

Interactions Among Organisms  
In An  
Aquatic Ecosystem



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### **Abstract**

Millions of people in the world own fish as pets but don't know the relationship to biology? The purpose of this research experiment is to study the interactions among ghost shrimp and fathead minnows in different aquatic ecosystems. Will they interact well with each other and especially their environment? What if abiotic factors are changed, what will happen? I hypothesize that the two species will have a relationship of mutualism because the ghost shrimp will benefit from the rosy red's leftovers while the rosy reds benefit from the maintenance of the ghost shrimp being the janitors keeping the aquatic ecosystem somewhat clean. Also, if abiotic factors are changed they will help each other more.

All three aquatic ecosystems will consist of ten gallons of water, three artificial plants, gravel, thermometer and air pump which are our controlled variables. First aquatic ecosystem will have a filter. Second aquatic ecosystem will not have a filter. Last aquatic ecosystem will have no filter but two air pumps. These are the independent variables. The dependent variable is the species interaction. Fathead minnows will be fed twice a day at 7:30 a.m. and p.m. using Tropical Fish Flake Food.

The abiotic factors that were changed in each aquatic ecosystem had little or no affect on the species. My hypothesis was proven wrong because they have a commensalism symbiotic relationship. More space and hiding places should be provided to prevent predation of smaller and weaker ghost shrimp.

### **Introduction**

There are hundreds of species of fish that can be kept as pets. Goldfish are the most commonly kept fish because they live in cold water. Tropical fish need to be kept in an aquarium with a filter to keep their water clean and some specific tropical fish require heated water and lights (Keeping Fish as Pets, 2009). What about interactions between to organisms in these aquariums? Does competition occur over the same resources? What type of symbiotic relationships do they have? When keeping fish as pets, people do not go in depth on how it can be related to biology. Ghost shrimp and fathead minnows are both tropical fish that will be used to learn about their interactions in an ecosystem kept in captivity.

The fathead minnow is a species of temperate freshwater fish belonging to the *Pimephales* genus of the cyprinid family and the scientific name is *Pimephales promelas* (Fathead Minnow, 2012). The fathead minnows are also known by a variety of names such as rosy reds, rosies, tuffies, tuffy minnow, blackhead minnow, red top minnows, rosy red feeders, ruby red feeders, feeder minnows, and bait minnows. The natural geographic range extends throughout much of North America, from central Canada south along the Rockies to Texas, to Virginia and the Northeastern United States. In addition, this minnow has also been introduced to many other areas via bait bucket releases.

The fathead minnow in the wild is generally dull olive-grey in appearance, with a dusky stripe extending along the back and side, and a lighter belly. There is a dusky blotch midway on the dorsal fin. These fish are sexually dimorphic. The fathead is quite tolerant of turbid, low-oxygenated water, and can be found in muddy ponds, in small rivers and streams that might otherwise be inhospitable to other species of fish (Fathead Minnow, 2012).

They need to be in a school because individually they will tend to be territorial and will ram its head into other species of fish and briefly chase them. These fish prefer a temperature of 10 - 21 °C (50 -70 °F) and a pH range of 7.0 - 7.5. They are social, active, and moderately hardy. This is an omnivorous species and like most cyprinids, they will accept almost any type of food such as small pre-soaked goldfish pellets or flakes as a dietary staple, supplemented with frozen insects and fresh, boiled, leafy-green vegetables. They can be bred in an aquarium, and the fathead minnow is one of the only cyprinids that protect its eggs in the nest. Males may be protective over nest sites, so exercise caution with tank mate selection if intended to breeding them. Fatheads kept in captivity may live about two years but may reach the lifespan of four years.

They may be compatible with species such as Hillstream Loaches, White Cloud Mountain Minnows, or in large tanks, Dojo Loaches. Fathead minnows are often kept in ponds with larger fish species, both as feeders and to increase pond diversity.

Also, this species is important as a biological model in aquatic toxicology studies, because of its relative hardiness and large number of offspring produced. EPA guidelines outline its use for the evaluation of acute and chronic toxicity of samples or chemical species in vertebrate animals (Fathead Minnow, 2012).

