

SCIENCE RESEARCH AND EXPERIMENTAL DESIGN

SREED

Pre-University New Visions Journal of Science

2013 - 2014

MASS EXTINCTION

DO WE FACE A
SIXTH MASS
EXTINCTION?



A YEAR OF INVESTIGATION

CHILDHOOD NUTRITION

*Examining
Techniques
Effective in
Advancing
Nutritional
Education*

FISHERIES

*Creating
Strategies
to Enhance
Survivorship
in Hatcheries*



CHARGING STATIONS

*Being Green
can Boost
Ulster
County
Tourism*

BIO- DIVERSITY

*American Eel
Population
Decline
Examined*



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From the Editor

A shift in the paradigm of education for science is occurring in schools across our country. Twenty-first century skills are needed in an ever changing work environment. The lexicon of science has grown exponentially in the past fifty years. From the genome project to the new ambitious “human proteome” (Kim) project, comes information overload. How can we provide skills to high school students which enable them to navigate this new ever changing environment? One of many parts to a large multi-pronged approach is to provide a space of learning that allows students to pursue topics of interests. The New Visions SRED class is an example of a platform that allows students to

explore science through primary experimentation and investigation. Conducting research, developing a hypothesis, designing an experiment, and processing those findings will add skills which help students steer through college and the work environment. Defining terms like human impact are a start, but designing and conducting an experiment extends the understanding of such complex phenomenon for a life time. This journal was made to show what can be possible. All research was conducted by students in the SRED class. Below is a list of individuals that were supportive of the students’ journey. Thank you for all the support.

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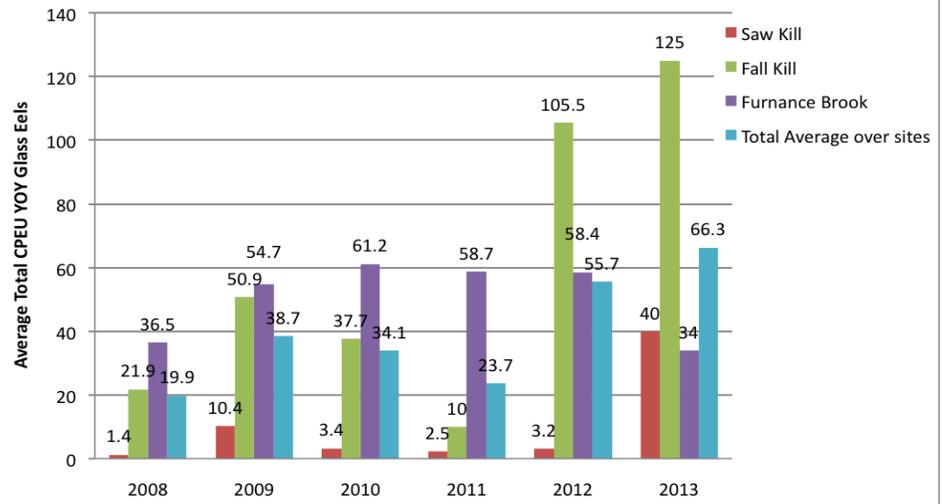
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Hypothesis:

The American eel population decline in the American East Coast is directly caused by human impact.

The American eel is a catadromous, benthic fish that spawns in the Sargasso Sea and matures in freshwater tributaries, rivers and streams. When the eggs of eels hatch, they are called glass eels due to the lack of pigmentation in the body making it hard for predators to see the young eels. The glass eels travel currents all the way up from the Sargasso Sea and head to different rivers and tributaries from Florida, all the way up to Canada. This journey can take as long as 7 to 12 month. As they approach the shore and enter brackish water, the eels start to get pigmentation, these are called elvers. At this stage this they are still sexually undifferentiated and this stage can last 3 to 12 months. The Third stage of the eel cycle is the yellow eels, which are now sexually differentiated but sexually immature. Yellow eels are known to mature faster in water with a higher salinity, rather than eels in complete fresh water. As the eels mature their pigmentation beings to change giving them a silverish color, this stage is called the silver eels. During this stage the eel’s appearance and anatomy changes. The pectoral fins of the eels enlarge to improve swimming, the diameter of the pupils increase and visual pigments in the retina to adapt to oceanic conditions, the digestive tract degrades and a percentage of some lipids increase to supply energy for migrating and spawning.

Total CPEU YOY Glass Eels Hudson River Sampling Site 2008-2013 for three sites: Sawkill, Furnance Brook and Fall Kill



Key Factors for Anguilla Rostrata (American Eel) Population Decline

Leo Amell

The American eels are a major part of diversity and a valuable indicator of the health of the ecosystem. The eels as a top predator, will keep fish species in check and keep invasive fish species populations down, such as the goby. The eels themselves are also a major part of the food web for other animals such as other fish, mammals, turtles and birds. They can also be used as bioindicators for pollutants because of their long life span.

Eel populations are on the decline for multiple reasons. The eels suffer from habitat loss fragmentation due to blockage of upstream passage. Silvers eels will get sucked into hydro turbines on their way down stream/river. Over exploitation of most of the life stages and unregulated commercial harvesting in the

Sargasso Sea affects the reproducing populations for future generations. The Introduced species, nematode *Anguillicola Crassus*, is a parasite from Europe that lives in the swim bladders of the European and American eels. The Parasite can give the eel bleeding lesions and swim bladder collapse. The parasite can stunt the eel’s growth, lower its immune system and sometimes, if severe enough, can kill the host. Since the parasite affects the swim bladder, it can stop the eel from reaching its mating location.

