

“Mafiish Mushkila”

My Journey through Egypt and Aquaculture

By Santiago Sanchez Warner

The experience I had in Egypt was life defining. Not a lot of people get the chance to experience a summer that I was lucky to spend in Egypt. For that I am extremely thankful. I wanted to formally thank everyone who made it possible and helped me through my stay. First of all Dr. Norman Borlaug, John Ruan, John Ruan II, and Ambassador Quinn for opening the door to such a great opportunity, Lisa Fleming for looking out for me and always making sure I was safe, My family for supporting me through my stay, Dr. Gamal El Naggar for his guidance, Samir Ali Zein for taking his personal time to show me all the wonders of Egypt, The WorldFish Center staff, especially Mohammed Abdel Qader, Mohammed Yahia, Waheed Elwan, Mohamed Megahed, Ahmed Nasr Alla, Nabil Ibrahim, and Mohammed Fathi, for answering any technical questions I had and making me laugh, Ahmed Shalaby for being patient and helping me transition into a different world, and finally Dr. Malcolm Beveridge for giving me a great perspective on life and sharing his insight with me.

When I first stepped off of the plane into the vivid sunlight and dry atmosphere, it hit me how far away from home I really was. Every one of my senses was confused with my new surroundings. The first sense I felt was smell. I could smell something foreign, something exotic. I shuffled off of the stair platform of the plane and down onto the runway. Walking into the airport was beyond chaotic. There was a crowd of men with signs reading dozens of names. I searched for mine but could not find it in the jumbled mess. I decided to go through passport check by myself and get my suitcases. I thought maybe my guide would be on the other side. As I shuffled through a crowd of people trying to get their passports stamped, I somehow ran into someone with my name on a sign. He introduced himself as Mohammed, and a second later I was off following his heels. He helped with my baggage and currency exchange. My measly 180 dollars converted to 1,024.08 Egyptian pounds. You could say it was the first real cultural experience that I encountered. It gave me a quick perspective about the economy in Egypt compared to that of the United States.

I was led out into the main area of the airport where I saw another man with a WorldFish Center sign. His name was Samir, and I learned that he would be my liaison. He seemed very friendly and happy to see me. Samir's accent was very thick, and I wondered if he was thinking the same thing about me. We went out into the street, and I saw a whole new world. It was like being dropped into some unknown place with a blindfold and all of a sudden it gets removed. The first things I noticed about Cairo were the buildings. Cairo is filled with buildings just like any other big city. Before I could mentally grasp everything, a silver coupe pulled up to the sidewalk. The driver and Samir helped get my suitcase in the trunk, and we were off. The drive was very intense. Streets winded like mazes and people and cars mixed together. There was no grass in sight. The trees were sprouted out of a dirt/sand mix of soil. The buildings in the less developed side of Cairo either looked modern or ancient. We then went by an army base, and I saw men in towers with AK-47's. It made me more nervous than safe, but I knew that I had nothing to worry *about*; *later*, I asked Samir who sort of shrugged it off, saying that it was for protection, but there was never any real violence. We went through a slum-like area and stopped at a little kiosk to get some refreshments. Samir got me some chips and coke. It was nice to see some familiar food. I was expecting everything to be completely different. After that, he let me call my mom from his cell phone, and we were off towards The WorldFish Center.

The WorldFish Center is located about seventy kilometers north of Cairo in a little city called Abbassa. Samir informed me that we would be taking the desert road, which did not really mean anything to me except that I would and did see the desert. The road was paved just like any interstate road in the United States. The only difference was fewer lanes and some sand scattered sporadically on the surface. The landscape was hilly, and the sand was a yellow-peach color. The sun slowly went down as we drove further and further. In the car, there was plenty of conversation. I was filled with questions, one after another. The first thing I asked was how to say simple English words in Egyptian Arabic. I learned "hello" and "thank you" and many other words that I forgot right away. I felt like I was overwhelming Samir with questions, and he had a difficult time understanding me, so I decided to focus on the surroundings.

When we arrived Samir showed me my fully equipped apartment and shortly, I was left to myself. In a period of hours, I experienced more than I could process. It felt surreal knowing that months ago I applied to participate in the World Food Prize Youth Institute and now I was in Egypt.

When my Spanish teacher told me that he and my journalism teacher had picked me to participate in the WFP Youth Institute, I had no clue what it was. I felt that it sounded very important so it would be a mistake to pass it up. As I continued to read, I started to feel honored to have been picked, let alone considered for my participation. Once I learned its importance, I felt almost embarrassed that I had never heard of the program. As I put my paper together, I knew that I had to diligently to make it my best work.

The WFP Youth Institute and award ceremony was amazing. The theme for the Youth Institute paper was developing different methods for securing food sources. The amount of variables for a country to develop a secure food source was staggering. Countries have to deal with issues that did not occur to me before: issues of fair trade, corruption in the government, bad infrastructure, lack of education, lack of funding, and many other equally important factors. The most important thing that I learned from my participation was that even with so many problems in need of being fixed, one person could still make a difference.