On the other hand, ghost shrimp, also known as Glass Shrimp, are excellent scavengers, and are efficient aquarium cleaners that will actively search for any kind of left over food in the aquarium. The Ghost Shrimp's body is transparent with an orange or yellow colored spot that is visible in the center of the tail. The body is segmented, and features ten sets of legs. The first four sets have tiny claws that aid the shrimp in feeding.

Ghost Shrimp are relatively small invertebrates reaching a maximum size of only 2" and their life span is up to two years old. Ghost shrimp are best kept in an aquarium with a water temperature of 65-82 F / 18-28 C (Ghost Shrimp, 2008). It's hard to determine their gender because there are no noticeable external differences between males and females (Ghost Shrimp – *Palaemonetes* spp.). Ecosystem of wild ghost shrimp consists of lakes and other slow moving bodies of water (Ghost Shrimp Profile, 2011).

The freshwater aquarium should be adjusted to at least 10 gallons with plenty of hiding places so decorating the aquarium with many hiding places that are too small for other fish to get in it provides a safe environment. The aquarium should be housed with small peaceful fish that will not pose a threat of eating these shrimp. Suitable companions for ghost shrimps include small Livebearers, small Tetras, Rasboras, and small Danios (Ghost Shrimp Profile, 2011). If too many shrimps are kept together in the same aquarium, Ghost shrimp can become aggressive towards other Ghost shrimp.

The shrimp will moult into new exoskeletons every few months as they grow. The first hours after moulting they are very vulnerable to attacks from interested fish before their new exoskeletons harden. Therefore, it is important to provide ghost shrimp numerous hiding places such as plants and terra cotta pots turned on their side (Ghost Shrimp, 2008).

The Ghost Shrimp are omnivores and will consume detritus and almost anything off the bottom floor that is why they are known as scavengers. Ghost shrimp are very easy to feed and will do well on a diet of flake food. It is however good to offer them some variation in their diet. For example, offer them some frozen food once in a while. They sometimes also swim upside down and eat food from the surface. Ghost shrimp are an excellent food source for many types of

both freshwater and saltwater fish. They are great for getting hard to feed fish such as seahorses, lionfish, grunts, and newly born sharks to begin feeding.

If kept in large enough groups then they will mate and the female will carry the eggs, which appear as small green dots under the tail. The female ghost shrimp will carry the eggs for a month or so, but unless they are in a species only tank the babies will just hatch and then become lunch. The mother may be moved to an empty container to drop her eggs, but the young are tiny and free floating for the first week. Unlike other shrimp whose eggs hatch as miniature replicas of the adult form, Ghost Shrimp go through a larval stage. During this time they are feeding on whatever they float into since they have under-developed and useless legs. Once they get past the larvae stage, they are just like a regular Ghost Shrimp that can be fed small pieces of fish food until they are mature (Ghost Shrimp Profile, 2011).

Overall, the purpose of this research experiment is to study the interactions among ghost shrimp and fathead minnows in different environments. There have been no previous research done on them but people have kept ghost shrimp and fathead minnows in captivity together with no bad results but ghost shrimp have a reputation of being aggressive to each other. I hypothesize that the two species will have a relationship of mutualism because the ghost shrimp will benefit from the rosy red's leftovers while the rosy reds benefit from the maintenance of the ghost shrimp being the janitors keeping the aquatic ecosystem somewhat clean. Also, if abiotic factors are changed such as temperature and filtration they will help each other more.

### **Materials & Procedures**

Over the course of 6 weeks, three different aquatic ecosystems will be set. A ten gallon tank will be used with ten ghost shrimp and thirteen fathead minnows or rosy reds. First aquatic ecosystem will consist of three artificial plants the colors of pink, purple and green, a filter, a thermometer, colorful gravel and an air pump for the two first weeks. For the second two weeks, the second aquatic ecosystem will consist of three artificial plants the colors of pink, purple and green, a thermometer, colorful gravel and an air pump. For the final two weeks, the third aquatic ecosystem will consist of three artificial plants the colors of pink, purple and green, a thermometer, colorful gravel and two air pumps. Fathead minnows will be fed twice a day which will be 7:30 a.m. and 7:30 p.m. using Tropical Fish Flake Food. The shrimp will scavenge for leftovers. Behavior of organisms in aquarium, temperature, and environment conditions will be recorded at 7:30 a.m. and 7:30 p.m. every day for the six week period of time.

