Fishing for Justice

An Egyptian Experience

Stephen Lauer

Gratefully Dedicated to:
Kareem Rasaki
My constant companion
Drs. Gamal and George
For their wisdom and their guidance
The WorldFish Center Staff
For opening to me their hearts and minds
Mrs. Lisa Fleming
For acting as my third summer parent
Dr. Norman Borlaug
His dedication and his vision made all this possible

Every journey has its beginning. Mine began quietly and perhaps fittingly, in the comfort of my own living room in Des Moines, Iowa. It was there (and I remember this clearly) that I made the decision to participate in the World Food Prize Youth Institute and what was to become the adventure of a lifetime. Sure, I had heard of the Institute before. In fact, several of my classmates had just received their internship acceptance letters. It was just that up until that time, I had never thought of the Youth Institute as "for me".

Perhaps it was the ad from UNICEF, shown on television that night, which finally pushed me to join. As I'm not in the habit of watching a lot of television, it was one of the first times I'd even seen pictures of what hunger looked like. The ad aroused a visceral sense of injustice within me that demanded I do something. So I did.

My participation in the Youth Institute only strengthened my commitment to work in the field of food security. Along these lines I applied for a Borlaug-Ruan Internship, hardly daring to hope that I would actually receive one. I was extremely excited when I found out that I had been selected to intern at the WorldFish Center in Abbassa, Egypt, and began preparations almost immediately.

Of course, nothing could have truly prepared me for my experiences in Egypt. This discovery came rather abruptly as I stepped off of the plane in Cairo into a whole new world. Fortunately for my weary and bedraggled self, I was almost immediately greeted by Mr. Samir Ali Zain: the WorldFish employee charged with transporting me from Cairo to Abbassa, one-and-a-half hours away. Samir gave me my first taste of Egyptian hospitality, insisting on carrying my bags and even buying me some Egyptian beef kabob and flat maka bread from a roadside stand.

My first surprise on the drive to Abbassa was the driving itself. Compared to American driving, Egyptians drove crazily! The only rules seemed to be not to crash and to follow the orders of the policemen that were stationed near every major intersection. In addition, cars shared the road with all manner of traffic: bicycles, donkey-drawn carts, even goats and dog packs traveled along the shoulder.

The road leading from Cairo to Abbassa began as a toll road through the desert and met up with the Ismalia canal near the city of Zagazig—Samir's hometown. The road near the canal was surrounded by rice farms. The delta is known for the summer crop of rice, in much the same way as corn is associated with Iowa. As we were driving, I was struck by the barrenness of the uncultivated land. Ever since the construction of the Aswan High Dam contained the Nile's annual flood, the ecosystem of the delta has relied on human irrigation. To see the lush green of a rice field adjacent to the parched barrenness of the Sahara desert was amazing.

As we entered the WorldFish center complex, I was surprised by the security fence that enclosed it. At first glance, the front of the place looked like a fort. It turns out that the fences are required to help prevent thieves from destroying the research projects by stealing the center's fish. We drove past the center's security guards and up to a plain white two story building, which would be my new home. I entered my apartment in Villa

Two and fell exhausted into bed.

The next day, I was invited to meet with Drs. George John and Gamal El-Naggar, my mentors-to-be. It was then that I had my first real exposure to the mission and goals of WorldFish. The WorldFish Center was established as ICLARM (International Center for Living Aquatic Resources Management) in 1977 with the mission of "reducing poverty and hunger by improving fisheries and aquaculture". It became a part of CGIAR (Consultative Group on International Agriculture Research) in 1992. The WorldFish Center is headquartered in Penang, Malaysia and consists of a network of research and outreach stations. The Regional Center for West Asia and North Africa, located in Abbassa, Egypt, serves the people of the world by supporting the development of sustainable and equitable aquaculture.

In order to reach their aquacultural goals, the WorldFish station in Egypt has three objectives. The first objective is to "support the development of sustainable aquaculture" by identifying constraints and opportunities. The second objective is to "develop technologies that can support sustainable aquaculture". The third objective is "harness learning from the regional experience in aquaculture and communicate this through regional (and multi-regional) training courses". The purpose of the WorldFish Center's Egyptian station can therefore be summarized as identification, development, and communication of sustainable aquacultural ideas and practices.

Both Dr. George and Dr. Gamal viewed my purpose at the center to be primarily that of a student (In Egypt one may address a Dr. by first or last name). Considering that I knew very little about aquaculture and even less about the work of the center, I had to agree. This meant that although I was eager to start a project, I would have to first spend a week observing the activities of the center staff. Though I must admit that I was disappointed at the time, the week of observation was the best introduction to the center (and to aquaculture research in general) that I could have hoped for. I was able to work some with each of the research departments; to see their projects and to discover how it fit in with the mission of the center.

One of the first departments that I visited was Genetics. Their research is overseen by Dr. Mahmoud Rezk, and is carried out by Mr. Mohamed Megahed and Mr. Tharwat Attalah. It focuses on improving the growth performance of the Nile Tilapia (*Oreochromis niloticus)* through selective breeding. This genetic improvement fits into the mission of the center because it stands to enhance both the economic sustainability of aquaculture and the availability of aquacultural technologies in general. Farmers in all locations can benefit economically because faster growing tilapia strains yield more marketable fish in a shorter amount of time, producing more quality protein for family consumption or allowing them to earn more money from sales. Moreover, some farmers live in areas where faster growing tilapia strains are necessary for any form of profitable aquaculture, due to the scarcity or seasonal availability of water supplies. Genetically improved tilapia are needed for their farming to take place at all.

