Bovine Fly Species of Economic and Veterinary Importance

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Kellogg Honors College Capstone Project

ABSTRACT

The four main fly species of economic importance for cattle producers are: horn fly, *Haematobia irritans* (L.) (Diptera: Muscidae), face fly, *Musca autumnalis* De Geer (Diptera: Muscidae), stable fly, *Stomoxys calcitrans* (L.) (Diptera: Muscidae), and blow flies (Diptera: Calliphoridae). Not only do these insects create an environment of annoyance, they also carry diseases that affect cattle health and reduce overall productivity. In this Kellogg Honors College Capstone Research Project, I focused on bovine fly pest life cycles, abundance, and seasonality in beef cattle barn and pasture environments. Bait traps were deployed at Cal Poly Pomona, Pomona, CA. Traps were checked and replaced weekly between June and October 2016. Trap captures were identified to species for *S. calcitrans*, and *M. autumnalis* and to family for Calliphoridae, enumerated for weekly abundance, and analyzed for seasonal population dynamics (1) within and between the bovine fly pests, and (2) within and between barn and pasture study sites. The goal of this project was to create an Integrated Pest Management (IPM) report on how these fly pests impact cattle, fly control treatments available to producers, with overall thoughts on how veterinarians can aid in cattle herd health by understanding bovine pest fly abundance and seasonality.

Figure 1. Horn fly (left); face fly (right). Photo: B. Mullens, UC, Riverside.

Figure 2. Stable fly after a blood meal. Photo: B. Mullens, UC, Riverside

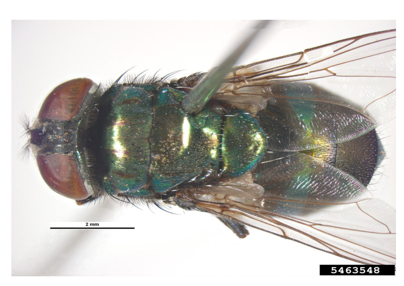

Figure 3. Blow fly. Bugwood.org

INTRODUCTION

Flies can transmit bacteria and viruses to their cattle hosts causing diseases that put the whole herd at risk for decreased feed efficiency, milk production, and poor overall health. For example, *Stephanofilaria stilesi*, a filarial parasite that causes dermatitis (Fig. 4) along the ventral midline (underside) of cattle, as well as udder and scrotum (Hibler, 1966). Lesions will form, mostly covered in blood or serous exudate. The intermediate host for *S. stilesi* is the female horn fly. They feed on the lesions, ingest microfilariae, and develop third-stage infective larvae in about 3 weeks. The infective filarial parasite larvae are introduced into the skin as the horn fly feeds. Not only is this painful for the cattle, it prevents them from participating in normal herd behaviors. Parasitized areas can lead to a hyperkeratosis (abnormal thickening of the skin); making cattle hides unsuitable for leather. There is no approved treatment for *S. stilesi* on the market at this time.

One of the most common infections seen in cattle, especially beef cattle is Infectious Bovine Keratoconjunctivtis. It is pinkeye in cattle. The bacteria responsible is *Moraxella bovis* (Kasimanickam and Parish, 2011). The pink eye pathogen is spread throughout the herd primarily by the stable fly and, to a lesser degree, the face fly. The flies carry *M. bovis* from animal to animal as they feed on nasal and ocular (eye) discharges (Kasimanickam and Parish, 2011). This highly contagious and infectious disease will cause discharge (Fig. 5) and corneal opacities (cloudiness) within the first two days. In the following days, blood vessels grow across the cornea which makes the eye look pink (Kasimanickam and Parish, 2011). Ulceration can occur along with scarring of the eye depending on the virulence of the bacterial strain. Financial loss is due to decreased weight gain, increased treatment costs, and low market prices due to eye disfigurement and blindness (Kasimanickam and Parish, 2011).

Understanding bovine fly pests as factors for the decreased efficiency of cattle is an important aspect of their control in the industry.

