The Analysis of Internal Parasites in Mosquitofish Throughout Texas

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Introduction

Western mosquitofish (*Gambusia affinis*) are small freshwater fish that are common in North America and received their name from the mosquito larvae that form part of their diet. These fish exhibit sexual dimorphism: females are typically 6-7 cm in length, and males are usually about 4 cm in length. Other than size difference, sex is detected by the presence of a gonopodium, which is an anal fin that aids in sperm transfer during mating. Although native to North America, these fish have been introduced all over the world as a means to control mosquito populations in areas where mosquito-borne diseases such as malaria are a risk to the human population[5]. Because of this and their ability to survive in a range of aquatic habitats, *G. affinis* has been considered an invasive species in many parts of the world.

Mosquitofish play an important role in aquatic systems by being both a predator and prey item. Thus, they have the potential to interact across the various trophic levels. An often under-studied aspect of these interactions is the parasitic species that infect these fish. The complex life cycles of parasites span multiple trophic levels and the presence of parasites can reveal important information regarding the dynamic interplay between abiotic and biotic factors of a habitat.

Objective

- Document the internal parasites of mosquitofish from 3 locations in Texas.

Methods and Materials

The mosquitofish specimens used for this research were acquired by a graduate student at my university from several locations throughout Texas. The specific locations used for this research were Mary's Creek in Fort Worth, Texas; the Devils river running through the Big Oak River Ranch in Val Verde County, Texas; and Sunset Pond in San Angelo, Texas. Only female fish were examined to avoid observing differences in the parasite community because of the sex of the host.

Prior to necropsy, total length was recorded by measuring from caudal to the cephalic ends. The fish was then examined for black spots and other external parasites. Following this, the operculum was removed to reveal the gills, and each gill was excised individually for further investigation to identify the presence of monogenean species. The internal organs were then extracted carefully and placed in a glass dish. The now empty body cavity was examined for any parasites within the peritoneal cavity or any encysted organisms living in the parietal peritoneum. The internal organs were then searched extensively for embedded parasites within them. Finally, the eyes were removed and opened.

Any parasites located in the body cavity, internal organs, and eyes were then placed into a storage container filled with 70% ethanol solution for further staining, mounting, and identification procedures. However, nematodes were fixed in Glacial Acetic Acid prior to being stored in the 70% ethanol.

Results

		Big Oak River Ranch		Mary's Creek, Fort Worth		Sunset Pond, San Angelo		Overall	
Phylum	Species	Prevalence (%)	Mean Intensity	Prevalence (%)	Mean Intensity	Prevalence (%)	Mean Intensity	Prevalence(%)	Mean Intensity
Platyhelmenthis	*Diplostomum* sp.					20	3.25	7.02	3.25
	P. minimum	75	4.2	11.8	3	40	4.6	43.9	4.24
	Clinostomum sp.			23.5	2.25			7.02	2.25
	Phyllodistomum sp	5	3					1.75	3
	Proteocephalus sp.					5	2	1.75	2
Nematoda	*Contracaecum* sp.	40	1			5	1	8.77	1
	Spiroxys sp.					25	5.6	8.77	5.6
	Eustrongylides sp.					5	2	1.75	2
Acanthochephala	*Neoechinorhynchus* sp.	5	2					1.75	2
Arthropoda	*Sebekia* sp.					5	1	1.75	1

Figure 1. Summarized data of the results found using prevalence and mean intensity

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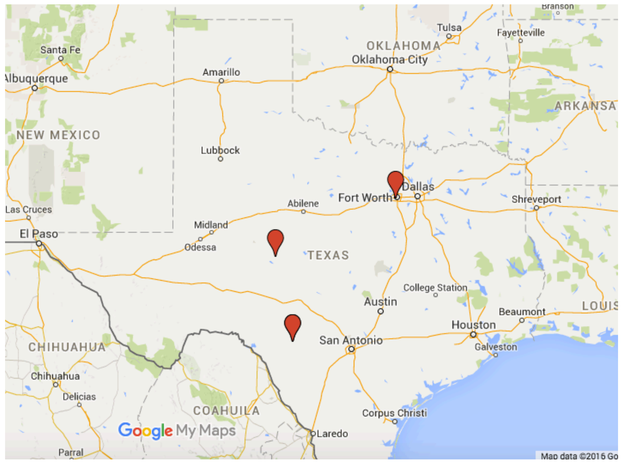

Figure 2. Locations throughout Texas from which the mosquitofish were gathered.

Figure 3. The larval Trematodes recovered from the mosquitofish. (A) Acetocarmine stained *Clinostomum* sp. (B) Unencysted *Clinostomum* sp. (C) Unencysted *Clinostomum* sp. among encysted *Clinostomum* sp. (D) Metacercarial *Phyllodistomum* sp.

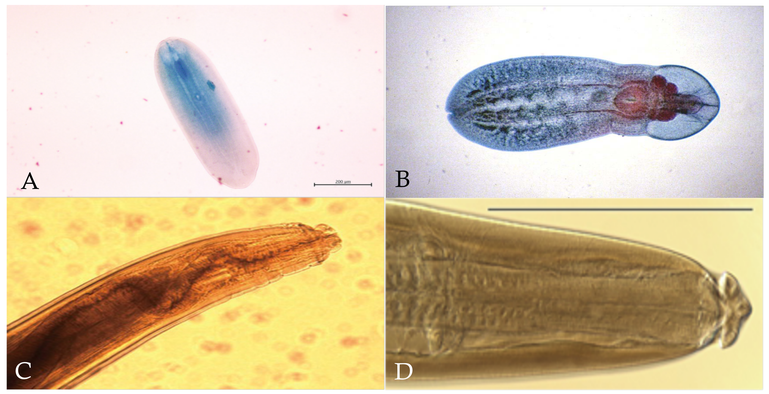

Figure 4. Larval parasites recovered from the mosquitofish. (A) Trichrome stained metacercaria of *Diplostomum* sp. (B) Trichrome stained metacercaria of *Posthodiplostomum minimum*. (C) Anterior region of the nematode *Contracaecum* sp. (D) Anterior region of the nematode *Spiroxys* sp.