I felt inspired having found out so much about the problems in the rest of the world. I left the WFP Youth Institute with one thought in the back of my mind: That I would try as hard as I could to become accepted as an international intern for the World Food Prize. I prepared my application and strived to convey my true self in the interview process.

Receiving my letter of acceptance was probably one of the happiest moments of my life. I remember seeing the World Food Prize letter head and quickly scanning the rest of letter for any positive sign. The moment I saw that I was accepted, I called everyone in my phone book. The most exciting thing to see was that my location would be at the WorldFish Center in Abbassa, Egypt. The first thing I thought of was The Great Pyramids, and the second thing I thought of was that I had no clue where Abbassa was located.

I was not apprehensive about going to another country or even flying on a plane. I was born and lived in Spain until I was seven, so I frequented back and forth to visit my family on both sides. However I was very nervous about being somewhere so far away without my family or any comforting friend. The experience would be mine and mine alone. Overall, I felt more excitement than anything else. I had a lot of expectations about what it would be like in Egypt, but none of them came from actual facts. I remembered Ambassador Quinn addressing all the interns at the interview process and stating that he was really proud of us taking the chance of going somewhere and doing something so important, but that many friends back home would not understand. He was more than

right. Whenever I mentioned why or where I would be going, everyone looked at me like I was crazy. It seemed that the only thing on people's minds was the fact that Egypt was in the Middle East, and that it was a part of the world neither stable nor friendly to Americans. I looked past all that as I got prepared to leave. I knew that Egypt was a safe country, and I felt the importance of going to another country and learning what research was being done to prevent future food security issues and ending hunger.

When I woke up after the long journey, I awaited for Samir to come and take me across the lawn to the research center. When I arrived I met with Tawfik Yanni, the administrative and finance director. He was very friendly and let me know exactly what my schedule would be for the day. I was to meet with everyone and then go get groceries for the week. The next person I met with was Dr. Gamal El Naggar, the research coordinator at the center. He explained that while I was there, I would first get to know the ins-and-outs of the center and then develop my own mini-research project. He made me feel extremely welcomed, and I started to feel more comfortable even though I felt completely lost.

Going grocery shopping became a weekly ritual, but the first time I went was the most unique experience. As we drove towards Zagazig, the capital of Sharkia, the area in which Abbassa is located, I got a chance to really see the environment in the light. I could not believe how green the landscape of Sharkia appeared. I was expecting just desert everywhere but instead, I found lush farmland. It looked much like it does driving on the interstate here in Iowa, just fields of vegetables in every direction. The houses throughout the farm area were primitive and made from wood and straw but as we got closer and closer to a city, it switched to brick apartments. Everything looked like it was either in the process of being built or destroyed. Many multi-level apartments had open top floors waiting to be added onto. I later found out that in Egypt, a lot of families all live in the same apartment and when a male family member, wants to marry the family prepares another floor for him and his wife to start their own family. However, it takes a lot of money to construct a level, so the process takes a while. The process was completely different from the one that has been adapted in the states. It was interesting to observe the culture differences.

Whenever Samir and I went out in Zagazig and I asked for help, he would say "mafiish mushkila". In fact, I heard that saying everywhere. I found out at the center that it was an Egyptian colloquial word meaning "no problem". It seemed to really capture the laid-back attitude of people in Egypt. Any request or favor was answered with "mafiish mushkila". People in Egypt were very hospitable and would help complete strangers. I began to adapt the word into daily vocabulary early on.

Throughout my first week at the center, I became introduced to everyone and everything. Mohammed Yahia, who is in charge of security and is a scientist in the fish nutrition department, showed me around the center for the first week or so. He was assigned as my liaison for the scientific part of my stay. I was first introduced to the workings of every department and its function. The WorldFish research center in Egypt covers almost every area of Aquaculture and fish production. They have departments that

range from fish health, nutrition, water quality, genetics, and fish hatchery. The WorldFish Center in Egypt is part of a string of other centers located in eight other countries in Asia and Africa with the headquarter center being located in Malaysia. It is a non-profit organization supported by the Consultative Group on International Agricultural Research (CGIAR). Originally, The WorldFish Center was established as ICLARM (International Center for Living Aquatic Resources Management) until 1992 when it became part of the CGIAR. The main mission of the center is “reducing poverty and hunger by improving fisheries and aquaculture”. The WorldFish Center achieves this by identifying necessary aquaculture research and developing the research into applicable practices that can easily be adapted by small-scale fisheries. They introduce the new practices into the industry through several outreach programs and training sessions as well as by publishing scientific reports and handbooks.

Early on I was surprised that I had been sent to an aquaculture center. When I originally researched and wrote my paper on the topic of food security I thought of agriculture and livestock. I never really considered fish. After learning more about the work accomplished by The WorldFish Center I learned how important fish is for a secure global food market. Fish are generally easy to take care of, mostly relying on good water conditions and proper feeding. The yield can also be substantial when compared to how much area is needed for the ponds to properly maintain the fish. Another positive benefit of fish is that it is nutritious with high protein levels. If the right steps were taken, fish production increase could substantially help fill the void in the food market and help create more sustainability.