Figure 4. Cutaneous stephanofilariasis. Photo: S. M. Abutarbush, Jordan University of Science and Technology

Figure 5. Beef cow showing the characteristic signs of Pinkeye. Photo: Veterinary Agri-Health Services.net

MATERIALS & METHODS

To collect various species of bovine flies, commercial fly traps (Rescue! Disposable Fly Trap, Sterling International, Inc.) baited with permethrin, sucrose, putrescent whole egg solids, yeast, and indole and water were deployed. Traps were placed in two habitat types defined as follows: (1) Main Barn (Beef Unit, Cal Poly Pomona, Bldg. 32); and (2) three pastures behind the Cal Poly Pomona Citrus Building (Bldg. 28). A single trap was placed in the Main Barn breezeway and another single trap was placed in the first dry lot off the Main Barn entrance. Behind the Citrus Building, a single trap was placed in each of the three pasture fields. Traps were placed in their respective locations every Wednesday morning and replaced the following Wednesday for a total of 10 weeks, August 17th, to October 26th, 2016. Each week, the traps were taken down and stored in a freezer in the Plant Science Laboratory until processing occurred.

The frozen traps were thawed overnight. Once thawed, each trap was cut open and its contents were strained through a small vegetable strainer lined with cheese cloth to drain liquid bait material and separate flies. Flies were rinsed and the cleaned sample returned to 400 mL jar of 70% isopropyl alcohol. The flies were kept in these jars until identification and counting occurred.

For ease of identification and counting, a white, square enamel pan with grid lines was used to filter the flies after which aquarium sealant about 2 mm thick and wide was laid down. This created a shallow "pooling" effect for each of the squares in the pan (B. Mullens 2016, pers. comm., 28 Nov). Each jar's contents were emptied into the enamel pan. Water was added until flies were distributed randomly among all 16 grid squares in the pan at a single layer on surface of liquid in the pan. A subset of the thin layer of the flies was randomly sampled. Stable, face, and blow flies were counted in the enamel pan grid under a 10X light. Horn flies were omitted from identification and counting due to difficulty and uncertainty of identification to species.

RESULTS:

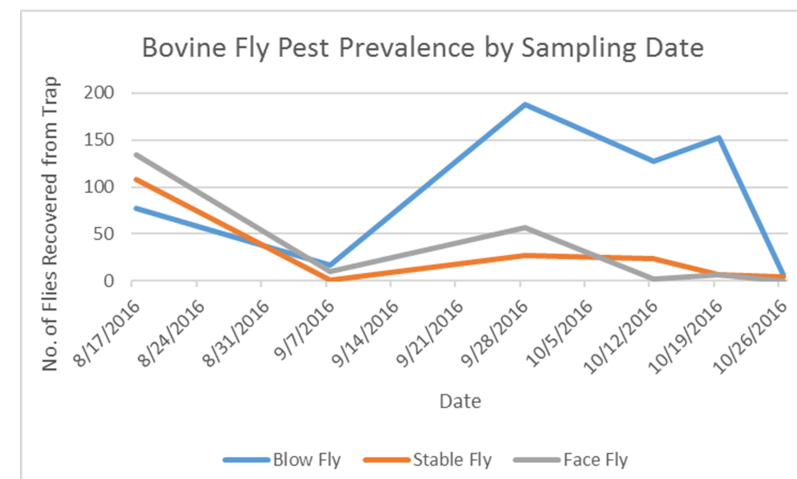

Figure 6. Bovine fly pest prevalence by trap capture sampling date, Beef Unit barn and pasture study sites combined. Cal Poly Pomona, 2016.

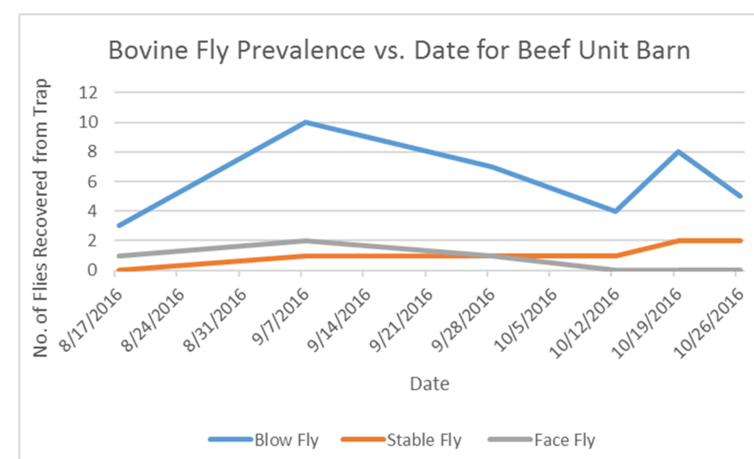

Figure 7. Bovine fly pest prevalence by trap capture sampling data, Beef Unit Barn. Cal Poly Pomona, 2016.

