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The Conservational and Economic Benefits of Modern Day Wildlife Manipulation: My Time at the Erwin National Fish Hatchery

Using my love for wildlife and the knowledge I have obtained thus far to make connections between fish hatcheries and modern-day conservation to learn about their importance and how I can be involved.

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If you look at the conservation timeline in America, you can see that it has constantly changed since President Ulysses S. Grant established Yellowstone as the first National Park in 1872. Not long after, Present Woodrow Wilson signed the act to initiate the National Park Service on August 25th, 1916. This service would be responsible for the 35 National Parks yet to be established. Early Americans went from turning wildlife habitat into farmland to turning farmland back into wildlife habitat. Management of wildlife resources began in the 1930s and efforts to enhance environmental quality rose in the 1960s. The main goal of conservation at the time was focused on preserving what was already there. Fast-forward to today; however, and you can see that preservation is no longer enough. Due to habitat destruction, the rising climate, and strenuous resource consumption, we are forced to manipulate the planet to try and prevent “the 6th Extinction,” as mentioned by Elizabeth Kolbert. Over 80% of endangered wildlife species depend on the human population and conservation for survival according to Jon Mooallem in his science non-fiction book, “Wild Ones: A Sometimes Dismaying, Weirdly Reassuring Story About Looking at People Looking at Animals in America”. This is where my interest comes in.

How I Got Started

Ever since I was a little girl, I have been obsessed with animals and the natural environment. I had stuffed animals instead of baby dolls and I was always spending my time outdoors. Once I was in

school, I began competing in a regional competition called Envirothon where we would study aquatics, wildlife, soils, forestry and natural resource issues and take tests to try and get the highest score as a team of five. I also attended various environmental summer camps such as the Soil and Resource Conservation Workshop at North Carolina State University when I was 12. From there, I obtained an associate degree in Fish and Wildlife Management Technologies at Haywood Community College to become a certified Wildlife Technician in 2014. I am now working towards a bachelor's degree in biology at East Tennessee State University. Attending school for wildlife was the only thing I could think of to do.



My Haywood Community College peers and I helping the South Carolina Department of Natural Resources with the alligator measuring project.

Service Assignment: A Volunteer Placement Based on Our Interest and Concern

The argue about conservation persists today. If you read Merriam-Webster's definition for conservation, it says "A careful preservation and protection of something; planned management of a natural resource to prevent exploitation, destruction, or neglect." As you can see, it says nothing about habitat manipulation or "changing" the environment. It focuses on the restoration of what is already there. In fact, funding for research and management has been suffering as of late due to this conflict. Based on my interest in this topic, I was assigned to volunteer at the Erwin National Fish Hatchery in

Erwin, Tennessee as my service placement for my Environmental Studies Seminar course. The goal was to see the benefits behind today's version of conservation. At the hatchery, the focus is population manipulation and has been for over a hundred years now. They have been breeding and raising rainbow trout to be shipped across the United States since 1894. Although the main driving force behind the breeding of the rainbow trout is recreational fishing, we can still use this type of conservation and the story of the rainbow trout and the American hatchery to discuss the benefits of today's habitat and wildlife manipulation.

Hatchery History

The birth of the American fish hatchery business can be traced all the way back to George Perkins Marsh (1801-1882). Anders Halverson, author of *An Entirely Synthetic Fish: How Rainbow Trout Beguiled America and Overran the World*, gives a brief but important history lesson on Marsh in relation to fish culture. Marsh is best known as one of the most important conservationists in the history of the United States. You might recognize one of his most famous writings, *Man and Nature*, which was published in 1864 and was one of the first books to recognize the detrimental effects humans have on the natural world. One of the many themes of this book included his statements about how human activity was diminishing the salmon and trout populations in New England. Some of the main causes of this decrease in population were overharvest, building of dams, pollution from factories, and the clearing of land for agriculture. However, despite his concern for the environment, he didn't believe in industry restrictions, nor in the regulation of hunting and fishing. He believed in progress and stated

“The unfavorable influences which have been alluded to are, for the most part, of a kind which cannot be removed or controlled. We cannot destroy our dams or provide artificial water-ways for the migration of fish which shall fully supply the place of the natural channels; we cannot not

prevent the wholly discharge of deleterious substances from our industrial establishments into our running waters.”