The genetics project is currently in its fifth year at the center. Each season the project's

fish are tagged and allowed to grow; their growth parameters are measured, and the fish with the highest "breeding values" are selected to produce the next year's offspring. While I initially thought that the breeding values would match up nicely with the growth performance of the fish, it turns out that growth is only one of many factors that have to be considered. In addition to individual growth performance; the degrees of relatedness between potential mates, the performance of each tilapia's relatives, and the pond environment all have to be accounted for. To do this, the researchers rely on both their extensive field experience and a complicated computer program. Over the course of my internship, I spent several days observing the genetics team as they mated the best of last season's fish and began this season's growth monitoring.

Another department that I visited early during the internship was the water chemistry department. Run by Mr. Diaa Kenawy and Mr. Mohamed Abdul-Kater, the water chemistry department's primary function is monitoring water quality and researching water quality issues. Water quality monitoring involves performing a series of chemical tests. Daily measurements are taken for dissolved oxygen, temperature, ammonia, and pH; parameters that could easily kill the fish if not kept within acceptable ranges. Measurements of nitrite, nitrate, and phosphorous; parameters which are important for algal growth, are taken less regularly. Algal concentrations are measured indirectly by measuring water visibility and chlorophyll-A concentration.

As I learned how to perform these tests, I became fascinated by how a pond's chemical and biological processes interact. I learned about how ammonia, pH, and temperature interact to produce free Nitrogen; which in high concentrations is damaging to the fishes' gills. I also learned a great deal about the role of algae in the ecosystem of a pond. While algae is generally beneficial to tilapia by serving as a food for the zooplankton that they feed on, too much algae negatively affects dissolved oxygen at night when the algae cease to photosynthesize and become net consumers of oxygen. Over-fertilization is not a problem in Egypt, were most farmers try to encourage algal growth through fertilization of their ponds and simply stop fertilizing when the algae become too prevalent.

I had only a brief contact with the fish health department, which employs Dr. Salah Aly and Mr. Mohamed Fathi. Their experimental work deals with discovering and testing immuno-stimulants that can be used to prevent fish diseases. Over the course of the experiment, the fish in the select group are fed the immuno-stimulants as a part of their diet. The performance of the fish fed the immuno-stimulants is then compared to that of the control group to see if the cost of the stimulant is justified by the increase in yield. Finally, the fish are transferred to aquaria and infected with a pathogen to test their immune response. Based on the effectiveness of the immuno-stimulant when compared to its cost, the center is able to make a recommendation for or against its use.

Upon learning of the center's work on immuno-stimulants, I became curious about their impact on aquacultural practices, and about why they are favored over the antibiotics that are commonly used in the livestock industry. The answer to my question was that immuno-stimulants are believed to be safer than antibiotics and are also more economical for use in aquaculture, where the effectiveness of antibiotics is eclipsed by their high

costs. While immuno-stimulants have the ability to improve all methods of aquaculture, they will mostly benefit the intensive aquacultural practices in which a significant percentage of fish are lost to disease.

I made contact with the hatcheries department during the second half of my first week at the center. Overseen by Mr. Waheed Elwan, the hatchery produces fry for the center's activities in addition to conducting research of its own. The focus of the hatcheries research is on improving spawning techniques for the African Catfish. While American aquaculturists generally induce spawning in the related Channel Catfish; the African Catfish is propagated almost entirely through natural spawning. The center focuses on finding ways of encouraging natural spawning between catfish and on maximizing the survival of the fry produced from such spawning.

In order to naturally spawn African Catfish in a hatchery, the parent fish are first put into fine-mesh nets known as hapas, which are partially immersed in warm water. The combination of high temperatures and the close proximity of the catfish is usually enough to induce spawning within twenty-four hours. During spawning the eggs are affixed by the female to the sides of the hapa and are fertilized externally. As soon as spawning is discovered, the parents are removed from the hapa to prevent them from damaging the eggs. The fry hatch three days after spawning, and grow to a releasable size in roughly a month. Starting ten days after hatching it is important that the fry be graded, or separated based on size. Regular grading prevents the fry from becoming cannibalistic.

I first visited the nutrition department at the very end of my week of observation. Under the direction of Dr. Mohamed Yahia, the nutrition department conducts research on alternative feed ingredients with the aim of reducing the cost of fish feed. For most farmers, feed accounts for fifty to sixty percent of the costs of doing business. The most expensive component of fish feed is fishmeal, which comes from low-quality wild fish. In addition to being its expensive, the decline of wild fish populations has cast doubt on the sustainability of fishmeal as a feed component. During my stay, the center began a study on the viability of processed soybean meal as a replacement for fishmeal in feed for tilapia. While soybean meal is both cheaper and more readily available than fishmeal, it may be less digestible for tilapia even after processing to remove toxins. Based on the growth and survival of the tilapia in Dr. Yahia's experiment, the center may be able to make a recommendation.

After spending my first week observing center activities, I was ready to see some of the rest of Egypt over the weekend. Dr. George invited me to attend his church on Friday, and Samir arranged for a car to take me into Cairo. The church was located in the Maadi neighborhood in Cairo, surrounded by shops and apartments. I was surprised to see that the church was surrounded by police, but Dr. George told me that they would guard any area in which foreigners were likely to gather. As it turned out, very few members of the congregation were Egyptian nationals. Many had jobs in Egypt, and many more were just tourists passing through. After the service, Dr. George invited me to his apartment. It was then that I learned that Dr. George was not an Egyptian citizen, but from India. He had taken a 6 year position with WorldFish in Egypt, and was actually planning to spend the

next six weeks in India visiting relatives. Before I went back to WorldFish for the afternoon, Dr. George and I shared a lunch of delicious Indian cuisine.

The next day, Samir took me to see the pyramids at Giza. We were allowed to drive partway there, but we had to make the final approach on foot. The entire area around the pyramids was surrounded by security guards mounted on camels and bearing assault rifles. When it comes to security, the Egyptian government certainly puts its muscle where its mouth is. After passing through the final set of metal detectors we were at last allowed to get close to the last remaining wonder of the ancient world. The shear size of the monuments was staggering, and the knowledge that each one was constructed under the orders of one man filled me with a sense of awe. I could not help but think of agriculture at this point, and how Egypt must have used its former status as breadbasket of the world to aid in the construction of these giant tombs.

