable. Results are showing 20-80% heritability. A survey of producers in Tennessee and Texas showed they would pay for horn fly resistance, if the trait would improve profitability.

 **Xing Hu** tested several trap designs for efficacy in capturing horse flies in Alabama residential areas. Traps worked, but clients wanted cheaper alternatives. Hu then used black helium balloons, sprayed with 3M spray adhesive, and found that these “sticky-helium balloons” were effective for 5 to 7 days in capturing flies.

**Objective 2: Insecticide resistance detection and management [Notes taken by Alec Gerry]**

**2a. Assessment of insecticide resistance (TX, NY, USDA)**

**Jeff Scott** is conducting studies to evaluate fitness costs associated with insecticide resistance alleles within house flies.  Field resistance is very high in some locations (e.g. KS17 fly population).  Future research will identify mechanisms for this resistance and identify mutations responsible for resistance.

*Research need to develop resistance management information in a form that producers will use.*

**Phil Kaufman** has established a new stable fly colony (Costa Rica strain) and found it was resistant to permethrin.  In fall 2018, he attended a meeting on stable fly management in Costa Rica and will attend a future meeting in Brazil during 2019 (Oct 21-25).  Phil mentioned that Pia Olafson manages a list-serve for stable fly researchers. Contact Pia Olafson if you want to be added to the list serve.

**2b. Leveraging the *Stomoxys* and *Musca* genomes for novel control measures (NY, USDA)**

No new comments.

**Objective 3. Investigation of the microbial ecology, epithelial immunity, and vector competence of biting and nuisance flies [Notes by Erika Machtinger]**

**3a. Identification of the key bacterial strains and their metabolites playing a major role in oviposition and larval development of stable flies (TX, KS, USDA)**

**Dana Nayduch** was unable to attend due to government shutdown so Trout Fryxell provided a research update for Nayduch. Nayduch has collected pilot data from three (3) sites to look at the gut microbiome of house flies. Flies were collected from mixed environments, agricultural environments, and urban environments. Gut microbiomes were distinctly different in pilot data among sites, but not among flies from each site. In 2019, flies will be evaluated from sites in NE, KS, OK, and TX with site and environmental factors correlated with microbiome and pathogens. The experiment will include different climate zones across the country in 2020-2022 (Zone 2- Florida, Texas, Zone 3- Oklahoma, North Carolina, Zone 4-Kansas, Tennessee, Zone 5 – Nebraska, Pennsylvania).

**3b. Investigation of the innate immune response of filth flies (KS, USDA)**

No new comments.

**3c. Consequences of fly-bacteria interactions: selection effects and evolutionary outcomes (USDA, TX)**

**Richard Meisel** was unable to attend so Trout Fryxell provided a research update for Meisel (*Differential Expression of Ribosomal Proteins following infection in flies*)*.* Gut integrity is important for survival after a septic injury. House flies downregulate ribosomal protein genes and other genes involved in protein synthesis after being fed *Pseudomonas aeuginosa.* Expression of these ribosomal protein genes depends on TOR signaling (target of rapamycin/TOR controls ribosomal protein synthesis), and TOR signaling affects immune response. JAK/STAT (Janus kinase/signal transducers and activators of transcription) signaling pathway could connect septic injury to gut response to bacteria.

**3d. Animal and human pathogen acquisition, dispersal, and deposition by muscid flies (AU, NC, MA, KS)**

No new comments, but the following three papers were mentioned:

**Barba, M, A. J. Stewart, T. Passler, A. A. Wooldridge, W. van Santen, M. F. Chamorro, R. C. Cattley, T. Hathcock, J. A. Hogsette, and X. P. Hu. 2015.** Experimental transmission of *Corynebacterium pseudotuberculosis* biovar *equi* in horses by house flies. Journal of Veterinary Internal Medicine [**https://doi-org.ezaccess.libraries.psu.edu/10.1111/jvim.12545**](https://doi-org.ezaccess.libraries.psu.edu/10.1111/jvim.12545)

**Barba, M, A. J. Stewart, T. Passler, T. Hathcock, A. A. Wooldridge, W. van Santen, M. F. Chamorro, R. C. Cattley, J. A. Hogsette, and X. P. Hu. 2015.** Experimental inoculation of house flies *Musca domestica* with *Corynebacterium pseudotuberculosis* biovar *equi*. Bulletin of Insectology 1:39-44.

