The hunting efficiency of natural mosquito larvae predators

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Abstract

We investigated the mosquito hunting efficiency of natural predators in Trang province, Thailand. We collected six types of predators (Thai fighting fish, guppy, water boatman, water strider, toad-tadpoles, and *Toxorhynchites* mosquito larvae) from water habitats and brought them back to the lab. We identified males and females of predators (except for tadpoles and *Toxorhynchites* spp.). We also collected two types of mosquito larvae (*Aedes* and *Culex* spp.) and brought them back to the lab. We kept the predators in containers for 3 days and fed them normally. Then let them starve for 24 hours before starting the experiment. Afterwards we put 1 male/female predator from each predator type and 10 *Aedes*/*Culex* mosquito larvae in one container. We had 6 replicates for each treatment, and in total we had 120 containers. We recorded the time predators took to hunt all the mosquito larvae in the container. We found that males and females of fighting fish and water boatman spent similar time to hunt mosquitoes but females of guppy and water strider spent less time to hunt mosquitoes than males. Moreover, fighting fish and guppy spent less time to hunt *Aedes* than to hunt *Culex* larvae. Tadpoles did not hunt mosquito larvae.

Keyword: Fighting fish, Guppy, Water boatman, *Toxorhynchites* spp., Toad tadpoles, Predator

Introduction

Thailand is located in the tropical region where most of the people are at risk of being attacked by several mosquito borne diseases such as dengue fever, elephantiasis, malaria etc. (Afolabi et al., 2013). Day by day the numbers of mosquito borne disease patients are

increasing in Thailand. There is currently no drug or vaccine that can be used for prevention or control of mosquito borne disease (WHO, 2018).

Trang province in Thailand is at high risk of mosquito borne diseases; every year higher number of patients come to the hospitals to get treatment for mosquito borne diseases. During the time 2008 - 2018 in Trang, there was a trend of disease outbreaks in every 2 years, (Ministry of Public Health, 2013) due to higher abundance of mosquitoes in this area.

Female mosquitoes lay eggs in water habitats. Different mosquito species prefer different habitats for laying eggs, for example *Aedes aegypti* likes to lay eggs in water storage containers inside houses while *Aedes albopictus* likes to lay eggs in natural containers outside the house. *Culex* spp. and *Toxorhynchites* spp. prefer live and lay eggs in dirty waters (Rueda, 2007). Killing mosquito larvae in the water is the best way to control mosquito population, as well as mosquito borne diseases. There are several ways to kill mosquito larvae but those are not safe for nature such as spraying insecticides which is highly toxic to mosquito larvae but also toxic to human and other animals/insects (BASF, 2015). Killing mosquito larvae through biological control is the best option as this method does not have any side effect. There are many fish, amphibians, and insects (Thai fighting fish, guppy, water strider, toad-tadpoles etc.) those hunt mosquito larvae for their survival and growth (Titiyajithansa, 1980; Suttipot Pongvor, 2009). *Toxorhynchites* mosquito larvae is another important natural predator of other mosquito larva. They feed mostly on *Aedes* and *Cules* larvae (Suttipot Pongvor, 2009). As Trang is at high risk of mosquito borne diseases, we should conduct a research on biological control of mosquitoes in this area. Our aim if this research is to investigate the mosquito hunting ability of different types of natural predators in Trang province. We would like to know (1) are these predators (Thai fighting fish, guppy, water boatman, water striders, *Toxorhynchites* larvae, tadpoles) able to hunt mosquito larvae? and (2) is there any effect of predator sex (Thai fighting fish, guppy, water boatman, water striders) on mosquito larvae hunting efficiency? We predict that (1) different types of predators would have different mosquito larvae hunting efficiency, and (2) male and female predators would have different mosquito larvae hunting efficiency.

Materials and methods

Study area

This research was conducted at Sikao district, Trang Province, southern Thailand, from February to March 2019.