I was allowed to enter the antechamber of one of the smallest of the nine pyramids, this one constructed for the mother of the Pharaoh Keops. It was amazingly cool inside, and though I was only a couple of meters away from the surrounding desert, I was effectively buried under a mountain of earth. The Egyptian tour guide allowed me to take several pictures inside the pyramid, probably because it increases tipping. As I had no small Egyptian bills at this point, Samir took care of the tips. Besides housing the pyramids, the plateau of Giza also provided a view of Cairo, a sprawling metropolis with a population over 10 million. As I turned away from the pyramids, I was struck by this modern marvel of humanity, sprawled out to the north as far as the eye could see. As the pyramids are a monument to the dead, so Cairo is a monument to the living, and to the land that after thousands of years is still largely able to support so great a number of people.

After taking photos of the monuments at Giza, we proceeded down into Cairo to shop for souvenirs. The traditional Egyptian shops operate on a system that is half haggling and half based on connections. I was fortunate that the shop owner knew our driver, and that Samir was a great haggler. I was thus able to purchase my souvenirs at a price that was very close to the price that would have been charged to a native Egyptian. Before we left Cairo for Abbassa, Samir took me grocery shopping at one of the modern Egyptian malls. There was a supermarket there that looked and felt very much like a Fareway or a Hi-Vee in the States. There was also an American food court where Samir bought me Kentucky Fried Chicken. This would be the only recognizably American fast-food that I would eat while in Egypt. After lunch, we went back to the center, where work would begin on Sunday.

It was about this time that I was approached by Farag, one of the chief security officers at WorldFish. Farag was somewhat upset because I hadn’t been spending time with the security personnel. He asked me if I was scared of them while assuring me that I need not be. I was astonished by this: I had no intention of hurting anyone’s feelings. I learned that my waiting to speak until after spoken too was not viewed as a sign of respect in Egypt but as a sign of fear or hostility. I quickly modified my behavior so that I regularly went to the security office instead of waiting for them to come to me. By doing so, I opened the door to many fascinating discussions about everything from Islam to immigration.

As I learned more about the activities of the center, I began to develop ideas for a project of my own. I wanted to do something useful for the center, but at the same time I didn't want my project to take away from my ability to learn about all aspects of aquaculture. I was extremely fortunate in having Drs. George and Gamal to guide me as I made this decision. Ultimately, I decided to do an experiment to determine the relationship between female weight and fry production in Nile Tilapia. I chose this experiment for two reasons. This relationship had been the subject of several earlier studies, which would give me some guidance in carrying out the experiment. On the other hand, there was still a need for more studies in the area, meaning that quality results would prove useful to the center. Additionally, the experiment would prove useful to me as a student because it would involve gaining knowledge of important aspects of aquaculture such as caring for brood stock and nursing fry.

As I began my experiment during the second week of my internship, I was in no way prepared for the challenges that would await me. I expected this experiment to go like the experiments that I had done in school: relatively easily and with near perfect results. It was with great anticipation that I gathered the first set of hapas from Mohammed Fathi and watched as the workers set them up in the tank. The next day, Waheed Elwan helped me to select and weigh my tilapia brood stock, which we placed into the hapas just before my weekend trip to Alexandria.

My roommate Kareem arrived just before my scheduled trip to Alexandria. Kareem was a Muslim man from Ogun state in the southwest of Nigeria. He came to the center as a part of his studies for a doctorate in fisheries economics. We got to know each other better on the trip to Alexandria (which involved several hours in our driver Gouda's cramped car). Once we arrived, Samir took us to several hotels, looking for the best price. After he checked us in Samir, his son, our driver Gouda, and Kareem went to pray. I stayed in the hotel room for about an hour, listening to the ocean waves and to the criers of the mosques, interspersed with the sounds of cars on the street outside.

When prayer was over, we went to the city museum of Alexandria, which had a large collection of artifacts that dated back to the Greek pharaoh-kings who made Alexandria the capital of Egypt. Next, we went to the Alexandrian library- the modern heir to the great library of ancient times. Housed in the lower level of the building were rare books including ancient copies of the Qur'an, letters of Christian and Muslim saints, and the last surviving papyrus scroll from the original great library. Knowledge was palpable within the building, and with so many religious documents the place felt more like a shrine than a museum or a library.

For dinner, Samir took us to an Egyptian restaurant. We were served a traditional four course meal with bread and salad, soup, meat and rice, and a desert that everyone was too full for. Food holds a special place in Egyptian culture, and meals like the one I was served are normally enjoyed on special occasions by those who can afford them. Something about the food made me feel valued, both as a guest and a person. Egyptian meals are as much the sustenance of the spirit as they are of the body.

As night fell, we went to see the coastal areas of Alexandria, where young lovers sat on benches along the narrow strip of land between city and ocean. Alexandria, Samir explained, is Egypt's playground. Affectionately known as "Alex", the city is rich in culture and endowed with a history that goes back four millennia. Alexandria is where the rest of Egypt comes to forget their problems and to revel in the carnival atmosphere that is a celebration of the Egyptian identity.

The next morning we went to the palace that belonged to Egypt's last modern king. The entire grounds have been preserved as a historic park, leaving intact the quasi-European landscaping that was a symbol of England's interference in Egyptian politics. The lavishness of the architecture was astounding; no expense was spared in the construction of the buildings. The entire palace grounds are a testament to the deep rooted dichotomy between Egypt's haves and have-nots, a system caused by centuries of foreign plundering that is only now being addressed.