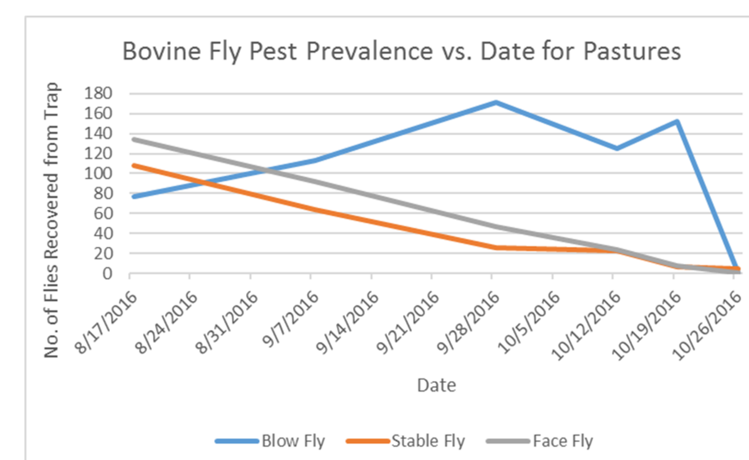

Figure 8. Bovine fly pest prevalence by trap capture sampling data, Pastures. Cal Poly Pomona, 2016.

DISCUSSION

Insects are temperature and photoperiod dependent in their life cycle (egg to adult) progression. Most fly species are multivoltine, with more than two generations a year. The flies in this study were no different. Adult female horn flies can lay 400 eggs in her lifetime, with 2-3 generations per year commonplace (Johnson D.R., et al. 2001). The face fly life cycle from egg to adult is 2 to 3 weeks long, with about 3 generations occurring per year (Boxler 2014). Adult female stable flies have the capacity to lay 600 eggs in her lifetime, with 3-4 generations per year (Talley, J. 2008). The blow fly life-cycle takes about 3-5 weeks and there are about 3 or 4 generations of blowfly per year (Strikewise, 2007).

Although originally intended as a variable in this project, horn flies were omitted from trap capture analyses for two reasons. First, they are difficult to accurately identify due to their size 3-5mm; half the size of a house fly (Ricciuti, 2017). Second, the Rescue! Disposable Fly Traps used in this study made it hard to distinguish horn flies after the filtering process. In practice, pest managers and cattle producers tally the number of horn flies on cattle visually and enumerate using a hand-held clicker to count as many flies on the cattle as they can. Economic control efforts begin only after a numerical threshold has been exceeded: 100 horn flies on a dairy cow or 200 horn flies on a beef animal (Ricciuti, 2017).

Face fly adults undergo reproductive diapause in barns and similar buildings from late October until late March/early April when they become active again (Fowler et al., 2015). Despite warm winter temperatures of Southern California, face flies still diapause during this time (Fowler et al., 2015). As shown in Figures 6-8, low numbers of face flies, especially in the latter months of trapping appear to confirm seasonality of their diapause cycle.

Stable fly adults typically appear in mid-late spring, peak in early summer, and begin to decrease in numbers in late-September when daytime temperatures are highest (Gerry et. al., 2007). Stable fly numbers seen during the trapping confirm their decreased presence (Figures 6-8) .

Blow flies seek out decomposing organisms, in which adult females will lay their eggs (Swiger, 2012). Blow flies can be present throughout the year in southern regions like Texas, as long as temperatures do not fall below 50 degrees. (M.J.R. Swiger, 2012). The entire life-cycle of the blowfly from egg to adult takes about 3-5 weeks and there are about 3 or 4 generations of blowfly per year (Strikewise, 2007). This explains their comparatively high abundance relative to face fly and stable fly throughout the study trapping period (Figures 6-8).