According to Halverson, he is basically saying the loss of wildlife is an inevitable outcome of the progress of civilization. This is where the first idea of a hatchery came into play. Marsh claimed that since industry was the cause of the decline in the fish populations, they could provide a technological “fix” for the populations through fish culture.



In the last decades of the nineteenth century, U.S. Fish Commission employees received and distributed fish eggs from all over the world at Central Station in Washington, D.C. The egg-hatching jars in the background are very similar to those in use today.

“Fish Farming,” as David Teague, the fish biologist at the Erwin National Fish Hatchery calls it, is an ancient practice. In fact, there are Chinese documents from as far back as 2100 B.C. that mention regulations such as what time of year fish spawn could be collected for the raising of naturally fertilized eggs. This practice also appeared in the social scene of the early Roman Empire. All these efforts relied on the natural

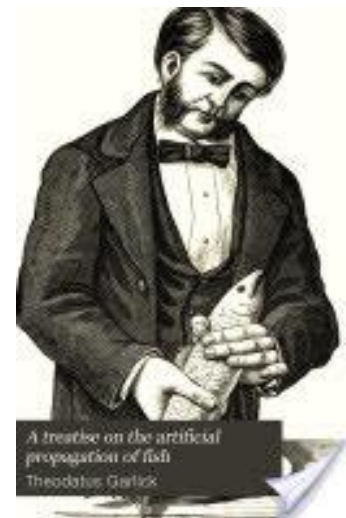
reproduction of fish (allowing them to spawn on their own and then collecting the fertilized eggs) until a French monk in the 15th century artificially propagated the fish by squeezing the egg from the female and the milt from the male into a pan. His efforts were never replicated.

Even though Marsh was the first to submit reports to the government on this practice as a proposal for helping the fish populations grow, the credit should be given to Joseph Remy and his partner, Antoine Gehin. They began the fish farming process 14 years before Marsh became involved. The following passage from “An Entirely Synthetic Fish” describes what they did in their own words:

“During spawning season, at the beginning of November, at the moment when the eggs are loose in the belly of the trout,” he wrote, “I have, by passing my thumb along and lightly pressing the belly of the female, so that it does not result in any harm for her, forced out eggs that I placed in a pot full of water. Afterward, I took the male, and with a similar operation as for the female, I made the milk run onto the eggs until the water was white. After this operation was completed, and the eggs became clear, I deposited them in tin boxes pierced with thousands of holes and full of large grains of sand. I placed one of these boxes in a running water fountain, and others in the water of the river, La Bresse, in a rather quiet place, though the water was running a little.”¹⁶

La Bresse is a commune located in northeastern France.

Based on these efforts, the French government had the first piscifactory (fish factory) built in 1852. The following year, fish culture made its way into the United States. A man by the name of Theodatus Garlick practiced fish culture with the native eastern brook trout in Cleveland, Ohio and wrote a book about the success of his efforts and the techniques he used in 1880 (*A Treatise on the Artificial Propagation of Fish: With Description and Habits of Such Kinds as are Suitable for Domestic Fish-culture*). This is how Marsh learned of this technique in increasing fish populations. By the year of 1865, there were approximately 200 private fish hatcheries in the United States. By 1872, it was declared that there probably was not a single stretch of stream that fish stocking hadn't been conducted or contemplated.



Modern historians even say that the fish culture movement was the first environmental crusade. Many of the New England states had established fishing commissions and were dedicated to raising more fish for the stocking of rivers and streams. On June 10th, 1872, a bill which appropriated \$15,000.00 to the U.S. Fish Commission under the Department of Interior for the commencement of fish culture was passed and became a law. This was done with the help of Spencer Fullerton Baird who was the assistant secretary of the Smithsonian and one of the main supporters of fish propagation at the time. In fact, he was the main driving force behind the United States Fish Commission transforming from a small and temporary commodity to a large and permanent agency.

This was the beginning of government funded hatcheries. Most of the funds went towards propagating the salmon and eastern brook trout populations and to not worry about the regulation of these species, the hatcheries would simply stock so many that regulation wasn't necessary.