Before leaving Alexandria, we went to the city's one surviving citadel. Constructed by the Ottoman governor as part of an "impenetrable" costal defense network, the citadel also served as the wartime capitol of Ottoman Egypt. Each of the costal towers was a microcosm of larger Alexandria, complete with a fresh-water cistern, mosque, quarters for the soldiers and the shops that served them. The towers boasted mighty cannons, more powerful than any European gun of the time. Unfortunately for the governor, the English naval guns had a longer range, and during the period of European interference all but one of them were destroyed from a distance by the ships of the English navy. Luckily for us, the citadel survived, and touring it made our trip to Alexandria complete.

The week following my excursion to Alexandria proved to be an experimental nightmare. During the two days after my trip I found half of my brood stock dead or dying. The smell inside the hapas was sickening. When I tested the water, I discovered relatively high levels of ammonia. After talking with just about everyone that I could find, I became aware of the source of the problem. The pores in the walls of the hapas were too small, which severely limited water circulation. To make matters worse, the hapas themselves were too small, further stressing the brood stock by keeping them in close proximity.

Once the source of the problem was identified, I was able to go to Mohamed Megahed for assistance. Because part of the genetics program involves breeding tilapia, I believed that he would be able to help me to acquire replacement hapas. Sure enough, the genetics team had leftover hapas in a backroom, which I was able to help them repair. We then replaced the old hapas with the new, better quality hapas. We transferred the remaining brood stock to them the following day. I was also able to replace the dead with fresh tilapia from the one of the center's ponds.

During my third week in Egypt, the center hosted a group of African trainees. The purpose of their stay was to learn practical aquacultural fieldwork. I decided to shadow them in order to enhance my own learning experience. The first day of training was spent studying water chemistry, particularly the procedure for collecting field measurements.

Because I already had some practical experience in this field, I was allowed to help the trainees measure the water chemistry of some ponds during the night shift. I stayed awake until 2:00 in the morning, at which time Kareem and I went out to the ponds with the trainees in order to help them take the measurements. Although I felt extremely tired, I also felt honored that the water chemistry department considered me enough of a chemist to help them in their work.

As the week progressed, I had the opportunity to learn about how to prepare diets with fish nutrition, identify tilapia by species and sex with genetics, and how to properly go about the artificial spawning of catfish. The spawning method was particularly interesting. First, a near-ripe female was injected with pituitary extract in order to ripen her eggs. After ripening, the eggs were stripped from the female by pushing down on her abdomen. Next, the eggs were fertilized in a dish using the testes of a freshly killed male. The eggs were transferred to an aquarium for hatching. Artificial spawning normally results in about three quarters of the fry of a natural spawning. After Mr. Elwan finished his demonstration he invited me to cook the dead male catfish for lunch. I did so, and all of us had fried catfish for a snack. Best of all, everyone liked it!

While the focus of the training was on field work, there were also several classes in aquaculture academics. My favorite of these presentations was given by Dr. Yahia on the topic of silage, its preparation, and its use as a fish feed. Silage is prepared by partially fermenting plants such as grasses and terrestrial or aquatic weeds. This process adds protein and breaks down otherwise indigestible cellulose, making for a nutritious fish feed. Silage is economical in situations where fish require supplemental feed and the farmer has access to grasses and weeds that are not already being used. In integrated agricultural systems, silage provides a way of recycling otherwise wasted nutrients by feeding them to fish.

In addition to learning about aquaculture, my time with the trainees gave me the opportunity to understand a little more about aquaculture in Africa outside of Egypt. All of the trainees had to work with fish as a part of their jobs in their home countries. Most of them were optimistic about the ability of fish farming to help provide food and jobs to their peoples. From speaking with them, I became aware of the problems of corruption and inconsistent policy that plague many of their countries and are some of the barriers to economic security. Empowerment of the people through the provision of food and jobs seemed to be one of the key needs that aquaculture could fulfill. Unlike many other development projects, aquaculture ponds are owned and operated by farmers of the community in which they are located. Aquaculture provides both a livelihood and a voice to rural societies, who are able to use their fish to bargain for political and economic power from their governments. As I spoke with the trainees, I began to see African aquaculture as part of a bigger picture of providing security, both economic and political, to the continent.

Towards the end of the week of training, I was invited by the Center's English teacher Mostafa to visit his home city of Ismalia. Located on the Suez Canal, the building of Ismalia was funded by the French to assist in canal construction. Ismalia harbors some of

the largest and most beautiful Catholic churches in Egypt. I was allowed to enter one of these churches, built using a mixture of French and Arabic themes. The imagery inside the church was amazing, and one of the monks volunteered to explain the significance of each of the mosaics and paintings. Before I left I was given the opportunity to donate to the Ismalia parish human advancement program which focuses on children with disabilities. Such children's needs are often neglected, and many families could go bankrupt providing them both because of their poverty and of the scarcity of doctors and facilities.

After leaving the church, Mostafa took me to see the Suez Canal. The size of the ocean freighters was impressive. The strategic and economic importance of the canal to the Egyptian government is hard to understate. Even as I was marveling at this feat of construction, my awe was tempered by the thought of the thousands of Egyptians who died to build it, literally worked to death by the occupying military. As we ate at a traditional Egyptian restaurant, discussion turned to politics. Mostafa wanted to know what Americans thought about Egypt and the Arab peoples, and why our government pursues a policy that is so often against the interests of the Egyptian people. These questions are extremely complicated, and I can't say that I was able to answer them completely. They did make me acutely aware of the need for more respectful dialogue between America and the Arab world. One aspect that I continually brought up was the diversity of opinion and of the need to avoid generalizations, a comment that could just as easily have been directed towards many Americans. I discovered that an open mind is the first prerequisite for productive dialogue.

During the week of training, I continued to keep up on my experiment. Just as I was beginning to think that it would work out, I was met by another rash of mortalities which continued from the end of the third week until well into the fourth. First I tested the water parameters, but all of the chemical indicators were normal. We did discover a fungus in the feed, but the fish had stopped eating and continued to die even after I ceased to feed. As the tilapia continued to die, one peculiarity emerged. All of the mortalities were female.