I spent most of the first week in the hatchery department where, at the time, a session was being held on African Catfish hatchery for a group of scientists from North Korea. When I heard catfish, I felt a sense of familiarity, but African catfish (*Clarias gariepinus*) is completely different from the channel catfish you find in the Mississippi river. It is a species of fish that has become more prevalent in African and Asian countries in the last couple years. An African Catfish is a versatile breed of fish that can sustain itself in poor water quality and can even live outside of water for up to eight hours. This makes the catfish easy to take care of and handle, thus making them easier and cheaper to produce while still having a profitable value.

Hatchery begins with the selection process. Catfish are hand-picked from a couple earthen ponds and then taken to an open concrete pond area. Spawning is the process of fertilizing the eggs. There are three methods to spawning: artificial, semi-artificial, and natural. The center has their own spawning method that they have developed. The fish are put into nets called happas, and the ponds are covered with a plastic tarp. The density and temperature that rises from the tarp creates a stress that causes the fish to spawn. If they do not spawn, the water level is lowered, and the process is extended for another day. Semi-artificial spawning is basically speeding up the natural process. A female fish that is not ready for spawning is injected with a solution created by the pituitary gland of a male fish; this makes the fish develop the eggs faster for spawning. Artificial spawning is carried out of the fish's body. The eggs are removed and mixed with the semen removed from male fish, then immersed into the

water. Within about three days, fry begin to appear in the nets. The only problem with catfish is that they can have cannibalistic characteristics so they have to be graded and separated by size. The whole process was completely fresh to me. I had no clue how much science was involved in the production of fish.

The next department I worked with was genetics headed by Dr. Mahmoud Rezk. The genetics department tags fish and monitors their growth to find the fish with the more dominant characteristics. This is all carried out through selection and not through genetic engineering. The work is primarily carried out with Nile Tilapia. The genetics department selects Nile Tilapia with superior traits of overall growth and capabilities to grow during the cold season, but they recently started similar research with the African catfish because of its rise in use. The time I spent in the genetics department was with Mohamed Megahed, a genetics research technician. Most of the time spent in genetics was collecting the fish and sampling their size. He instructed me on the correct way of tagging fish with either Floy tags or PIT tags.

Although the work was tedious, it was spent in good conversation. Mohamed Megahed was like most everyone else I met in Egypt and filled with humor. He bombarded me with hundreds of questions about western culture, which was a topic that I got a lot of questions about. The most common conversations were about marriage, religion, and government, things that normally would not be talked about in a casual conversation. I tried to be the most open-minded person I could be, which I think helped people feel more comfortable opening up to me. It seemed, through my conversations with Mohammed Megahed and several other workers, that the common attitude about western culture was that everyone had more freedom. You would think so in a country whose entire government is based on a declaration of freedom and independence, but it really depends what you are talking about. As religiously strict as the government in Egypt is, the people can enjoy simple freedoms without any worries. In the United States we have a lot of laws that restrict everything in life; while some obviously are there to protect everyone, the fact is that there are still a lot of restrictions like from how you walk across the street (jaywalking) to how you drive. It definitely went both ways and some things that would be personal choices in the United States are not left as a choice in Egypt. Marriage, for example, is a very formal process. Any real relationship before marriage is completely prohibited by law. Different countries have different customs and some things work better for other countries because of the history and culture. As deep as the conversations were, they were mostly laughed off.

After a couple of days working with Mohammed Megahed, I decided to tag along with Mohammed Yahia and his experiment. He and Nabil Ibrahim, another research technician, were working on an experiment with the effects of different fertilizers being introduced into ponds. Again, I was amazed by the diversity of topics that could be researched in the field of aquaculture. Fertilizers are used in ponds to encourage algae to grow; with more plant life, more oxygen can be introduced into the pond during the day, and the algae can create a food source for the fish. However like anything else, there are negative effects. The experiment would be very beneficial to farmers because farmers use both organic and chemical fertilizers, and chemical fertilizers are expensive. I watched

and helped them collect and sample fish from several of the earthen ponds to record their weight. I felt a little out of place because I was only a high school graduate from Iowa who had no clue about aquaculture. I still did not feel completely comfortable with the scientific side of my stay at the center but for my first week, I really could not expect much more

When I was not working, I spent my time in a quaint office that I shared with Ahmed Shalaby, who helped schedule and prepare the training sessions at the center. He became a very close friend throughout my stay. I felt a little bit like a burden because of the number of questions I asked him. He and I, like with Mohammed Megahed, shared conversations about every aspect of life. The most prevalent topic was religion. We questioned each other about our respective religions, his Muslim, mine Catholic. It was never because we were questioning our own faith, merely for our educations. I was really interested in Islam because of how intertwined it was in Egyptian culture. The laws were based off of Islamic values and every city that I saw in Egypt, no matter how small, was bound to have several mosques. I was also very interested because it is a religion that gets somewhat stigmatized in the United States, especially because of countless amounts of stories on the news about Islamic terrorists. Any religion can be misinterpreted into a negative purpose and from what I have learned about Islam, that was the same case. Every religion followed correctly is for the purpose of being a better person and helping those around each other. This is no different from Islam.