CONCLUSION

Livestock producers and veterinarians all over the world understand how devastating flies can be on cattle. They create an environment of annoyance, which takes away from normal herd activities like grazing and bring with them a whole host of diseases that not only take a toll on the cattle's overall health, but also leads to decreased profits for the producer. Each of the above-mentioned flies has adapted specific ways of breeding and feeding to increase their survival. Methods of treatment tend to vary among species, but the consensus among producers and veterinarians is that sanitation is one of the easiest and most cost-effective ways to decrease fly prevalence. In addition to sanitation practices, sprays and dips that contain pesticides are utilized in industry. Many producers favor insecticidal feed additives to target fly maggots breeding in fresh animal manure. Every treatment has varied effectiveness for each species and most industry professionals agree that a combination of fly treatments and preventative measures like sanitation are the best course of action in improving the health of a herd of cattle. Regardless of new treatments under development, controlling the breeding grounds for these fly species by appropriate waste management and feed storage is imperative. Adding fly treatments is simply a second line of defense.

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References

Hibler, C. P. (1966). Development of *Stephanofilaria stilesi* in the Horn Fly. The Journal of Parasitology, 52(5), 890. doi:10.2307/3276527

Kasimanickam, R. and Parish, S. (2011, February). Infectious Keratoconjunctivitis: Pinkeye in Cattle. Retrieved 21 May, 2017 from http://vetextension.wsu.edu/wp-content/uploads/sites/8/2015/03/PinkEye_Feb20113.pdf

Klei, T. R. (n.d.). Stephanofilariasis - Integumentary System. Retrieved May 21, 2017, from http://www.merckvetmanual.com/integumentary-system/helminths-of-the-skin/stephanofilariasis

Boxler, D. J. (2014, May 01). Controlling Flies on Pastured Cattle. Retrieved April 1, 2017, from https://www.agweb.com/article/controlling_flies_on_pastured_cattle_naa_university_news_release/

Johnson, D.R., G. Lorenz, G. Studebaker, J.D. Hopkins. 2001. Horn Flies on Beef Cattle. FSA7031. University of Arkansas Division of Agriculture CES. Retrieved 21, May 2017 from https://www.uaex.edu/publications/PDF/FSA-7031.pdf

Ricciuti, E. (2017, March 08). Counting Horn Flies: No Easy Task, Whether In Person or In a Photo. Retrieved March 9, 2017, from https://entomologytoday.org/2017/03/08/counting-horn-flies-no-easy-task-whether-in-person-or-in-a-photo/

Strikewise. (2007). Blowfly Strike. Retrieved 21, May 2017 from http://www.strikewise.com/blowfly.html

S.L. Swiger. (2012, August) Managing External Parasites of Texas Cattle. Retrieved 18 January, 2017 from http://livestockvetento.tamu.edu/files/2010/10/Managing-External-Parasites-of-Texas-Cattle.pdf

Fowler, F. E., Chirico, J., Sandelin, B. A., & Mullens, B. A. (2015). Seasonality and Diapause of Musca autumnalis (Diptera: Muscidae) at its Southern Limits in North America, With Observations on Haematobia irritans (Diptera: Muscidae). Journal of Medical Entomology, 52(6), 1213-1224. doi:10.1093/jme/tjv123.

Whitworth, T. (2006). Keys to the Blow Fly Species (Diptera Calliphoridae) of America, North of Mexico. Forensic Entomology, 108(3), 581-625. doi:10.1201/noe0849392153.ch19 from

Gerry, A. C., B. A. Mullens, and N. G. Peterson. 2007. Predicting and Controlling Stable Flies on California Dairies . Oakland: Univ. Calif. Agric. Nat. Res. Pub 8258.

Talley, J. L. (2001). Management and Characterization of Stable Fly Larval Habitats at Round Hay Bale Feeding Sites in Pastures. Kansas State University Department of Entomology. Retrieved 21, May 2017 from http://krex.k-state.edu/dspace/bitstream/handle/2097/1072/JustinTalley2008.pdf;jsessionid=E78138A9187207D0A7FEF9FC05D0D1AC?sequence=1