Infection rate of grasshoppers in Montana, parasitized by Sarcophagidae flies: a host range and parasite species determination

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Introduction

Grasshoppers (Fig. 1) cause significant damage to crops and rangeland which leads to economic losses in the US and worldwide (Fig.3). Chemical insecticides are traditionally used to prevent grasshoppers' outbreaks but these chemicals are harmful to the ecosystem and are costly for pest managers. Parasitic flesh flies (Fig.2) are one promising approach to biological control of grasshoppers. Fly larvae have a noticeable impact on reproductive physiology and survival of grasshoppers (Glogoza and Weiss, 1997). Only a few research groups have investigated the relationship between parasitic flies and grasshoppers (Danyk et al., 2005; Miura and Osaki, 2007) but none specifically for pest control (Table 1).

Figure 1. *Melanoplus sp.* (http://cakeninja.wordpress.com/)

Figure 2. *Sarcophaga sp.* (www.away.com)

In the present project, I propose to investigate whether the numerous flesh fly species (Diptera: Sarcophagidae) that parasitize grasshoppers are species-specific or generalist in their behavior. Results from this project will provide important information regarding the suitability of flesh flies as a biological control agent for grasshoppers, particularly in terms of safety to release them into environment.

Table 1. Change in initial host dry mass and survival of individuals in some species of grasshoppers experimentally parasitized with one larva each of *Blaesoxipha atlanis* relative to unparasitized controls. (Danyk et al., 2005)

Host species	Host sex	Number of larvae per host [a]	Change in host dry mass[b], [c] (mg, mean+SE)	Host Lifeloss [b, d] (h, mean+SE)	Host Mortality [b] (%)
Melanoplus bivittatus	M	0 *	+28.7±3.3bc		
		1	+15.7±6.3c	48.0+11.1	35.0a
	F	0	+121.0±8.1a		
		1	+62.0±16.9b		40.0a
M. Packardii	M	0 *	+23.1±4.4b		
		1	+8.7±4.9b	58.2+13.7	30.0a
	F	0	+59.6±3.4a		
		1	+13.5±9.5b		35.0a

[a]In each host species and sex combination: n = 20, *n = 19.
[b]Within host species, numbers in columns followed by different letters are significantly different (P < 0.05); Tukey's test for means; z-test for percentages.
[c]Mean values with positive and negative signs indicate that during the 9-day period of observation insects, respectively, gained or lost dry mass relative to dry mass at parasitism.
[d]Reduction in survival time of parasitized insects in comparison to surviving unparasitized controls; data from male and female hosts pooled.

Figure 3. Grasshopper and grasshopper damage to soybean pods and leafs
http://www.ent.iastate.edu/soybeaninsects/node/187

Specific Aims and Hypothesis

The aim of proposed study is **to determine if grasshoppers in Montana are infested by generalist or specialist flesh flies.**

➢**The null hypothesis**: All Sarcophaginae flies infest all grasshopper species. That means it doesn't matter which flies pest managers can use to attack grasshopper outbreaks.

➢**Alternate hypothesis**: Not all Sarcophaginae flies infest all grasshopper species. That is predictable based on studies conducting by a few research groups (Danyk et al 2005; Miura and Ohsaki, 2007). In this case, many different fly species must be reared to deal with various pest species; and considerably more planning would have to go into a fly-based control program.

Research plan

Grasshoppers will be collected at random with a sweep net (Fig.6) from various locations outside Big Sandy, Montana during 1-2 weeks in June, 2010 (Fig.4).

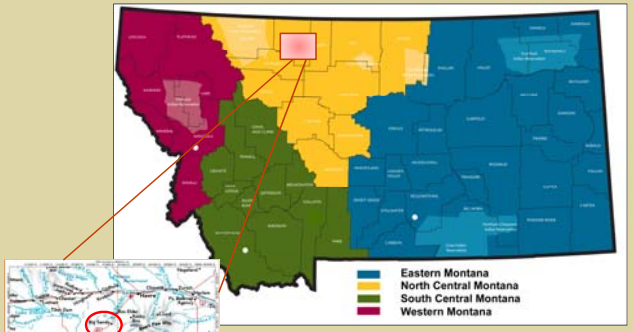

Figure 4. Montana regions
(http://healthinfo.montana.edu/Downloadable%20Maps.html
http://knol.google.com/k/topographic-map-interpretation-of-big-sandy-creek-birch-creek-drainage-divide#)

Grasshoppers (Fig.5) will be visually identified, sorted by species, and placed in a wire mesh cylindrical cage with from 25-55 conspecific individuals (according to Winslow, 1960). Then, cages with grasshoppers inside will be placed in metal funnels to which glass jars will be attached basally for reception of parasite larvae. As the post-feeding phase larvae emerge from the hosts, they will drop through the heavy mesh cage bottoms into the collecting jars (Fig. 7-8).