The hardest adjustment I had to make was being by myself for so much of the time. I did not have a roommate, so when everyone went home at 4:00, I was left with my apartment to myself. I brought a lot of books with me, and the television had a couple of English channels. Being by myself was only difficult because it gave me time to think about home. The center had to be protected at night because otherwise, robbers would come and take all of the fish and ruin the experiments. This explained the huge surrounding gates and walls. A team of security guards also stayed overnight to watch the center, so I was not completely alone, but very few of the guards spoke English. I made an effort to communicate but found it difficult. The subject matter had to always be really light; otherwise, it was impossible to explain. I managed to create a really basic form of English that left out most verbs in a sentence so that I could be better understood. They were all very friendly and curious about life in America. It also made me feel safe knowing that there was someone there to watch over the place.

On several weekends when I was not working, I was fortunate enough to travel with Samir Ali Zein to different locations of Egypt. The three big cities that I visited were Cairo, Alexandria, and Sharm-el-Shekh. Each had its own style and beauty: Cairo was a crowded metropolis with hundreds of stores and restaurants everywhere, Alexandria was a European influenced city with plenty of relaxing beaches, and Sharm-el-Shekh was a mountainous paradise with the perfect waters of the Red Sea. I was more than lucky to experience the diverse beauty of Egypt, not to mention seeing the Great Pyramids, which were beyond amazing.

All the weekend trips that I took around Egypt gave me an awe-inspiring glimpse of what Egypt was like geographically but socially, it was a little misleading. All these places were great, but I really enjoyed seeing Abbassa and its neighboring cities. They showed the humbler side of Egypt, the side you do not see on the postcards. It was there that you found people who might not necessarily have all the comforts of life but the most glowing smiles. There was no doubt that a lot of people live in what would be considered poverty in the United States, but I never saw any desperately gloomy people feeling sorry for themselves. I just saw people working in shops or working hard on their fields, kids playing soccer in the streets and laughing, and groups of people having conversations about what I could only guess. Those were the places that reflected the true personality and life of Egypt.

After a couple of weeks of working in genetics and hopping in and out of some of the other departments, I found myself in the dry labs with Mohamed Abdel Qader, research technician, and Diaa Kenaway, head of the water quality department. In the lab, I learned how to test several barometers to test the quality of water. I was given instruction on testing water samples for pH, ammonia, nitrate, nitrite, chlorophyll-a, phosphorus, and dissolved oxygen. I thought that the work in genetics was tedious until I worked in the lab. Frequently, it was sample after sample, over and over all day, and eventually, the data would have been analyzed which would have been a lot more eventful but at the time, the samples only needed to be measured.

The Fish Health Department diagnoses and treats fish diseases through several different methods. Like immuno-stimulants or maybe cheaper preventative methods. For farmers with little capital, it can be very expensive to treat the fish. Mohammed Fathi worked as the research technician in the fish health department. I did not get chance to help in the fish health department.

After getting a chance to work in the other departments, I was given a chance to develop my own project. I was unsure of what I wanted to do for my project, so I did some research and attended some of the training sessions that the center was offering and running. Going to the training sessions not only helped me understand aquaculture but it showed me the process of passing along all the research and information for other teachers, scientists, and farmers to use.

During the course of my stay, I was at the center for three training sessions. Two training groups were from all over Egypt, and one was composed of people from all over Africa. It was really nice to receive some company while I was at the center. They stayed overnight in the guest quarters next to my apartment, so I got a chance to converse with them and ask them questions. Of course, I was again hit with similar questions about America. From talking to most of the groups from Egypt, I realized a common trait in Egyptian people was that they all love to laugh and joke. Every minute was an opportunity to smile or laugh. It was interesting how humor never got lost in translation. Life just seemed to slow down a lot from what it was like in America; everyone took time to appreciate every minute of life given to them. I also got the chance to play soccer with most of the trainees, which was nice since I had not played since I was very young. I was

not the greatest player to step on the field, but it was nice to blow off some steam after working a grueling day.

One of the greatest conversations I had in Egypt was with Dr. Malcolm Beveridge, the Discipline Director of the Aquaculture and Genetic Improvement. I had met him at the center and scheduled a time to meet him in Cairo. I met him at the Cairo office for the WorldFish Center. The office was located in Zamalek, which was located right on a sandbar island in the middle of the Nile River in the center of Cairo. It was an interesting part of the city because it had a lot of embassies and the American university, making it appear more expensive and luxurious than the rest of Egypt. Dr. Beveridge and I talked over lunch covering a myriad of topics. It was pleasant talking to him because he was from the U.K., which made it easy for me to use my normal range of vocabulary. We talked about Egypt, politics, and the work at the WorldFish Center. It was rewarding to hear his opinions and thoughts on the status of aquaculture in many of the African countries.