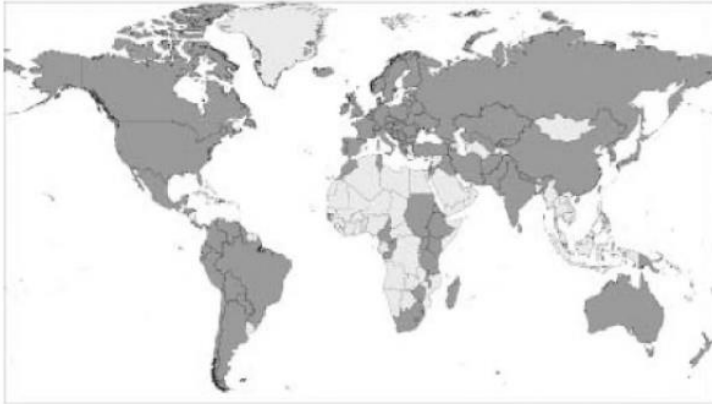


The Biography of the Rainbow Trout

Now that you know a little about the history of hatcheries in the United States, you're probably wondering where America's most famous fish came into play, the rainbow trout (*Onchorhynchus mykiss*). The answer is destruction. After the civil war, during what is called the Gilded Age (late 19th century) logging and land use were intensifying as civilization and industries grew. This was causing more and more pollution of streams which in turn was causing a decrease in the brook trout population, as they are a very sensitive species. Rather than trying to manage them, Marsh and several other fish propagation enthusiasts decided that they needed another fish that would be popular with the anglers but heartier than the brook trout.

Livingston Stone, a former pastor of a Unitarian Church in Charleston, South Carolina, who resigned to pursue the salmon propagation business in 1868, first laid eyes on a rainbow trout on an expedition to California to try and harvest salmon ova. Many fish culturists today believed that the reason their propagation began is because they were encountered so many times in the fishermen's nets while trying to catch other species. However, the real cause of the introduction of rainbow trout across the United States was the Ornithological and Piscatorial Acclimatizing Society of California. Their mission was to import species from Europe and older states to all parts of America and certain parts of the world because they wanted people to be able to have a more enhanced experience of the natural world. So, by the instructions of Baird, the assistant secretary of the Smithsonian, with the Acclimatizing Society efforts and Stone's combined, over the next 12 years, rainbow trout were sent to 33 of the 38

states that were established. They also sent rainbow trout to England, Germany, Switzerland, Canada,



Rainbow trout, native only to the Pacific Rim from Mexico to Kamchatka, have been widely introduced and now thrive in countries all over the world (those shown in dark gray).

and Mexico. The other reasons behind the propagation of rainbow trout were that although they weren't considered as beautifully marked as the brook trout, they were equal in taste and made a better fight against capture. They could also withstand higher temperatures which was important since excessive logging was causing the cool forest streams to have

increased temperatures since they were no longer shielded from the sun.



Erwin National Fish Hatchery History and Mission

The Erwin National Fish Hatchery was one of many hatcheries established in the United States in the late 19th century during what seemed to be a fish culture revolution. It was opened in 1897 by the U.S. Fish Commission under the Department of the Interior. The Commissioner of Fisheries, in his report for the fiscal year of 1897, recommended to Congress that a hatchery should be built in the state of Tennessee. Congressional Act 28 Stat. 387 (August 18th, 1894) mandated funding for a hatchery that was

to be built in Unicoi County near Erwin, Tennessee. The station was officially established in 1897 when 10 acres of land were purchased for \$1,025 which included the spring water supply for the runways.

Their mission statement is as follows:

“Over a century ago, it was recognized that conservation measures were necessary to maintain good fishing in our public waters. Fishing has probably always been one of America’s leading forms of outdoor recreation. As part of the National Broodstock Program, Erwin National Fish Hatchery produces rainbow trout eggs that are shipped nationwide to other hatcheries to help preserve this tradition for present as well as future generations of Americans.”

Each year, the hatchery produces 10-13 million disease-free rainbow trout eggs from their rainbow trout brood stock (trout kept at the hatcheries for spawning). These eggs are shipped across the United States to other Federal, State and Tribal hatcheries where they will be raised into adult trout for stocking, brood stock, and education purposes. The eggs are also sent to research centers, classrooms, and universities.