**Xu, Y.M., S. Tao, N. Hinkle, M. Harrison, and J. R. Chen. 2018.** *Salmonella*, including antibiotic-resistant *Salmonella*, from flies captured from cattle farms in Georgia, USA. Science of the Total Environment. 616-617: 906-96. https://doi.org/10.1016/j.scitotenv.2017.10.324

**Objective 4. Characterize population biology of biting and nuisance flies [Notes taken by Justin Talley]**

**4a. Characterize effects of climate and landscape features on dispersal (KS, TX, USDA-NE)**

 **Justin Talley** is investigating the role of Eastern red cedar and Tabanidae from Oklahoma. He found that an increase abundance is associated with open-canopy cedar habitats.

**4b. Phenology of biting and nuisance flies (AU, FL, KS, TN, USDA-NE)**

 **Trout Fryxell** with **Brad Mullens** is working on two *Tabanus* projects. (1) The first is characterizing *Tabanus sulcifrons* with different morphological patterns, seasonal patterns, and two morphotypes. Genetic differences from 101 different specimens were identified with morphology, seasonality, and genetics. More on this will presented at LIWC. (2) The second is with her student Travis Davis, and they are characterizing population biology of *Tabanus* species using ecological niche modeling and DNA barcoding. Trapping locations have H-traps, Nzi traps, and self-designed traps at sites throughout the southeastern US, some were collected weekly. They also looked into different museum collections (TN, NY, AL, and FL) and identified 616 specimen records; most of these provided county identifications. Trapping resulted in *Tabanus* specimens representing 42 different species; DNA will be amplified from a subset of these collections for DNA barcoding with the COI gene. They also looked at the 5 most pervasive *Tabanus* species and built an ecological niche model using different predictive parameters.

**4c. Genetic structure of biting and nuisance fly populations (TN, TX, USDA-NE)**

 **Trout Fryxell** with **Olafson** and **Taylor** are characterizing the genetic structure and conducing genome wide association studies (GWAS) of *Stomoxys calcitrans.* The three experiments include fly age (**Friesen**), kdr-associations (**Olafson**), and population genetics from different states and countries (**Taylor**) conducted at UT-Knoxville. This project will be used in a recently funded bioinformatics, genetics and genomics project targeting female scientists.

**Objective 5. Extension and community engagement** **[Notes taken by Alec Gerry]**

**5a. Improve project website to maximize extension and community engagement**

**Alec Gerry** presented on the S1060/1076 project website. The website has been moved from the UC-R site and is now a Wix-associated site (<http://veterinaryentomology.org>). Gerry and Trout Fryxell are current editors. The goal for the next year is to delegate site responsibilities to additional editors for the website. We discussed changes to the website, announced that some level of advertising is available (but not to sell products). We discussed the home page and inclusion of LIWC page (with sub-pages and other national sites). Gerry described the various drop-down menus across the site. He is looking for additional blog posters for the “news” drop-down menu.

New issues were discussed.

(1) VetPestX database, it is difficult to have all states reviewed each year so updating the database is challenging. HOW the database remains updated will continue to be a challenge. Those interested in working with the VetPestX database should contact Alec. The database will be put into googledocs. The group decided that the database will maintain a state level product listing for states that are willing to do the annual review.

(2) A training section is being developed into two sections: Pest Management and Insect Identification. New and updated content is needed for the pest management tab and common presentation of materials with links to other pages. Gerry is also developing an online (Wix site) for an insect key to be used in future Medical and Veterinary entomology laboratory courses; the idea is to build a non-comprehensive key.