Through our conversation, I learned a lot about Egypt and the rest of the world's future problems, specifically relating to aquaculture. The topic we talked about the most was the fact that a lot of the sources for usable water were being dried up, especially in Egypt. Agricultural farmers in Egypt irrigate water out of the Nile River and its canals, but the demand for water has been increasing and with limited rainfall, there is only so much that can be used. Dr. Malcolm also told me that it had been recently discovered that seawater from the Mediterranean was possibly seeping under the soil and contaminating wells in the desert. For farming, it means an increasing demand to develop safe and productive ways to reuse water.

Dr. Malcolm showed me the rest of Zamalek while we talked more about Egypt. He gave me a completely different perspective on the world. We were talking about the dramatic difference of culture and status in Egypt, when he pointed out that we, an American and an Englishman, were the ones from the weird places, that the majority of places in the world looked more like Egypt than the United States or the United Kingdom. He pointed out that Egypt was in fact a better representation of the world. I never really thought of it in that way. I thought about that a lot and what could be done in the future to make everyone's lives comfortable in every country.

A little bit past the halfway point of my stay, I finally had a project to work on. Originally, I wanted to test how PIT and Floy tags comparatively affect fish's growth, since the genetics department was still using both. The only problem was lack of supplies, so Dr. Gamal helped me find an alternative project. He suggested that I compare the growth of Tilapia fry under two different densities of Tilapia and amounts of water exchange. I enjoyed my project immensely because of the ownership of it. I had my own fish to take care of, which made me feel like I was really contributing. The challenging part of the experiment was whenever I needed additional help from any of the field workers. This was because none of them understood English. I became incredibly fluent in my own type of sign language mixed with English and Arabic words. It was really comical because everyday they would talk to me in Arabic even though they

knew I had no clue what they were saying. They would even try speaking slower, thinking that I would be able to understand if it was not as fast. Besides my contact with the workers I also learned a lot about the scientific methods and the hard work it takes to develop your own experiment. Everyday, I was in charge of emptying and refilling the tanks, feeding the fish, and testing the water quality twice a day. It was not always easy and required me to work after everyone left and sometimes on the weekends. I did not mind, however, because I felt more like I was finally earning my keep.

Over time, my project became more like clockwork. I set a schedule to handle all the work for my day and stuck to it religiously. I was checked upon regularly, but no one was spoon feeding me or looking over my shoulder. Anytime I had a problem everyone was more than willing to give me an answer. By the end of my experiment just about everyone at the center had given me a helping hand.

My stay was slowly coming to an end, and I had a sad feeling knowing that all the people that I had made such a strong connection with would soon be across an entire ocean. I wanted to see my family and friends, but I did not want to leave my new friends in Egypt. Driving back from our last excursion was great because Ahmed had just learned how to drive which made the journey a little more exciting. We took what was like a back road so that we did not have any real traffic. We hit every speed bump going back, but it was nice to enjoy the beautiful Egyptian countryside one last time.

The last week of my project I had my final sampling of the fish for size, which included everyone's help. I then finished putting my data together. It was nice to be busy before I left so that I did not have to think about leaving. Everyone said very kind words congratulated me on my work. I also had a meeting with Dr. Gamal to talk about how I had progressed from the first day to the last. It was nice to hear that I held my own. I felt a tad lost most of the time even with the right directions from everyone else but apparently, I had done well, and that was enough to make me proud. I also heard from Dr. Gamal that Mr. Waheed Elwan would be continuing my project, as they keep growing to a bigger size. This was the most exciting thing to hear because I was passing my work on to a veteran in aquaculture and maybe in the future, something helpful would be concluded from my project. To show my gratitude from everyone that helped me, I decided to have a small party that Samir helped me plan. It was really nice to just sit down, have some refreshments, and talk about how my stay was. It was somber, but I could not help but smile with all the people that taught me so much and kept me from becoming lost in a foreign culture. That night, I packed and waited for a car to take me to the airport. I did not sleep a minute thinking about the memories I made. I also missed my family and friends and was excited to see them again. The flight home was bittersweet.

My trip through Egypt at the WorldFish Center was the most rewarding event in my life. I remember being nervous before I went to Egypt, thinking that as an American, I would stand out for being a foreigner and run into problems with someone's opinions of American culture. I was more than happy to see the opposite. While people in Egypt may not agree with our government, they still do not feel a need to hate Americans. There

are a lot of relationships that different countries have that are not political, like a scientific field and in my case, aquaculture. If the WorldFish Center in Egypt discovered a new method to improve income and food for a farmer, they would pass that information on to the other centers or to a trainee, no matter what country they came from. The best way for a relationship to tie two cultures together is through the spread of knowledge and compassion. Food security is a problem that sooner or later every country will have to face, no matter how rich or poor. The technology is quickly being implemented but it will take the governments of the world to come together to ensure a stable future.