Data collection

We selected some water habitats (e.g., ponds, water gardens, ditch etc.) to colect different types of predators (e.g., Thai fighting fish, guppy, water boatman, water strider, toad-tadpoles, and *Toxorhynchites* mosquito larvae). Afterwards we brought them back to the lab to identify their sexes and to count them. We could not identify the sex of toad-tadpoles and *Toxorhynchites* mosquito larvae. We put the predators in glass containers (5 x 10 x 6 inches) and fed them normally. Then let them starve for 24 hours before starting the experiment. We collected types of mosquito larvae (*Aedes* spp. and *Culex* spp.) from different water habitats and brought them back in the lab. Afterwards we put 1 male/female predator from each predator type and 10 *Aedes*/*Culex* mosquito larvae in one glass container (3x3x6 inches). We had 6 replicates for each treatment, and in total we had 120 containers (figure 1). We recorded the time predators took to hunt all the mosquito larvae in the container.

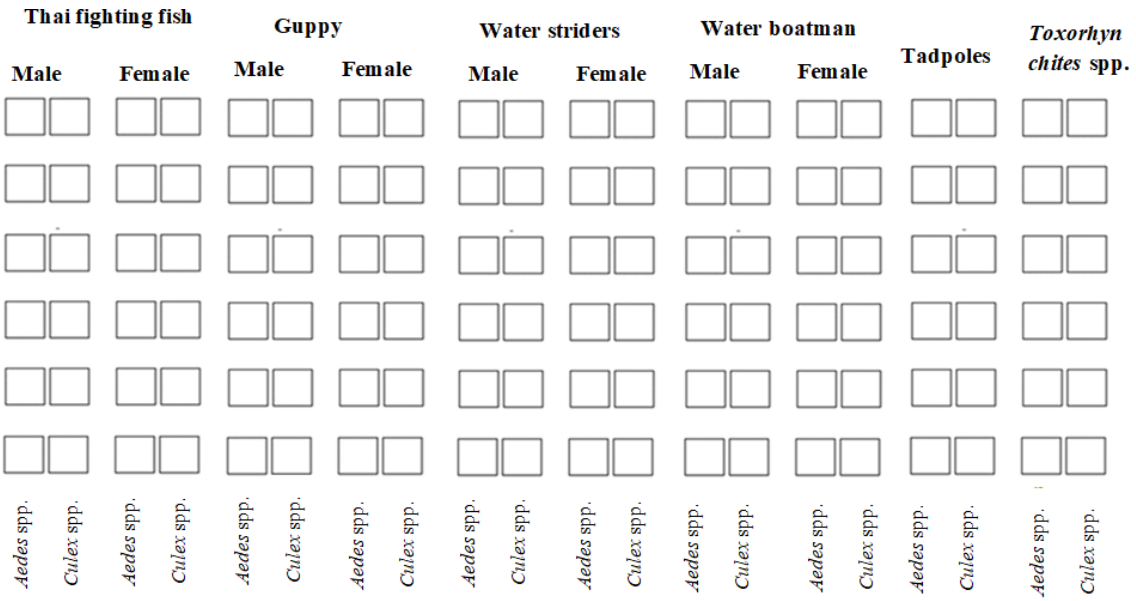


Figure 1. Experimental set-up

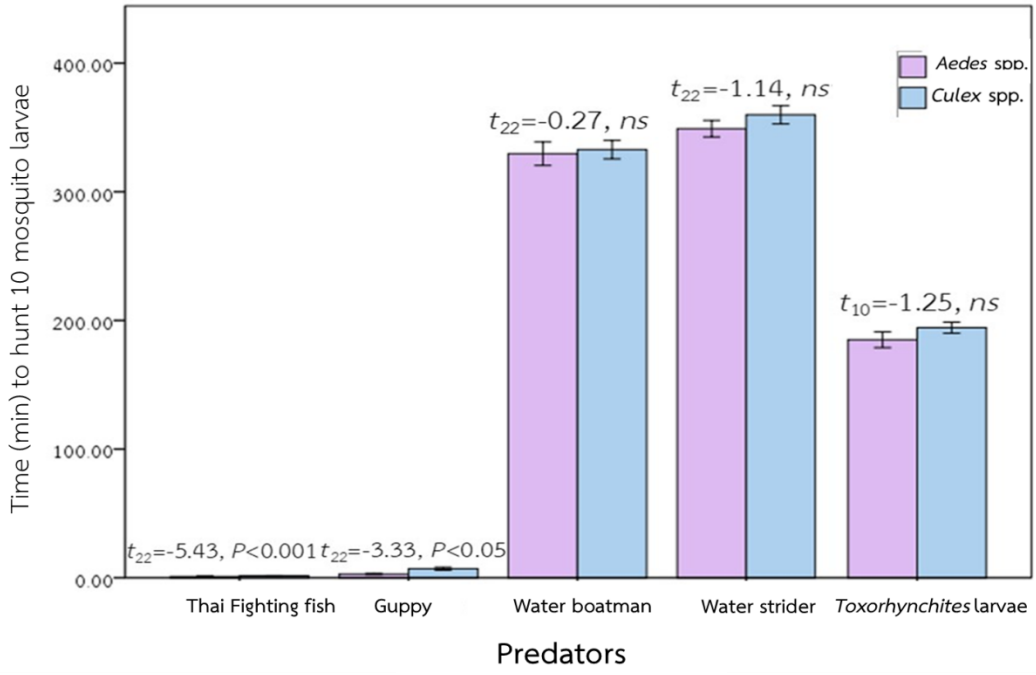
Statistical analyses

We used SPSS to analyses data. *T*-tests were used to see the differences in hunting time for *Aedes* spp. and *Culex* spp. for each predator type. Two-way ANOVA was used to see the effects of sex and mosquito types on the hunting time for each predator type. Data were reported as significantly different at $P<0.05$.

Results

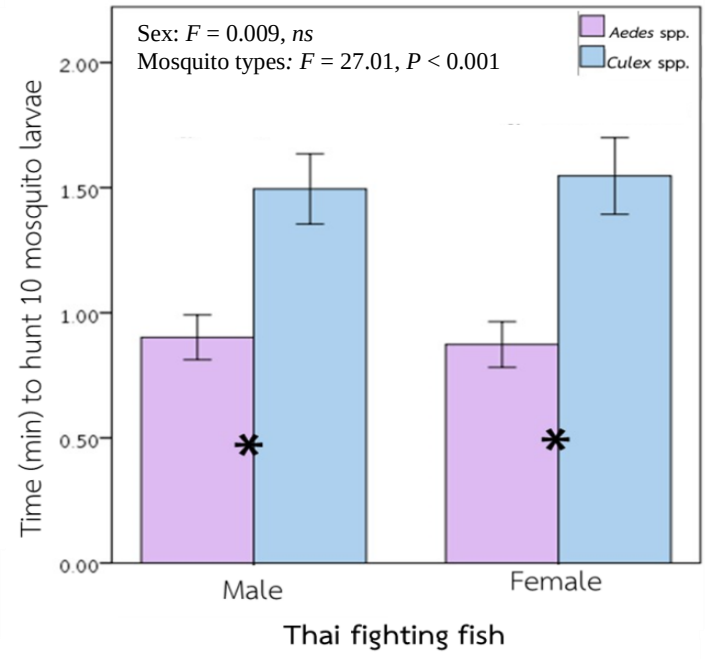
Mosquito larvae hunting efficiency of predators

Thai Fighting fish and Guppy spent shorter time to hunt *Aedes* larvae than to hunt *Culex* larvae. Other predators spent similar time for hunting *Aedes* and *Culex* larvae. Tadpoles did not hunt mosquito larvae.



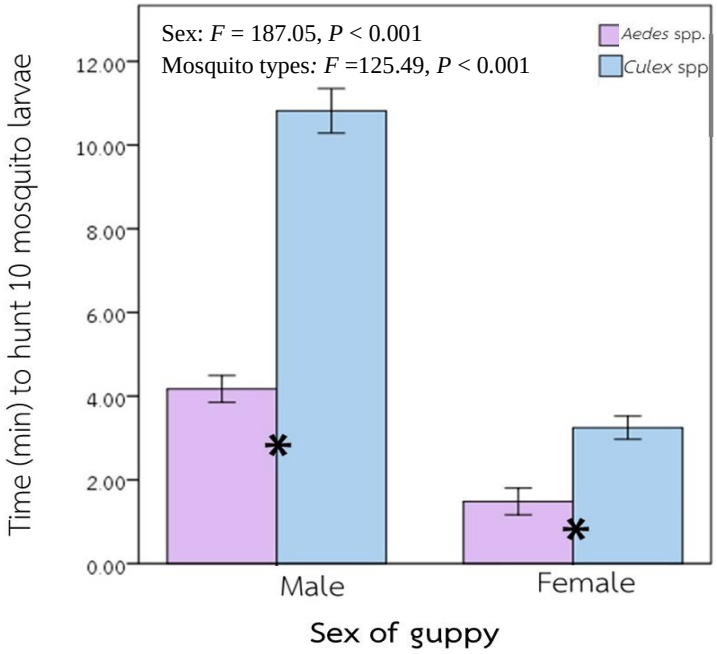
Mosquito larvae hunting efficiency of Thai fighting fish

Sex did not affect the mosquito hunting. In case of males and females, they spent less time to hunt *Aedes* spp.