When transitioning to next aquatic ecosystem its important to add 1 teaspoon of Start Right<sup>®</sup>, with Aloe Vera, to help remove chlorine, chloramines and heavy metals in tap water before adding the ghost shrimp and fathead minnows. Start Right<sup>®</sup>, with Aloe Vera, is to be used when setting up a new aquarium, making regular water changes, adding fish and when fish are injured from fighting, netting or disease.

To begin transitioning from the old environment to new one, remove all organisms from main aquarium and put them in a temporary environment with their previous environment's water while main aquarium is under maintenance. For the organisms not to die in new aquatic ecosystem replace one cup of their dirty water from their previous environment with one cup of



clean water to their temporary environment every fifteen minutes for thirty minutes. Once thirty minutes have passed add organisms to new main aquatic ecosystem.

## Results

### Aquatic Ecosystem #1

DAY (DATE)	Feed Time	Temperature
DAY 1 (October 27)	7:30 a.m.	72°F/ 22°C
	7:30 p.m.	72°F/ 22°C
DAY 2 (October 28)	7:30 a.m.	64°F/ 18°C
	7:30 p.m.	68°F/ 20°C
DAY 3 (October 29)	7:30 a.m.	72°F/ 22°C
	7:30 p.m.	76°F/ 24°C
DAY 4 (October 30)	7:30 a.m.	76°F/ 24°C
	7:30 p.m.	64°F/ 18°C
DAY 5 (October 31)	7:30 a.m.	64°F/ 18°C
	7:30 p.m.	64°F/ 18°C
DAY 6 (November 1)	7:30 a.m.	64°F/ 18°C
	7:30 p.m.	64°F/ 18°C
DAY 7 (November 2)	7:30 a.m.	68°F/ 20°C
	7:30 p.m.	68°F/ 20°C
DAY 8 (November 3)	7:30 a.m.	68°F/ 20°C
	7:30 p.m.	70°F/ 21°C
DAY 9 (November 4)	7:30 a.m.	68°F/ 20°C
	7:30 p.m.	70°F/ 21°C
DAY 10 (November 5)	7:30 a.m.	70°F/ 21°C
	7:30 p.m.	70°F/ 21°C
DAY 11 (November 6)	7:30 a.m.	68°F/ 20°C
	7:30 p.m.	68°F/ 20°C
DAY 12 (November 7)	7:30 a.m.	68°F/ 20°C
	7:30 p.m.	68°F/ 20°C
DAY 13 (November 8)	7:30 a.m.	68°F/ 20°C
	7:30 p.m.	68°F/ 20°C
DAY 14 (November 9)	7:30 a.m.	70°F/ 21°C
	7:30 p.m.	70°F/ 21°C