Figure 5: Some of grasshoppers species feeding on different plants
(http://es.treknature.com/gallery/Europe/Greece/photo47347.htm)

Figure 6: Sweep net for catching grasshoppers (http://www.gbnets-uk.com/images/DSC06408.JPG)

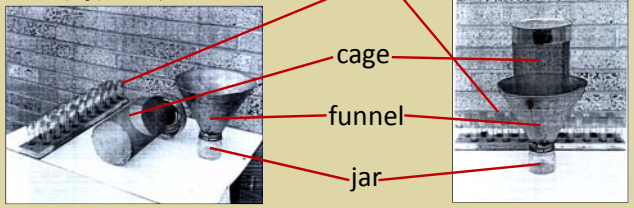

Figure 7. Collecting and rearing apparatus, disassembled (Winslow, 1960)

Figure 8. Collecting and rearing apparatus, assembled (Winslow, 1960)

Larvae will be removed to individual eight dram vials, filled approximately one-third full with fine soil and screen stoppered (Fig. 7-8). Larvae will be allowed to pupate during the next couple weeks, emerge as adults in the vials and will then be mounted on insect pins.
The identification of flies and grasshoppers will be done using existing morphological taxonomic keys. The basic units of data will be the fly species that infest each species of grasshopper.

Perspectives

The results will be important for planning next steps of my research:

➢ If fly species are generalist parasitoids, then I need to verify this specifically in the lab and to see the rate of infestation for each fly species versus each grasshopper species (to determine whether some parasites are better than others or not). It could be important information for pest managers about the range of potential non-target grasshopper species (Fig. 9-10).

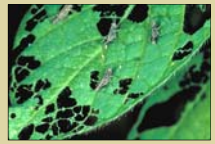

Figure 9. Grasshopper nymphs on leaf.
http://www.ent.iastate.edu/soybeaninsects/node/185

Figure 10. Grasshoppers defoliating corn leaves.
http://www.ent.iastate.edu/imagegal/orthoptera/ghoppersonears.html

➢If fly species are species-specific parasitoids, then I also need to verify this issue in the lab and to determine the specificity of the flies vis a vis the grasshoppers (Table 2). It would also be useful to know why these flies are specific--are they attracted by grasshopper sounds, etc. This information could also facilitate the process of growing the specific flies by pest managers (Fig. 11-12).

Table 2. Grasshoppers species inhabited Montana and parasitic flesh flies found in different Montana grasshoppers.

Grasshoppers' species	*Flesh flies' species (Sarcophagidae)*
Trimerotropis pistrinaria, Hippiscus rugosus, Mestobregma plattei, Trimerotropis fontana, Acropedellus clavatus, Boopedon nubilum, Buckellacris nuda, Asemoplus montanus, Melanoplus infantilis, M. cinereus, M. dodgei, M. indigens, M. differentialis, M. montanus (Helfer, 1953); M. femurrubrum (Helfer, 1953; Bland, 1976; Belovsky and Slade, 1995); M. sanguinipes (Rees, 1986; Belovsky and Slade, 1995)	Acridomyia sacharovi, Blaesoxipha lineata (Rees, 1970); Blaesoxipha sp. (Rees and Onsager, 1982); B. atlanis (Danyk et al, 2005); Sarcophaga sp. (Bland, 1976); Sarcophaga hunter (Aldrich, 1915; Greene ,1925); S. kellyi (Kelly, 1914; Hayes and DeCoursey, 1938); S. opifera (Smith, 1944); S. rapax (Morgan, 1901); S. sarracenioides (Morgan, 1901; Washburn 1905; Aldrich 1915); S. sinuata (Aldrich 1915), S. aculeata, S. reversa (Smith, 1944, 1958); S. coloradensis (Smith, 1958)

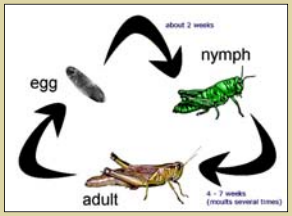

Figure 11. Life cycle of grasshoppers
(http://www.vtaide.com/png/grasshopper.htm)

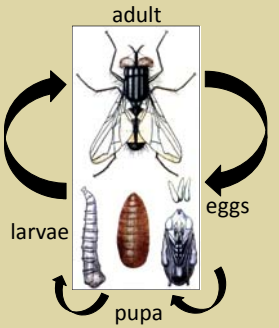

Figure 12. Life cycle of flesh flies
(http://www.cartage.org.lb/en/themes/sciences/zoology/Insects/InsectDrawings/Diptera.htm)

References Cited

1. Danyk, T., Mackauer M. and D. L. Johnson. 2005. Reduced food consumption in the grasshopper *Melanoplus sanguinipes* (Orthoptera: Acrididae) parasitized by *Blaesoxipha atlanis* (Diptera: Sarcophagidae). Can. Entomol. 137: 356–366.
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Acknowledgements

We thank Dr. Greg Dahlem (Northern Kentucky University) for taking the time to discuss this subject and for providing guidelines for the improvement of this research plan.