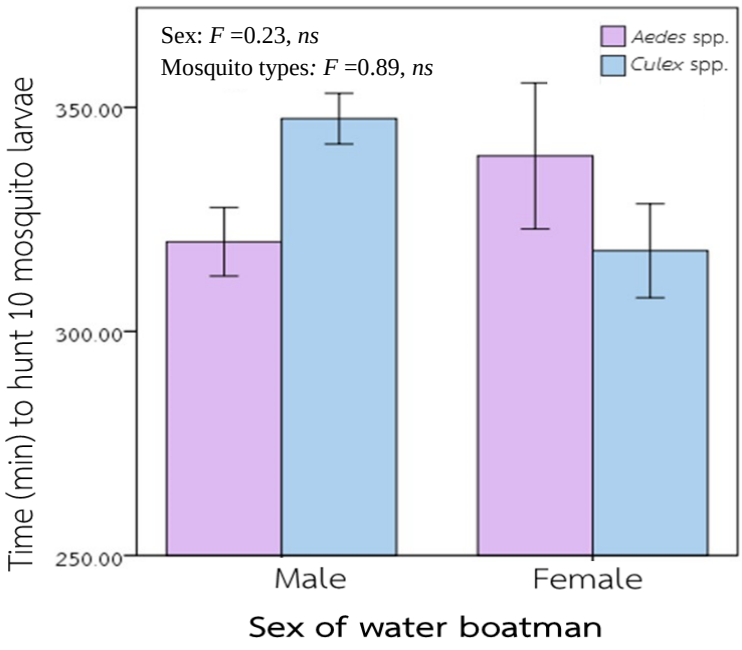
Mosquito larvae hunting efficiency of Guppy

Sex had an effect on mosquito hunting. Female spent less time to hunt mosquito larvae compared to male.



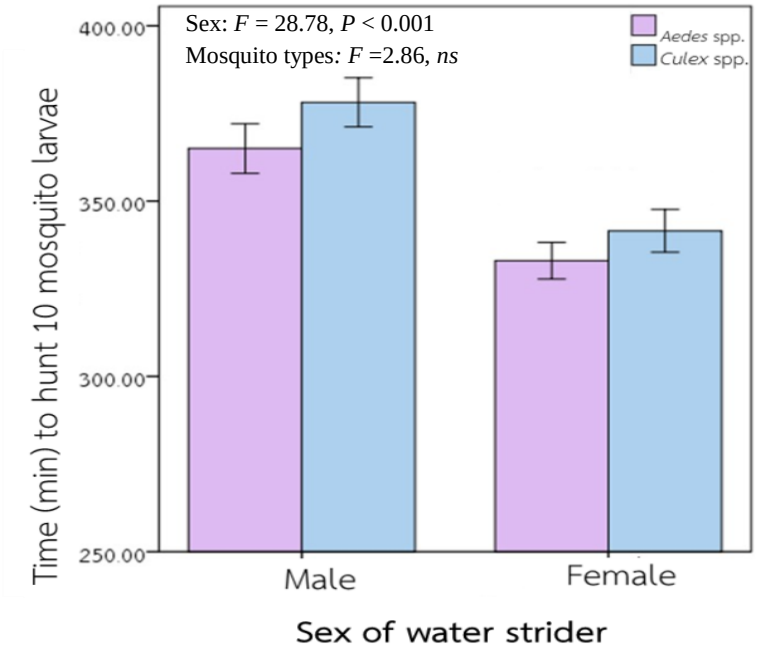
Mosquito larvae hunting efficiency of Water boatman

Sex did not affect the mosquito hunting efficiency. Male or female spent similar time to hunt both mosquito species.