When you hear the word hatchery, you probably think of a place that raises fish; a fish farm if you will. You would be correct; however, there are a lot more processes going on than you might think than just raising fish. I’ll give you a brief overview of what goes on at the Erwin National Fish Hatchery to give you a better understanding of what working at a hatchery entails. There are several different groups of rainbow trout of different ages at the hatchery. They are kept in separate holding tanks that are called “runways” due to the water being circulated through. The younger fish and the eggs that will be used for the hatchery’s new generation of brood stock are kept in the runways inside the building. Once these young trout get to be about four inches long, the largest and oldest trout in the last runway will be stocked (released into the wild) and the rest of the trout will just shift up a runway in order to empty one of the first runways for the newer and younger trout. It is a constant cycle. Once the males of

the brood stock are 3 years of age, they will breed them with 2-year-old females to create eggs for the next generation of brood stock in order to maintain genetic variability. The process used for producing brood stock eggs and the process used for producing eggs to be shipped are the same. It is called the spawning process and this same process has been used ever since the beginning of fish culture. They sedate the females using clove oil and by pressing along their abdomen, they release the eggs into a bucket of water. Then they take the male and using the same motion, release the milt (semen) into the bucket with the eggs. This fertilizes them and is called the spawning process. Once the eggs have been fertilized, they put them into the egg sorting machine which uses a laser to shine through them to see if they are transparent or not (see pictures below).



Egg sorting machine



If they aren't transparent, they are bad eggs and are separated into a different bucket to be dumped into the fish dumping site at the top of the hill as you enter the hatchery. Once females have been used in the spawning process once, they are released into a nearby river or stream and that empties up a runway for newer females to move in. Once the eggs have been separated and placed into their holding tanks, they are treated with a chemical called Ovadine which keeps them from growing any bacteria or

fungi and then they are measured out by volume (picture below and to the left) and packed to be shipped (picture below and to the right).



Egg Packaging

Service Placement: My Daily and Weekly Tasks at the Hatchery

Throughout the course of two months, I completed approximately 30 hours of service for the Erwin National Fish Hatchery alongside Scott Sellers, the Deputy Hatchery Manager, David Teague, the Fish Biologist, Tony Garland, the Facility Operations Specialist and Keith Wilson, the Electrician. I went every Monday and Wednesday morning from 7:30 to 10 am and an occasional full 7-hour day whenever I had an opening. Each morning, we started out by measuring up the fish feed. There are 12 different runways (water tanks) and each has an A side and a B side. Each runway has rainbow trout of different ages so different amounts of feed are needed for each one. The sheets next to the feeding bins were labeled with the pounds of feed needed for each week as the fish get older and bigger (see picture on the top left of the following page).



I would measure the feed using a large scale set to zero once the bucket is in place (top right). Once the feed was measured out, I would help clean the runways by using a long brush to push the excess food and waste down to the drain at the end. Some days we would also go around and collect and tally up the dead fish and take them up to the fish dumping site at the top of the hill as you enter the hatchery road. Once the feeding and cleaning was complete; the eggs would need to be treated with Ovadine and a peroxide solution to keep them from growing any fungus or bacteria. On Wednesdays, I helped prepare the eggs for shipping (bottom left) and on Mondays, I helped collect the water samples to be taken to the water treatment plant for testing (bottom right).



I also helped move the trout from one runway to another by using a wooden paddle to help guide the trout from the tank on the stocking truck into the chute that leads to the water (picture below). I did this during one of the stocking trips as well when the trout were stocked into the Nolichucky River.



Not only was I able to help with the daily duties, but I was also able to learn about the more in-depth processes that go on at the hatchery. I learned about the egg counting method that I mentioned in the previous section and how they estimate the amount using a volumetric container filled with water and how the eggs are separated based on their transparency. I also learned about the relocation cycles and how once the minnows that are inside the building in the smaller runways reach 4 inches (4 weeks, 1 inch per week), they are moved into the 1st runway that is located to the right of the building, the ones that were there before are moved out to the runways behind the hatchery, and the trout that were in those runways behind the building either get moved to the end runways or get stocked. They are then stocked the following week to empty up a runway for another group of rainbows and keep a mix of genetic material rather than using the same females more than once.