In my opinion after going to Egypt, I believe that people are inherently good and not evil, but it is the environment and conditions that they grow up in that convert them into cynical people. That is why aquaculture or any means of food security is vital. If people are fed, they can live happily and have healthy lives because their environment is stable. Thus, they grow to have an overall positive view of the world and can contribute in more productive ways.

This experience has opened my eyes to many problems that are easy to forget in my everyday comfortable life. It has inspired me to continue my pursuit of knowledge and to use my knowledge to contribute a helping hand to the problems of the world. While I am not continuing in the field of aquaculture as a professional focus, I know that the processes I learned while at the center will help with whatever route I take in college and further on in my future career. I will never forget the friends I made at the WorldFish Center. I am overwhelmed with happiness for the people of Egypt, the culture of Egypt, and the beauty of its terrain. I will wait in anticipation for the day that I can step on its soil again.

Performance of Nile Tilapia under Different Densities and Water Exchange Levels

By Santi Warner

Abstract

Nile Tilapia (*Oreochromis Niloticus*) are often stored in different densities as they grow in size, specifically in an intensive culture. In this experiment the performance of Nile Tilapia was monitored under two different stocking densities and water exchange models. The two densities were 400 fish/m³ (D₁) and 800 fish/m³ (D₂). For both densities the amount of water exchange was 30% (E₁) and 100% (E₂). There were two replicates for each formula. The fish were stored in 2 m³ cement tanks at an initial size of 0.2g. The tanks were drained daily. For E₂ the water was drained 50% then filled 100% then drained 50% and filled again. The water quality was monitored twice a day, in the morning and afternoon, to see the affect of the water exchange on the quality of the water. The morning water quality barometers considered were: Temperature, pH, Dissolved Oxygen, Ammonia, Nitrite and Nitrate. The afternoon barometers, after the water had been replaced, were: pH, Ammonia, and Nitrite. The fish were fed a 40% protein feed of about 15% of the biomass, adjusted weekly to fit the growth of the fish. The fish were sampled weekly over a 4-week period to monitor growth, and a final sample was taken to determine the mortality.

Introduction

In intensive aquaculture, fish are often raised and maintained in a closed circulation system or an indoor artificial circulation system. This means that instead of being developed in a natural setting the fish are maintained in a closed tank or cement pond. This closed system requires that the fish are fed by hand, instead of through the ecosystem, and the water and oxygen levels are maintained manually, basically the fish kept under complete life support. This healthy balance of diet and environment quality is maintained through one of the most important factors in aquaculture, which is water exchange. In a closed system, without water exchange or purification, waste is allowed to build up causing toxic amounts of ammonia, which if too high can damage the fish gills and then lead to poor growth and high mortality. The metabolic waste of fish is primarily ammonia. Depending on the organisms in the pond the ammonia can be fixed into more toxic chemicals like nitrite or nitrate, these chemicals can suffocate the fish if they reach a high level. The density of fish has to also be considered because the more fish you have the more waste is produced.

Materials/Method

The first day fish were stocked with two separate densities in 8 cement tanks randomly selected. Each treatment had two replicates. Mesh nets were put around the drains so that the small Tilapia fry would not be removed when the water was drained. Feeding platforms were also built using empty feed bags and iron bars. The platforms

were suspended about 5 inches under the surface of the water. The platforms were created to keep the feed from falling to the bottom of the pond and to monitor the feeding habits of the fish. Oxygen was also pumped into the pond with plastic tubes connected to air stones. The average weight of the fish was calculated and used to determine the number of fish needed in each tank. The tanks were set up in a closed circulation system so that the amount of water exchanged would be kept constant. In this experiment the amount of feed given was equal to 15% of the total fish biomass, which was adjusted weekly based off of the average mass of the fish. The first week the feed was given in three equal feedings at 9:00, 12:00, and 3:30. The water barometers were checked before the water exchange and after, at 10:30 a.m. (Before) and 2:00 p.m. (After). These barometers were taken at the same time through out the entire experiment

During the second week of the experiment the procedure was the same, except for the amount of feed, which was recalculated because of the growth of the fish. The sampling was taken the first day of the week by averaging the weight of 100 fish randomly collected. The water exchange for treatment D₂E₁ was also adjusted from 33% to 50% because of the dangerous levels of nitrite and ammonia.

The third week was again the same procedure with the sampling and feed adjusted. Halfway through the week the ammonia and nitrite levels decreased so the water exchange for treatment D₂E₁ was lowered back to 33%.

The final week was a half-week. Since the final sampling would be taken from the last day the average growth was predicted from the previous three weeks. This predicted average was used to find the 15% of biomass for the feeding. The predicted average weight was 0.79g. The final sampling was taken, by collecting all the fish and finding the total biomass for each pond. Then 200g samples of fish were taken twice from each pond to find the final average weight. This final average weight was used to find the total amount of fish. This total amount was then used to find the mortality and survival.