(3) Using the wix site to monitor our reach. **Justin Talley** offered to work with Alec and find a social media person at OSU to help with monitoring visits and other google analytics.

(4) **Justin Talley** and **Becky Trout Fryxell** mentioned the need for systems-based learning material. The material could focus on the commodity, not the pest and the pest material can be redundant. For example, flies affecting dairy, cow/calf, etc.

**5b. Demonstrate research value to stakeholders and funding decision-makers**

**Alec Gerry** spoke about developing objective priorities from our project (initially the 3-year priorities) a google doc where we can address our outcomes. We can create sub-groups to work on needs assessment, then we can move to addressing these needs. We could start with Diptera as is the focus of this group, and then add other organisms (e.g., ticks, beetles, etc.). It was noted there is no multi-state project associated with other ectoparasites (e.g., ticks) of animals.

**Becky Trout Fryxell** mentioned the need to develop more “how to” information pieces for our stakeholders to post onto the website and address our needs. Such videos could include “how to count stable flies”, “how to apply a pour-on insecticide”. **Kateryn Rochon** agreed and described her 2-min video on “how to remove a tick,” which has >2.1 million views (<https://www.youtube.com/watch?v=27McsguL2Og>).

There was discussion of a short course (development of an Extension team) to come up with a plan and ideas for useful multi-state or integrated projects. **Justin Talley** agreed and said that a systems approach was the best method (not individual flies) which would include traditional and organic; intensive, extensive, and hybrid; and different commodities (e.g., poultry, beef cattle, dairy, equine, swine, and/or small ruminants). Many liked this idea. There was discussion of getting some of our talks/presentations into a continuing education unit (CEU), but this would need to be in conjunction with state veterinarians.

**5c. Seek funding to support these extension/outreach efforts by developing proposals that will be submitted to various granting agencies including our Regional IPM Centers.**

In order to be successful at the above, the group recognized that it will take a lot of effort (time and dollars). There was discussion of working together to get funding. Two large ideas were generated, each building on one another. **Dave White** said he could work with other deans to put small pots of money together to fund a larger preliminary project. If five schools put together $10,000; then there would be $50,000 for preliminary data towards a project. The group would then work together to draft (in year 1) a Sustainable Agriculture project which would be submitted in year 2. Sustainable grants are large, $100million and are integrated projects so it would involve Research, Teaching, and Extension as well as multiple disciplines.

**Alec Gerry** will send out an announcement/google document to group to self-assign to a sub-group and then have groups report in 2020 meeting (5 min or so).

**Erika Machtinger** suggested using PSU money to host a tick project to develop needs and products. Is Extension based and looking to find engaging concepts. Deadline is Feb. 18, 2019. *[After the meeting note, the grant was submitted and it focused on poultry production and development of the research needs piece.]*

**BUSINESS MEETING**

**Old Business**

* **Becky Trout Fryxell** and the group thanked **Brandon Smythe** and Deb for hosting the meeting.

**Site selection for 2020.** While absent, **Jerry Hogsette** offered to host the 2020 meeting in Orlando. There was discussion for **Wes Watson** to host in North Carolina, but he was absent. **Becky Trout Fryxell** and **Dave White** suggested Tennessee for 2021. There is a person who can help us draft outcomes and impacts, but the meeting would have to occur in Nashville. This was tabled until next year, and Orlando was selected.

Dates for meeting: 16 & 17 January 2020

No other old business.

**New Business**

* **Becky Trout Fryxell** discussed the new listserve which is available in an excel googledoc. Those interested in being added to it or removed can do so on their own. Please use this list-serve to communicate with the group. Those who were previously on the list-serve have asked to be removed.
* **Becky Trout Fryxell** thanked everyone for attending the meeting but mentioned to everyone that it was clear that the meeting was not the same without our federally employed colleagues. The following statement was drafted and unanimously decided to put into these notes:

*The absence of key federal scientists at our yearly meeting was felt throughout the meeting, particularly while we were reviewing yearly projects and in discussions of future priorities and projects. Federal research is integral to the project.*