It was this realization that would finally lead me to a solution. Soon after I discovered this pattern, I shared it with Dr. Gamal who referred me to Dr. Rezk for assistance. Once again, the genetics department was able to help me out. Dr. Rezk recommended that I cut off the premaxillary, or upper lip of the male tilapias. He informed me that male tilapia become extra aggressive when paired with an individual female and that they were likely harassing the females to death. The next day, Mr. Attalah helped me to remove the male's premaxillaries. This simple operation involved anesthetizing the tilapia, cutting the premaxillary with a pair of scissors, and sanitizing the area with potassium permanganate. Amazingly, the day after the operations the mortalities stopped. I was exuberant.

Just before the cessation of brood stock mortalities, I had talked with Dr. Gamal about the possibility of my picking up a second experiment. My idea was to test the possibility of using algae as either a replacement or a supplement to artificial feed for tilapia fry. I had been developing this idea for a while in the back of my mind. With the cost of feed

running up to half of the costs of a hatchery operation, the search for a cheaper alternative would be of great importance to fish farmers. As tilapia eat algae in the wild, it seemed logical to test its worth in a hatchery environment.

To my great surprise and pleasure, Dr. Gamal responded enthusiastically to my idea. He quickly drew up an experiment design that would test the merits of algae as a feed replacement and as a supplement at two stocking densities. The algae feed would be added directly to the experimental tanks as liquid “green water”. The control tanks would receive powdered artificial feed instead. Another set of experimental tanks would receive both feeds in order to test the ability of algal feed to act as a supplement to artificial feed. The fry mortality and growth rate would indicate the benefits of each treatment to the fry.

As my fourth week drew to a close, Samir took Kareem and me shopping once again in his hometown of Zagazig. Shopping in Egypt always made me feel somewhat guilty. As if out of habit I would buy relatively expensive items such as cheese and maka bread instead of cheaper alternatives like rice and lentils. My shopping caused me to think hard about how spoiled I had been in America where expensive, often unhealthy processed foods have become a way of life.

I was already guilty when the beggar approached me. She was an elderly woman and from her face I could tell that she really was underfed. She made the traditional begging sign and thrust out a chapter of the Holy Qur’an- most likely one involving charity. I was about to give her something when she was noticed and quickly removed from the store. I felt terrible.

Begging is strongly discouraged by many portions of Egyptian culture. Those who are forced to beg for their food can suffer from a strong prejudice and even persecution at times. Only the desperate will lower themselves to the station of beggar, which is normally reserved for those who are dying of hunger or who are out of work and have dependent children. Despite the prejudice, this was not the first time that I had seen an Egyptian beggar. It was the first time that I had been approached.

I was morose for several days afterwards. Something about the woman’s eyes stuck with me, refusing to leave my mind. I felt helpless. How were a few experiments with fish going to help this woman? The answer of course, was that they wouldn’t help her directly. Even so I came to realize that my continued efforts were important, possibly to many people. It is only through each person doing their part that the world can be improved.

I spent most of the fifth week of my internship experience preparing the hatchery room for the feeding experiment. The aquaria were located in a small room just off of the indoor hatchery, and they looked like they hadn’t been used for a while. Before I could begin my experiment I would have to clean the room and the tanks, and check the tanks for leaks. This was hard work, and the room was hot, humid, and a haven to mosquitoes. It was times like these that made me remember Dr. Gamal’s aphorism that aquaculture is as much about mud and sweat as it is about fish.

Partway through the week, Dr. Gamal informed me that he had met with other scientists at the center and that they had decided to make the feeding experiment a center project. From then on I would be working with Dr. Yahia, who would continue the experiment after I left. Dr. Yahia, Mr. Elwan and I decided to begin the experiment on Thursday.

We began by stocking 5 fry per liter in each of the low density tanks and 10 fry per liter in the high density tanks. Over the weekend, I fed them 50% of their body mass in artificial feed before leaving to visit fish farmers with Kareem and the center's economist: Ahmed Nasr Alla. The purpose of our visit was to collect data on the economics of local fish farms. The farms were grouped together near a drainage canal, which provided water for their ponds. The farmers rent land and water access from the Egyptian government, and earn their income by growing tilapia fry into marketable adults. I learned that in this area of Egypt farmers put priority on maximum yields, sometimes at the expense of long-term profits. Mr. Nasr Alla attributed this to the insecurity that results from the farmers not owning their land.

The farmers that we visited were extremely welcoming and hospitable. We were offered hot Egyptian tea, and Mr. Nasr Alla talked with the farmers about mundane things before any business could be done. While this slowed down the collection of his data, such discussion built trusting relationships that are so valuable among Egyptian farmers and that insure that Mr. Nasr Alla is given truthful answers to his questions. Relationships are of paramount importance to the Egyptian farmer, providing him with support and economic security through his network of friends. However, what struck me the most was the hospitality that I was shown as an outsider. I was considered a guest and was treated as a friend by people who must have known that they would never see me again. On the Egyptian fish farm business *is* personal, and a successful aquaculturist is one who takes this to heart by developing personal relationships as well as scientific ability.

Upon returning to the WorldFish center, I found out that the results of my weekend feeding were disastrous. When I checked on the fry on Saturday night, I discovered that almost all of them had died. The water was brown and the stench of the room was terrible. It turned out that I had added too much food. I spent Sunday cleaning up the mess. We decided to try again, this time feeding 25% body mass. The results looked fine until partway through the week, when the fry again died en masse.

By this time, I was beginning to feel discouraged. Twice now my fry had died, and while my broodstock were surviving, there was still no sign of any spawning. I had only two weeks left in my internship and I was worried that I might not have time to gather any experimental results. I went to Dr. Gamal to talk about starting the fry experiment for the third time. He was encouraging, even telling me about his graduate experiments and how many fish had to die to get him his doctorate. Dr. Yahia, Kareem and I decided to do the experiment again, but to make some changes in the design.