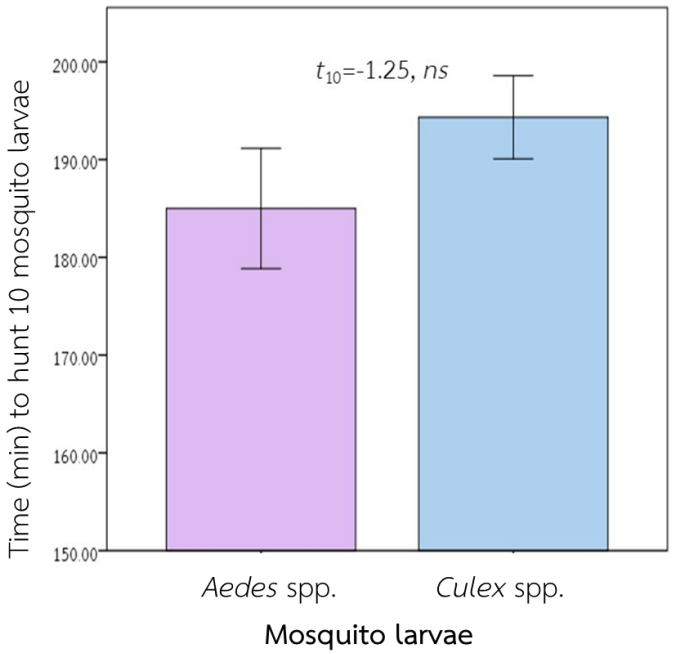
Mosquito larvae hunting efficiency of Water strider

Sex had an effect on mosquito hunting efficiency. Female spent less time to hunt mosquito larvae compared to males.



Mosquito larvae hunting efficiency of *Toxorhynchites* mosquito larvae

Toxorhynchites larvae spent similar time to hunt *Aedes* spp. and *Culex* spp. larvae.



Discussion

We show that all of the natural predators, except toad-tadpoles, are able to control *Aedes* and *Culex* mosquito larvae within short time. It indicates that these predators (both males and females) act as efficient mosquito larvae predators. Among different predators, Thai fighting fish and guppy hunted mosquito larvae within very short time (15-20 min.). It shows that Thai fighting fish and guppy act as more efficient mosquito larvae predators compared to other natural predators.

Wijesinghe *et al*. (2009) found that *Toxorohynchites* spp. larvae had the ability to eliminate 10 mosquito larvae within 330 minutes. We found that in this study *Toxorohynchites* spp. killed 10 mosquito larvae within 200 minutes. Aditya *et al*. (2009) found that *Toxorohynchites* spp. larvae had the ability to eliminate around 1-34 *Culex* larvae per day.

We found that water boatman and water strider killed 10 mosquito larvae within on average 350 minutes. Toad-tadpoles did not kill any mosquito larvae. Similarly, Weterings (2015) observed that tadpoles did not eat *Culex* larvae. On the other hand, Bowatte *et al*. (2013) from Sri Lanka put tadpoles in the water containers, and found eggs of 5 mosquito larvae in the intestines of the tadpoles after finishing of study. It indicates that tadpoles might be used for biological control of mosquitoes.

Between males and females of natural predators, both acted as efficient predators, but in case of guppy and water striders, females acted more efficient predators. Titiyajithansa (1980) was found that female predators were more capable to hunt mosquito larvae compared to male predators. In case of guppy and Thai fighting fish, females took less time to hunt *Aedes* larvae than to hunt *Culex* larvae. It indicates that females of guppy and Thai fighting fish can be used for effective control of *Aedes* larvae as well as *Aedes* borne diseases.

Conclusions

We observed that tadpoles did not hunt any mosquito species that means they do not act as mosquito predators. Sexes of guppy and water striders showed different hunting behavior. Females hunted all mosquitoes within shorter time compared to males. It indicates that female guppy and water striders act as more efficient mosquito predators compared to males. Fighting fish and guppy took less time to hunt *Aedes* larvae than to hunt *Culex* larvae. Other predators took similar time for hunting of these two mosquito species. It indicates that fighting fish and guppy act as more efficient *Aedes* predators. Based on our research**,** people in

Trang province can use natural predators to control mosquito populations, as well as to prevent mosquito borne diseases. People can protect mosquito predators in natural and environment and people can keep some predators inside the water containers in their house to control mosquitoes.

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