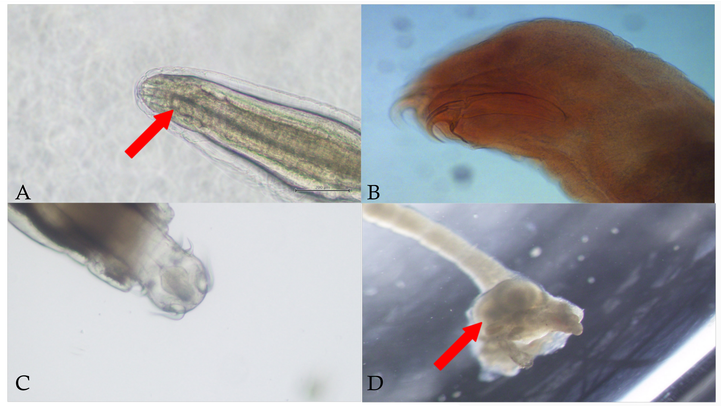

Figure 5. Larval parasites recovered from the mosquitofish. (A) Anterior region of *Eustrongylides* sp. Arrow pointing to nerve ring. (B) Scolex of *Sebekia* sp. (C) Proboscis of *Neochinorhynchus* sp. (D) Scolex of *Proteochephalus* sp. Arrow pointing to suckers.

Discussion

The data gathered from this research has yielded some interesting results. The most common parasite found was the digenetic trematode *Posthodiplostomum minimum*. (Fig. 4B). This species utilizes fish as the second intermediate host. The parasite is an economic concern, especially for fishermen, because they infect sport fishes and can decrease host survivability. They also have a very generalist life cycle and can infect many different hosts of fish, which is why they could be found fairly easily in the mosquitofish[4]. Further examination of mosquitofish in freshwater lakes could provide an indicator of the prevalence of *P. minimum* in areas popular for sport fishing because they are easier to obtain in greater numbers than larger fish.

Diplostomum sp. (Fig. 4A) parasites appear very similar to *Posthodiplostomum minimum*, but *Diplostomum* sp. are unencysted unlike *P. minimum*. *Diplosotmum* sp. are also known for infecting the eyes of their intermediate fish hosts. The eye provides an advantage to the parasite because there is little to no competition with other species, which allows relatively heavy infections in this small area. Moreover, the parasite may hinder vision, thus making them more susceptible to predation by piscivorous birds, which are the definitive hosts[2].

The *Clinostomum* sp. found only in fish collected from Mary's Creek (Fig. 3A-C) were all very interesting specimens. These parasites are also digenetic trematodes. The genera of parasites are known as "yellow grubs" as they appear yellow in the metacercarial stage of the intermediate fish host. They emerge from the snail host, often *Helisoma* sp., and penetrate the fish in the cercaria stage. From here they transition into the metacercaria stage and become the "yellow grub"[1]. Notably, the *Clinostomum* sp. from Mary's Creek were white in appearance and encysted within the body cavity instead of in the muscle.

A few encysted nematode larvae were recovered from these fish. *Contracaecum* sp. (Fig. 4C) is the largest of the two species and exhibits an anteriorly directed appendix. These stomach worms utilize piscivorous birds, fish, and mammals as the definitive host[6]. Notably, this parasite is related to the nematodes that cause Anisakiasis in humans. The infection is acquired by eating raw or undercooked fish that possess the 3rd stage larvae. The second larval species, *Spiroxys* sp., is a small, red worm found in the mesenteries. It was identified by its characteristic head (Fig. 4D)[3]. Fish, the 2nd intermediate host, acquire this parasite by consuming infected crustaceans. The definitive host is a turtle. *Eustrongylides* sp. (Fig. 5A) are large nematodes located within the body cavity of the fish. They are a common cause of disease for many birds and fish and are zoonotic, meaning that they can be transferred to human hosts[7].

Several parasites were uncommon. *Neochinorhynchous* sp. (Fig. 5C), an acanthocephalan, was only found in mosquitofish gathered from Big Oak River Ranch. The armed proboscis aids in attachment to the gut mucosa. *Sebekia* sp. found from Sunset Pond is a pentastome (Arthropoda) and is characterized by 4 hooks surrounding its mouth (Fig. 5B). *Phyllodistomum* sp. are typically common trematode species, however they appear to be uncommon in the Devil's River at Big Oak River Ranch (Fig. 3D). This finding was unusual in that these parasites are typically found in the swim bladders of their hosts[8]. However, these were all found free within the body cavity. The *Protocephalus* sp. is a tapeworm found within the intestines of the mosquitofish. These are characterized by the suckers on the scolex. Two were found within this sample, however one had it's scolex missing and was located in the body cavity rather than the intestines. The other had its suckers securely attached to the intestinal tissue, so out of fear of damaging the scolex not all of the tissue was removed.

Conclusion

- Mosquitofish play a crucial role as an important intermediate host in the life cycles of many freshwater parasites
- Utilizing the presence of parasites in mosquitofish can act as a useful tool in describing the ecology of that environment