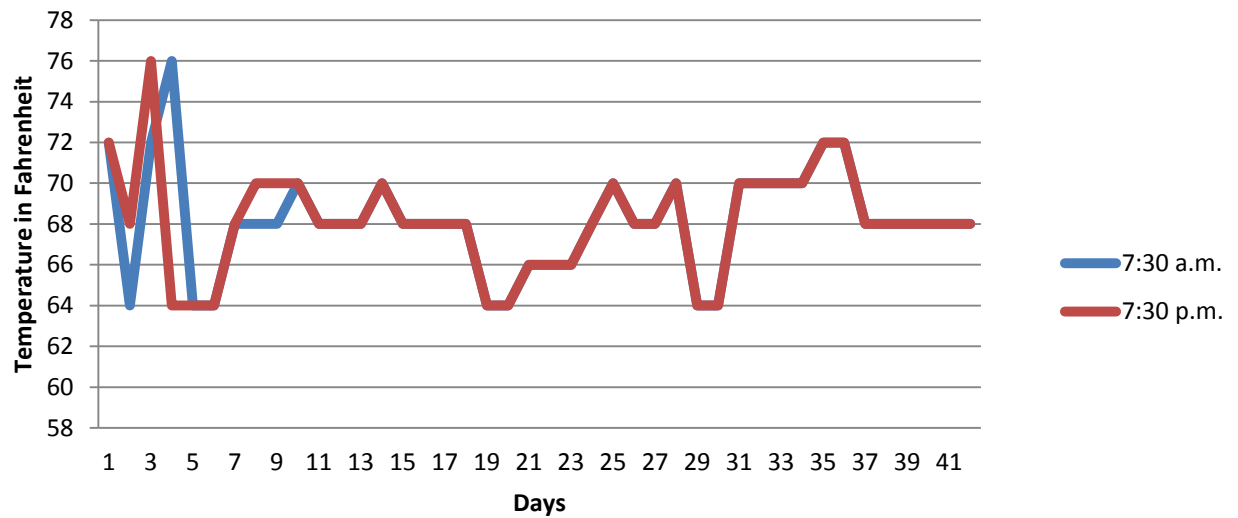
**Aquatic Ecosystem #2**

DAY (DATE)	Feed Time	Temperature
DAY 15 (November 10)	7:30 a.m.	68°F/ 20°C
	7:30 p.m.	68°F/ 20°C
DAY 16 (November 11)	7:30 a.m.	68°F/ 20°C
	7:30 p.m.	68°F/ 20°C
DAY 17 (November 12)	7:30 a.m.	68°F/ 20°C
	7:30 p.m.	68°F/ 20°C
DAY 18 (November 13)	7:30 a.m.	68°F/ 20°C
	7:30 p.m.	68°F/ 20°C
DAY 19 (November 14)	7:30 a.m.	64°F/ 18°C
	7:30 p.m.	64°F/ 18°C
DAY 20 (November 15)	7:30 a.m.	64°F/ 18°C
	7:30 p.m.	64°F/ 18°C
DAY 21 (November 16)	7:30 a.m.	66°F/ 19°C
	7:30 p.m.	66°F/ 19°C
DAY 22 (November 17)	7:30 a.m.	66°F/ 19°C
	7:30 p.m.	66°F/ 19°C
DAY 23 (November 18)	7:30 a.m.	66°F/ 19°C
	7:30 p.m.	66°F/ 19°C
DAY 24 ( November 19)	7:30 a.m.	68°F/ 20°C
	7:30 p.m.	68°F/ 20°C
DAY 25 (November 20)	7:30 a.m.	70°F/ 21°C
	7:30 p.m.	70°F/ 21°C
DAY 26 (November 21)	7:30 a.m.	68°F/ 20°C
	7:30 p.m.	68°F/ 20°C
DAY 27 (November 22)	7:30 a.m.	68°F/ 20°C
	7:30 p.m.	68°F/ 20°C
DAY 28 (November 23)	7:30 a.m.	70°F/ 21°C
	7:30 p.m.	70°F/ 21°C

**Aquatic Ecosystem # 3**

DAY (DATE)	Feed Time	Temperature
DAY 29 (November 24)	7:30 a.m.	64°F/ 18°C
	7:30 p.m.	64°F/ 18°C
DAY 30 (November 25)	7:30 a.m.	64°F/ 18°C
	7:30 p.m.	64°F/ 18°C
DAY 31 (November 26)	7:30 a.m.	70°F/ 21°C
	7:30 p.m.	70°F/ 21°C
DAY 32 (November 27)	7:30 a.m.	70°F/ 21°C
	7:30 p.m.	70°F/ 21°C
DAY 33 (November 28)	7:30 a.m.	70°F/ 21°C
	7:30 p.m.	70°F/ 21°C
DAY 34 (November 29)	7:30 a.m.	70°F/ 21°C
	7:30 p.m.	70°F/ 21°C
DAY 35 (November 30)	7:30 a.m.	72°F/ 22°C
	7:30 p.m.	72°F/ 22°C
DAY 36 (December 1)	7:30 a.m.	72°F/ 22°C
	7:30 p.m.	72°F/ 22°C
DAY 37 (December 2)	7:30 a.m.	68°F/ 20°C
	7:30 p.m.	68°F/ 20°C
DAY 38 (December 3)	7:30 a.m.	68°F/ 20°C
	7:30 p.m.	68°F/ 20°C
DAY 39 (December 4)	7:30 a.m.	68°F/ 20°C
	7:30 p.m.	68°F/ 20°C
DAY 40 (December 5)	7:30 a.m.	68°F/ 20°C
	7:30 p.m.	68°F/ 20°C
DAY 41 (December 6)	7:30 a.m.	68°F/ 20°C
	7:30 p.m.	68°F/ 20°C
DAY 42 (December 7)	7:30 a.m.	68°F/ 20°C
	7:30 p.m.	68°F/ 20°C

## Aquatic Temperature Over Time



In the aquatic ecosystem #1 from day one to day fourteen, there were dramatic temperature changes between 7:30 a.m. and 7:30 p.m. and both organisms were unaffected from these changes. In the aquatic ecosystem #2 from day fifteen to day twenty-eight, the temperature evened out between 7:30 a.m. and 7:30 p.m. In the aquatic ecosystem #3 from day twenty-nine to day forty-two, the temperature continued to remain evened out between 7:30 a.m. and 7:30 p.m.