A Learning Experience

Although I was unsure how working at the hatchery would relate to my interest in wildlife conservation when I first started my placement, I wound up making many connections along the way. The first thing I learned is what steps I need to take if I want a position with the U.S. Fish and Wildlife. The guys I worked with at the hatchery said experience is key. Scott informed me that although a bachelor's degree in biology is very important, it is mostly who you know and how much experience you

have. Neither Keith nor Tony went to college but have been working at the hatchery for over 30 years. Moreover, both Scott and David have the same degree as me from Haywood Community College, an associate in Fish and Wildlife Management Technologies. They then went on to get their degrees in biology which is exactly what I am doing. According to them, I am on the right track. In fact, due to the number of hours I put in at the hatchery, all the guys there spoke to me about a possible job opening at the hatchery that they would like for me to fill. I will just have to continue my volunteer service throughout the summer to have first dibs on the position.

If you go to the website of the Erwin National Fish Hatchery, you will see this statement, “Brood stock operations are performed in a manner that will preserve or optimize the genetic diversity of hatchery fish.” While I was there, I learned that for their brood stock, which are the trout that they keep there at the hatchery to produce the eggs, they breed a 3-year-old male with a 2 year old female to ensure that no inbreeding is occurring and that there will be a good mix of genetic material as I have already mentioned. This will allow them to continue to have a healthy rainbow trout population at the hatchery and a higher success rate in their eggs. If you study other wildlife populations that are being managed such as the whooping crane (bred at Wood Buffalo National Park), you will find that genetic diversity is key in the success of that species and although they are very different from the rainbow trout, the same thought process goes into their breeding plan to have a higher success rate. Moreover, to protect certain species in North Carolina from being overtaken by the rainbow trout, the Erwin Hatchery sends triploid eggs (eggs that have an extra set of chromosomes that are sterile) to Western North Carolina so the trout that hatch from them cannot reproduce. Another way the hatchery is important in the conservation realm of things is that through the recreational use of wildlife management, light is shed on other conservation efforts. By carrying on an old tradition of getting out and going fishing, the hatchery is getting people outdoors to promoting the enjoyment of nature and

the natural world that surrounds us, so we can see why it is important to manage certain wildlife populations.

Not only is the hatchery beneficial for conservation, but it is also beneficial for the economy and if there is a better economy, the funding of conservation programs will be ampler. Hatcheries are under the Agriculture, Fishing and Hunting sector of the National Economic Impacts chart from the U.S. Fish and Wildlife Service National Survey of Wildlife Watching Economic Impacts. This sector produces almost 2% of the total economic impact which may not seem like much but that is approximately \$1,563,617,629.00 and this sector 17,931 people.

Bibliography

Garlick, Theodatus. *A treatise on the Artificial Propagation of Fish: With Descriptions and Habits of Such Kinds As Are Suitable For Domestic Fish-Culture*. J.B. Savage Printer, 1880.

Halverson, Anders. *An Entirely Synthetic Fish: How Rainbow Trout Beguiled America and Overran the World*. Yale University Press, 2011.

Kolbert, Elizabeth. *The Sixth Extinction: An Unnatural History*. Picador, Henry Holt and Company, 2015.

Marsh, George Perkins. *Man and Nature: Or, Physical Geography as Modified by Human Action*. Charles Scriener, 1864.

Mooallem, Jon. *Wild Ones: A Sometimes Dismaying, Weirdly Reassuring Story About Looking at People Looking at Animals in America*. Penguin Books, 2014.

U.S. Fish and Wildlife Service. "International Whooping Crane Recovery Plan ." U.S. Fish & Wildlife Service, U.S. Fish and Wildlife Service, 13 Nov. 2012, www.fws.gov/refuge/Aransas/wwd/science/intl_recovery_plan.html.

U.S. Fish and Wildlife Service. "Wildlife Watching in the U.S.: The Economic Impacts on National and State Economies in 2011: Addendum to the 2011 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation Report 2011-2." U.S. Fish and Wildlife Service National Digital Library, U.S. Fish and Wildlife Service, 2014, digitalmedia.fws.gov/cdm/ref/collection/document/id/1906

Young, Debbie, and Wildlife Service. "Erwin National Fish Hatchery." Official Web Page of the U S Fish and Wildlife Service, U.S. Fish and Wildlife, 26 Mar. 2018, www.fws.gov/erwin/index.html.