The first change that we made was to flow fresh water through the tanks every night. This way, the tanks would be flushed of any uneaten, decomposing food before it fouled the

water. Additionally, Dr. Yahia discovered that some of the water I had been using in the tanks was chlorinated. We decided to use a different faucet system to add water to the tanks. Dr. Yahia also wanted to reduce the amount of feed given to the fish to 15% of their body weight in order to help prevent contamination of the water. Finally, we decided to use slightly larger fry to start the experiment and therefore we reduced the stocking density to one fish per liter for the low density treatments and two fish per liter for the high density treatments.

At the beginning of the second to last week of my internship, we began the feeding experiment again. Dr. Yahia and the hatchery workers counted out the numbers of fry for each tank, which were added to their tanks and allowed a day to recover before feeding. We then set up a pump to push green water from an outdoor concrete tank into the hatchery area. Beginning the second day after stocking, I fed the fry each day by pumping green water and/or dropping dry feed into the tanks, as the treatments required. For the first two days I replaced the dead. Afterwards, I simply netted them out and recorded mortality.

During this week, I finally established a routine. Every morning I spent about two hours netting out dead fry, recording mortality, and feeding the remainder their green water and/or their first third of dry feed. Twice each afternoon I gave the fry in the dry feed treatments another third of their daily rations. Before I went to the apartment each night I turned on the overhead faucets to allow water to flow through the tanks. In between these activities, I continued to follow scientists and to observe their work.

I was surprised when, on Thursday of my second to last week, Mr. Elwan came to me and told me that my brood stock had spawned. He had discovered fry swimming in the breeding hapas. I had not seen them earlier; but Mr. Elwan was experienced enough in the hatchery to tell me which hapas contained fry even though many remained in their mothers' mouths. The news of the spawning excited me, and I immediately went with Mr. Elwan and Dr. Yahia to collect and count them.

While I had been able to successfully breed tilapia in the hapa setting, the data that I collected failed to show any relationship between the number of fry produced and the weight of the mother. I believe that the lack of good data was due my failing to notice the fry as soon as they were spawned, thus allowing some of them to die before we could count them. Dr. Gamal was still pleased with my learning experience. I was pleased as well, not with my data, but with the amount that I had learned. Not only had I finally been able to keep brood stock alive, but I had also been able to create conditions favorable to spawning- one of the most stressful events of a female tilapia's life.

Meanwhile, I was largely pleased with the results of the feeding experiment. The changes that we had made to the experiment design had created a tank environment that largely supported fry survival. Instead of finding extremely high mortality rates across the treatments as happened earlier, I discovered that mortality varied greatly based on which foods the fry had available. Over the course of the week, it became apparent that green water by itself could not support large numbers of fry. It may have the potential to work

as a supplement though, as the tanks in which both feeds were made available supported slightly higher numbers of fry than those in which only one feed was available. When I measured the fry on the last day of my internship, I discovered roughly equal sizes in the treatments using artificial feed only and the treatments using both artificial and green water feeds. The sizes did vary with the stocking density, and were slightly higher in treatments being fed artificial feed only. I attributed this size difference to be largely due to the higher mortality in treatments in which only artificial feed was available, resulting in lower density and increasing the size of the fry.

Though the data from the experiment does not show a scientifically significant difference between the treatments that received both green water and artificial feeds and those receiving only the latter, I feel that the project was a success for a couple of reasons. First and foremost, the project was of immense educational value to me. This was Dr. Gamal's priority when he helped me to design it, and the project achieved this objective. The second reason that the project can be considered successful is that it proved the green water supplemental feed to be ineffective under the conditions of the WorldFish hatchery. This will allow the center to focus future nutritional research on supplemental feeds that show more promise. The third reason that the project was a success was that it opened the door to future WorldFish research into hatchery nutrition. After I left WorldFish, Kareem and Dr. Yahia have continued my experiment, looking for insights that will lead to further research. In this way, what began as an educational research project may become much more.

The day that Dr. Yahia, Kareem, and I measured the fry from the hatchery feeding experiment was also my last day in Egypt. I spent most of the rest of the day saying my goodbyes. I had a final supervisor meeting in which I expressed my gratitude to Dr. Gamal and Dr. George, both of whom were pleased with my internship experience. I then went to each of the labs, thanking and bidding farewell to the people who had become my teachers and my friends. I had brought a bag full of postcards and other Iowa souvenirs, which I distributed to the WorldFish center staff. Though I was sad to be leaving my friends behind, I was also grateful to everyone for helping to make my experience the highlight of my life and for the opportunity to keep in contact through email.

There is an old Egyptian saying that he who drinks from the waters of the Nile is obligated to return again. Since boarding the plane out of Cairo at 8:00 on Monday July 31st, there has not been a day in which I have not returned. My experiences in Egypt have made their indelible imprint on my being. Since returning to America, I have become more cognizant of global issues, not only those relating to food security, but also those of intercultural awareness and the need for dialogue. Since returning from Egypt, I find that I can no longer disassociate myself from the problems that affect other people. It is no longer sufficient for me to write off the problems of others as unimportant or as not affecting me. I learned in Egypt that everything I do has importance, and I began to understand the need to think through my actions from more than one perspective.

My experience at WorldFish has taught me to be a scientist in ways that could not be achieved through academic study or school laboratory projects. I learned what it is like to

venture into areas where there is no known answer, and I discovered the enormity of the work behind a simple page of statistics. Through my experiences at WorldFish I saw firsthand the power of knowledge and the importance of its application to the problems of world food security. Through my experiences shopping outside of the center, I got a taste of the need for such knowledge. From the African trainees and the Egyptian staff, my eyes were open to the abuses of knowledge and of political power that are wreaking havoc in so many places. Food is so many things in this world: sustenance for the family, stability for the community, and power for the people. As citizens of the global community, we have the responsibility and the obligation to manage food appropriately and to correct the abuses of knowledge and power that can be found all around us.