Data

Treatment	Water Exchange (%)	Fish Density (fish/m ³)
D1E1	30	400
D1E2	100	400
D2E1	30	800
D2E2	100	800

Table 1

Treatment	Tank	Mortality (%)	Total Fish
D1E1	3	19.75	642
D1E1	5	21.94	625
D2E1	4	31.86	1090
D2E1	8	25.96	1185
D1E2	1	7.89	745
D1E2	7	15.08	679
D2E2	2	17.36	1344

D2E2	6	13.31	1387
------	---	-------	------

Chart 1

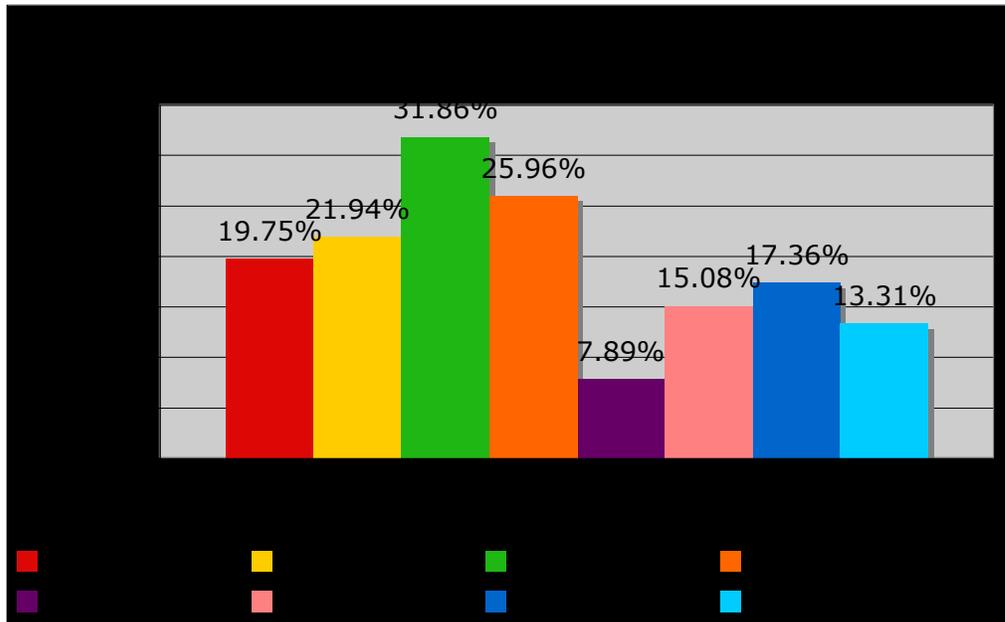


Table 1 and Chart 1 are showing the mortality rate of the Nile Tilapia in each treatment and tank. Looking at the data one can see that the mortality of the high-density low water exchange is significantly higher than that of the low-density high water exchange.

Chart 2

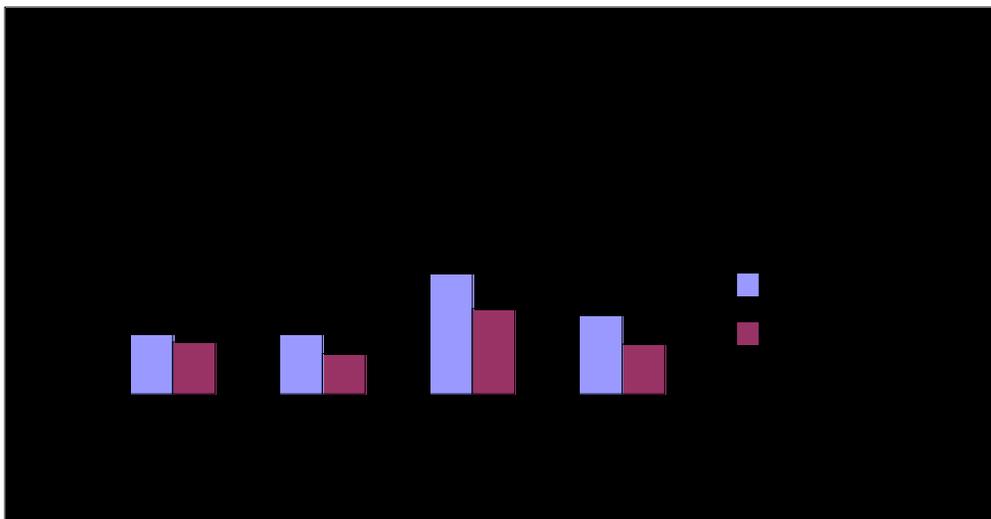


Chart 2 shows the comparison of the mean value of concentration of ammonia in ppm before the water exchange and after. Looking at the chart, you can see that the water exchange worked tremendously in controlling the amount of ammonia in the tanks. The

higher density produced an overall higher concentration that throughout the experiment grew larger and larger as the fish grew.