### **Discussion and Conclusion**

Over the six weeks of research, results have been recorded. We started out with thirteen rosy reds or fathead minnows and ten ghost shrimp.

In the aquatic ecosystem #1, there were dramatic temperature changes between 7:30 a.m. and 7:30 p.m. and both organisms were unaffected from these changes. Rosy reds remained in a school most of the time while the ghost shrimp became very aggressive towards each other. The older and larger ghost shrimp would easily outsmart the smaller ghost shrimp and devoured them. The ghost shrimp would even be aggressive towards the rosy reds and the weaker ones became their lunch. At the end of the aquatic ecosystem #1, ten rosy reds and two shrimp remained.

In the aquatic ecosystem #2, the temperature evened out between 7:30 a.m. and 7:30 p.m. and the two ghost shrimp that remained killed each other which was bad to the ecosystem. Without the filter and the ghost shrimp to clean the tank a green slime of trash seemed to pile against the gravel and artificial plants. The rosy reds remained neutral after the shrimp died out and slime grew but some became aggressive. One smaller rosy red injured a larger rosy red around its tail fin. I added Start Right<sup>®</sup>, with Aloe Vera, to help the injured fish but after a few days the slime covered its injury with slime. The injured fish was nicknamed Tutu fish for the slime that grew around its injury around its tail forming a tutu structure. The slime grew forming a larger tutu structure around the tail and finally the Tutu fish died. Now nine rosy reds remain and zero ghost shrimp.

In the aquatic ecosystem #3, the temperature continued to remain evened out between 7:30 a.m. and 7:30 p.m. With no filter and two air pumps for oxygen the rosy reds were barely

affected. They continued to swim in a school and were less aggressive between each other. The slime did begin to grow back after day thirty-five but not as bad as in the aquatic ecosystem #2. In the end, nine rosy reds survived the six week experiment.

The ghost shrimp and rosy red shared a commensalism relationship. Why? The ghost shrimp benefited from the rosy red's leftovers while the rosy reds were not affected. After the ghost shrimp died out they left the aquarium with no janitors which allowed for slime to grow which did not affect the rosy reds. I thought the two organisms would have a mutualism relationship but my experiment proved that wrong.

The abiotic factors that were changed in each aquatic ecosystem, such as removing filtration or adding two oxygen pumps, had little or no affect on the organisms that inhabited these aquatic ecosystems. The rosy reds seem to adapt quickly to each aquatic ecosystem.

Overall, I believe that if the aquarium was a bigger size and had more hiding places the ghost shrimp would not be aggressive with more space and places to hide from predation. Otherwise, the ghost shrimp become very aggressive when they are put in an aquatic ecosystem that doesn't provide enough space or shelter for each individual species. Also, instead of having the ghost shrimp to scavenge for their food some variation in their diet should be offered to prevent them from eating each other. For example, some frozen food once would help vary their diet.

**Acknowledgements/ Credits**

- I brought in some of the slime that grew inside of aquarium to be tested to Mr. Pederson. Unfortunately, nothing was found in water but high levels of nitrogen.
- Wal\*Mart Salesman at aquatic life area said that before adding fish to new aquatic ecosystem the filter must have run through the water for a whole day and to wait thirty minutes before dumping fish in the aquatic ecosystem.



References/ Bibliography

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**Appendix**

Materials:

- Ten Gallon Aquarium
- Three artificial plants the colors of pink, purple and green,
- A Filter
- A Thermometer,
- Colorful Gravel
- Two Air Pumps
- Start Right<sup>®</sup> with Aloe Vera
- 13 Rosy Reds
- 10 Ghost Shrimp
- Tropical Fish Flake Food