My experiences at the WorldFish Center in Egypt have solidified my resolve to be an active participant in the struggle for decency and compassion in people's relationships with the environment, with the global society, but most importantly with each other. Since returning to America and beginning my studies at Drake University, I have assumed an active role in the genesis and sharing of knowledge through working towards undergraduate research opportunities, preparing educational fire-safety brochures for the Latino community, and volunteering to be a part of Drake's adult literacy program. In the words of Nelson Mandela, "A person is a person because of other people." During my time in Egypt, I witnessed firsthand the truth and the power in this statement. My Borlaug-Ruan internship has infinitely expanded my world while whetting my appetite for service. And it is through service that one becomes fully human.

The Prospects of Green Water as a Feed for Tilapia Fry

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Abstract

Nile Tilapia (*Oreochromis niloticus*) is often raised in hatcheries for the use in aquaculture. In this experiment, high algae (green) water was tested for its prospects as a supplement to processed feed and as a replacement for processed feed in the growing of tilapia fry. Fry were raised in glass aquaria at two different stocking densities and were fed a control diet of standard processed feed, an experimental diet in which processed feed was supplemented with green water, or an experimental diet in which processed feed was replaced with green water. The fry were divided into six treatments based on their diet (control, green water supplement, or green water only) and their stocking density (2 fry/L or 4 fry/L). After two weeks, the fry being fed only green water suffered significantly higher mortality when compared to the control and the fry on the green water supplement diet, indicating that green water is not likely to prove effective as a replacement for processed feed under aquarium conditions. Further research is being done into the benefits of green water as a supplement to processed feed.

Introduction

Tilapia is among the most valuable aquaculture species of fish in the world. Tilapia yields were valued at 1427 million USD in the year 2001 (FAO, 2001) (cited by El-Sayeed, 2002). However, the expansion of tilapia culture is limited by a shortage of fry (El-Sayeed, 2002). In order to produce the fry needed for ever increasing tilapia culture, hatchery operations will need to be expanded, and improved methods of fry production developed. One of the major costs of any hatchery operation is the feed for the fry. Traditional feeds such as fishmeal and even soybean meal are out of reach for many smaller hatchery farmers (Frasakin et al, 1999). This has led to the continuing search for cheaper, alternate feeds for tilapia fry.

Algae, particularly those of the genus *Chlorella*, *Scenedesmus*, and *Spirulina*, have been recognized as an important feed for tilapia for some time (Olevera-Novoa et al, 1998). The purpose of this study was to determine the effectiveness of mixed algal species, delivered as green water liquid, as a supplement or a replacement for 25% protein processed feed.

Materials and Methods:

Using the hatchery facilities at the WorldFish Center in Abbassa, Egypt, eighteen glass tanks were filled to the 50L mark with water. The tanks were set up as a reticulating system, and were equipped with adjustable drainage pipes to prevent overflow. The pipes were fitted with a polymer mesh to prevent fry escape. The tanks were randomly assigned to one of the six treatments, with three tanks to each treatment.

On the first day of the experiment, *Oreochromis niloticus* fry with a mean weight of 0.354g were counted and transferred to the experimental tanks. Tanks in treatments one, three, and five received 100 fry for a stocking density of 2 fry/L, while tanks in treatments two, four, and six received 200 fry for a stocking density of 4 fry/L.

During the first two days the fry were not fed, and the mortalities were replaced, but not recorded. Beginning on the third day of the experiment, the fry in treatments one, two, five, and six received 15% of their aggregate body weight in 25% protein processed feed, divided into three feedings over the course of the day. The fry in treatments three, four, five, and six received 15L of green water once a day. For approximately eight hours from midnight to 8:00 am, water was allowed to flow through the tanks to flush out any wastes and uneaten food.

During days three through thirteen of the experiment, fry mortalities were recorded, and the dead were netted out. On day thirteen, a sample of the surviving fry from each tank was weighed to determine growth. Measurements were compared using single-factor ANOVA.

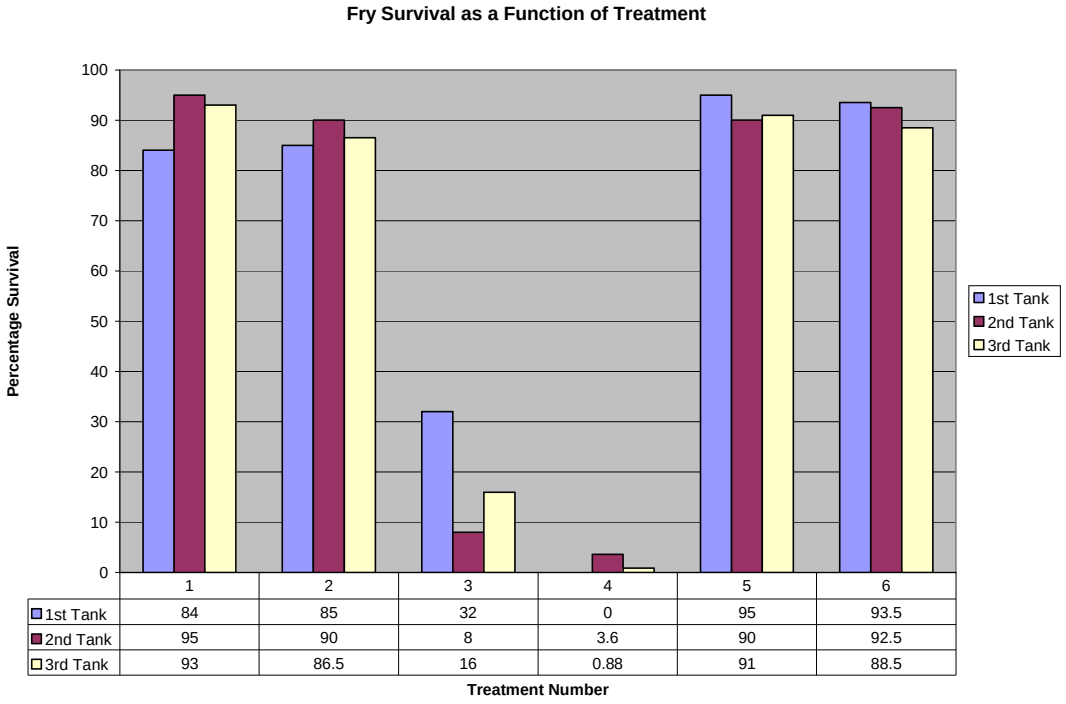
Results:

Figure 1: Treatments

Treatment Number	Stocking Density	Feeds Available to Fry
1	2 fry/L	Processed feed
2	4 fry/L	Processed feed
3	2 fry/L	Green water
4	4 fry/L	Green water
5	2 fry/L	Processed feed and green water
6	4 fry/L	Processed feed and green water

The tanks involved were divided up into six treatments, with three tanks to a treatment. Treatments one and two were control treatments with regards to food. Treatments three and four were designed to test the merits of green water as a replacement feed. Treatments five and six were designed to test the merits of green water as a supplemental feed.

Figure 2: Fry Survival



	1	2	3	4	5	6
1st Tank	84	85	32	0	95	93.5
2nd Tank	95	90	8	3.6	90	92.5
3rd Tank	93	86.5	16	0.88	91	88.5

Note: The decimal figures in treatment four suggest that more than 200 fry were accidentally added to the 2nd and 3rd tank.

Figure Two shows fry survival percentages in each treatment. Treatments three and four, in which the fry were only fed green water, showed a significantly lower fry survival percentage than treatments one, two, five, and six, in which processed feed was available. There was not a significant difference between the control treatments and the treatments in which both processed feed and green water were made available; nor was there a significant difference between the high density and low density treatments.

Figure Three: Significant Differences in Fry Survival

Treatment Number	Significance
1	A
2	A
3	B
4	B
5	A
6	A

Different letters signify statistically significant ($p<0.05$) differences between treatments.

Figure Four: Fry Weight

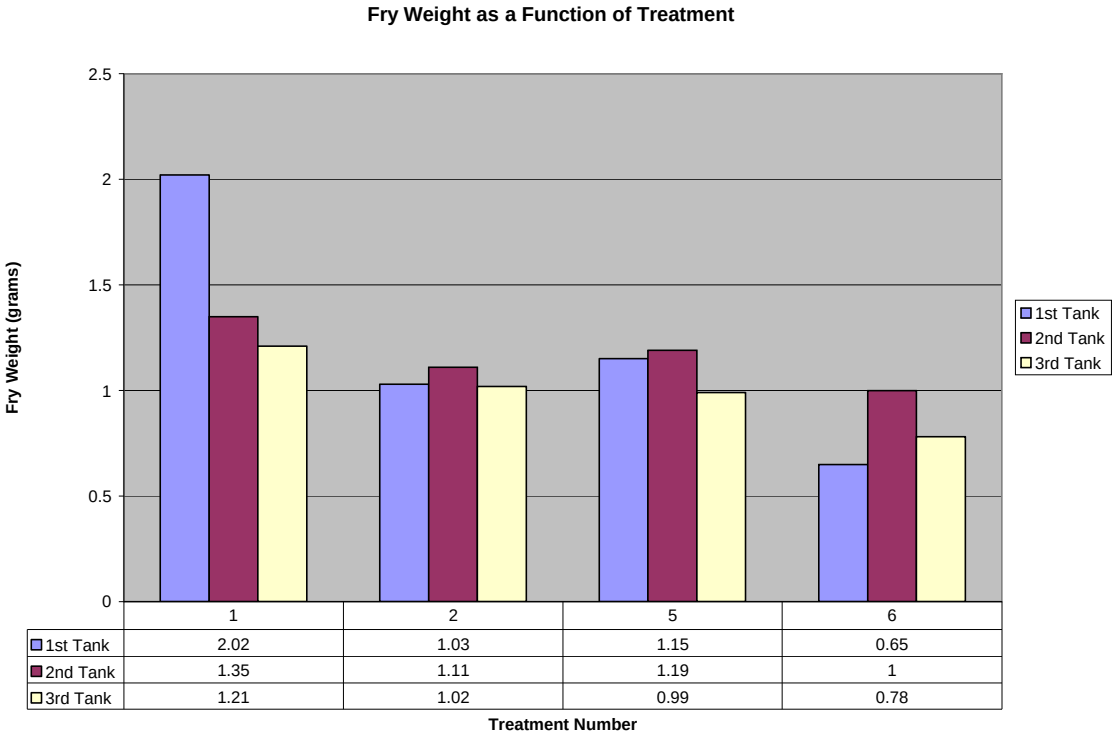


Figure Four shows fry weight as a function of treatment. Treatments three and four, in which only green water was made available to fry, had too few surviving fry in some or all of the tanks for the weighing to yield valid data. There were no statistically significant differences between treatments in which fry weight was measured.

Discussion and Conclusions

This experiment showed that Nile Tilapia fry showed significantly lower survival when only green water was made available than when processed feed was made available both by itself or in addition to green water. There was no significant difference in fry survival between treatments in which fry were fed only processed feed and treatments in which both processed feed and green water were made available. There was no significant difference in fry weight between any of the treatments.

From these results, it can be concluded that green water does not make a good replacement for processed feeds when raising Nile Tilapia under aquarium hatchery conditions. The prospects of green water as a supplement to processed feeds are unclear. Further research is being done into the merit of green water as a supplementary feed. Future research projects in this area should focus on green water as a supplementary feed or on different replacement feeds.

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