Chart 3

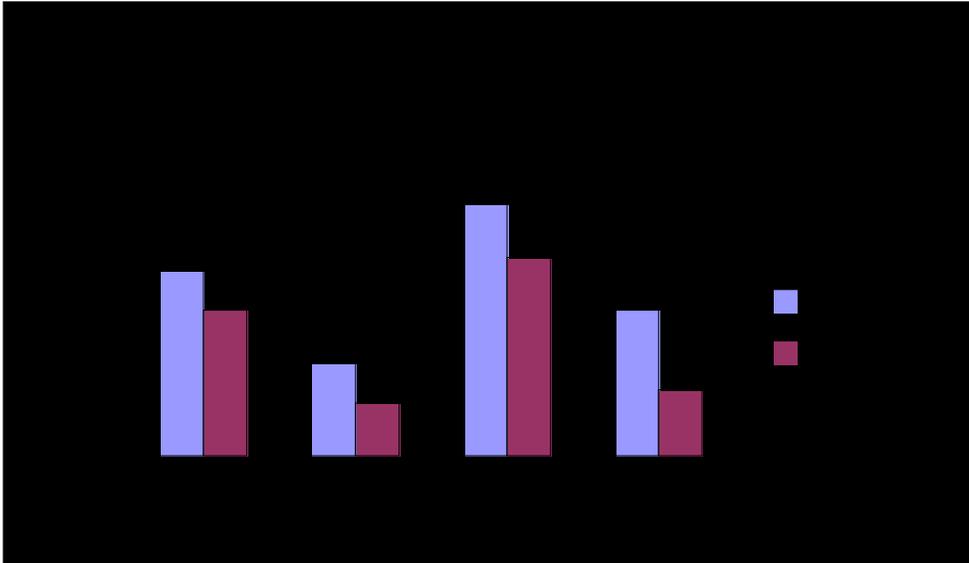


Chart 3 shows the mean value concentration of nitrite in ppm before and after the water exchange. Again you can see the effect of the water exchange on the overall concentration of nitrite in the tanks. In treatment D2E2 one can also notice the dramatic difference that the 100% water exchange had on the water quality even with a higher density, but the overall nitrite concentration reached a high level.

A quantitative analysis showed that the ammonia and nitrite concentrations were the most influential on the growth of the fish the other barometers did not affect the fishes' growth as directly.

Discussion

Looking at Chart 2 and 3 one can see that overall the higher water exchange was the most effective for maintaining safe levels of nitrite and ammonia. One exception would be the treatment D2E1, which is the high-density low water exchange treatment. This would be opposite of what was expected, but if you take into account the fact that the percent of water exchange had to be increased throughout week three. Also the mortality rate of both of the high-density treatments was a lot higher than the low-density treatments. The high mortality caused the density of the fish in the tanks to decrease over the course of the experiment, which means that there were less fish creating waste that could turn into ammonia and also less of a density stress on the fish.

Conclusion

I believe that with a high density the amount of water exchange needed to control the quality of water should be at least 100% water exchange. The low density with 30% water exchange seemed to maintain steady levels of ammonia and nitrite as well as the other barometers tested. This conclusion fits the experiment but in a real world setting where a maximum amount of yield is necessary to make enough profit to cover the capital it would not be profitable enough to follow the concluded amount. Also in certain areas the source of water is scarce making it difficult to use this much water. To come to a meaningful conclusion the experiment would have to be performed on a larger scale. It would also be necessary to look at different ways to control the water quality, which could include filtering systems.

References

Barbosa, J. M., S. S. S. Brugiolo, and J. Carolsfeld. "HETEROGENEOUS GROWTH IN FINGERLINGS OF THE NILE." Scientific Electronic Library Online. 20 July 2007. <<http://72.14.205.104/search?q=cache:YVbobhAVFUMJ:www.scielo.br/pdf/bjb/v66n2a/a20v662a.pdf+nile+tilapia+stocking+densities&hl=en&ct=clnk&cd=12&gl=us>>.

Emerick, Sue. "Nature's Nitrogen Cycle." Pond Hobbyist. 19 July 2007 <<http://www.pondhobbyist.com/articles/NitrogenCycle.html>>.

Pillay, T. V. R., and M. N. Kutty. Aquaculture: Principles and Practices. 2nd ed. Blackwell Publishing, 2005. 20 July 2007. <<http://books.google.com/books?id=iCDBCGtUiusC&pg=PA136&lpg=PA136&dq=danger+of+ammonia+in+aquaculture&source=web&ots=3q39vU0MC2&sig=TIISRgbsWqBVmOnrZrE25InNgXo#PPA374,M1>>.

Rice, Mike. "Aquaculture." Seagrant. 2007. 18 July <<http://seagrant.gso2007.uri.edu/factsheets/Aquaculture.html>>.

Yang, Y, L.c. Kwei, and J.s. Diana. Influence of Nile Tilapia (*Oreochromis Niloticus*) Stocking Density in Cages on Their Growth and Yield in Cages and in Ponds Containing the Cages. Ingenta Connect. Elsevier, 1996. 22 July 2007 <<http://www.ingentaconnect.com/content/els/00448486/1996/00000146/00000003/art01377>>.