Method:

The information gathered will be data mined from fishery results and environmental agencies studies for the most accurate results. I will also use the information of the estimated weight of eels caught annually compared to the average weight of

DATA

Total CPEU YOY Glass Eels
Hudson River Sampling Site

	2008	2009	2010	2011	2012	2013
Saw Kill	1.4	10.4	3.4	2.5	3.2	40
Fall Kill	21.9	50.9	37.7	10	105.5	125
Furnace Brook	36.5	54.7	61.2	58.7	58.4	34
Total Average over sites	19.9	38.7	34.1	23.7	55.7	66.3

Total CPUE Older Eels
Hudson River Sampling Site

	2008	2009	2010	2011	2012	2013
Saw Kill	0.96	1.96	0.6	0.2	0.34	2
Fall Kill	2.75	2.3	5	3.5	3.1	3.4
Furnace Brook		2.6	0.3	0.24	0.35	0.2
Total Average over sites	1.9	2.3	2.0	1.3	1.3	1.9

Total CPUE YOY and Older
Hudson River Sampling Site

	2008	2009	2010	2011	2012	2013
Saw Kill	2.36	12.3	4	2.66	3.5	42
Fall Kill	24.65	52.9	42.6	13.6	108.6	128
Furnace Brook	36.5	58.2	61.5	60	58.75	34.3
Total Average over sites	63.51	123.4	108.1	76.26	170.85	204.3

American Eel con't.

eels to estimate the number of eels harvested annually. I will recreate and create my own charts with collected data from past years of American eels collected and estimated a population number to show a trend in the eel's population.

Materials and equipment:

The results will be gathered from online sources to gather information and data charts from fisheries all over the East Coast. All information will be presented on a poster showing all results and information.

Discussion and results:

The American eel population shows all the evidence that is declining due to the impact each factor has on the eels and the over harvesting but because the eels are a migrating animal

and have complex life cycles, determining a total number of the population is a complex procedure and has yet to be accurate. The eels are found from Panama, all the way to Greenland, which will make determining populations count an extremely difficult task. Since the population numbers are unknown we cannot confidently say that the American eel populations are declining. But since we have hard facts that over harvesting, pollution, hydro turbines, loss of habitat and disease are affecting the eels we should make conservation efforts to keep the American eel populations at a healthy level in the ecosystem. The American eel (*Anguilla rostrata*) population decline cannot be proven because no population number is recorded and compare data to.

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Children Learning About Nutrition through Books

Esther Elise Harrington

Abstract:

Nutrition is a large part of human development since the dawn of time. The Nutrition Industry uses science to help the human population with energy and develop a healthy lifestyle. Companies use science and nutrition to market unhealthy products to the public. One of the largest groups marketed to are children. Junk food and fast food companies use television, propaganda techniques to market a fun lifestyle when eating junk food and fast food products.

Exposing children to these marketing tactics has lead to an increase in obesity among children. To help to reverse these marketing tactics healthy food companies have come out with similar marketing contacts. In addition parents have worked to explain what a proper diet is towards their children.

Introduction:

This research paper is testing the

hypothesis, "Does reading a book on fruits and vegetables influence or change the knowledge children, ages 6-8, have on fruits and vegetables?" This hypothesis and study is important for the earth's population because of human health. This study could find lapses in teaching children about healthy foods fruits, vegetables. These lapses can be filled with better programs using technology or other media outlets to teach kids about nutrition. If a child or group of children has better knowledge of nutrition then they will avoid health defects such as diabetes, depression, and obesity. If these health defects decrease then taxes paid by the public for health insurance will lower and it will be easier for the population to get health insurance.

The Journal of the American Medical Association completed a study on childhood obesity and its increase. Obesity in children is defined as having a BMI (Body Mass Index) over the 95th percentile in children of the same sex and age. (Center For Disease Control and Prevention) According to the study over 17% of youth in the United States of America are overweight. (Ogden, Carroll and Kit) The health risks of obesity include high blood pressure, and cardiovascular health problems. (Center For Disease Control and Prevention) An obese child can also develop emotion problems such as depression or poor self esteem. (Center For Disease Control and Prevention)

One main reason children begin



DATA

Question	Choice A		Choice B		Choice C		Percentage Correct	
	Before	After	Before	After	Before	After	Before	After
1	1	4	28	25	4	5	84.85%	73.53%
2	3	4	27	22	3	4	81.82%	73.33%
3	25	22	9	6	1	5	71.43%	66.67%
4	22	20	0	9	3	4	88.00%	60.61%
5	21	18	14	13	0	1	60.00%	56.25%
6	4	5	11	14	19	14	67.65%	57.58%
*Red color indicates anticipated or healthy response								

to crave unhealthy foods is because of the advertisements children see advertising unhealthy foods. On average the food and beverage industry spends \$2 billion per year advertisements. (Prevention Institute) In addition nearly 40% of children's diets come from sugars and fats. (Prevention Institute) A child exposed to food advertising on television will consume 45% more food than children not exposed to non-food content advertising. (Prevention Institute)

Materials:

Difficulty: Average
 Participants: Randomly chosen classes in schools

- Paper
- Ink
- Pencils
- Children
- Pre and Post Exam
- Book
- Presenter

Methods:

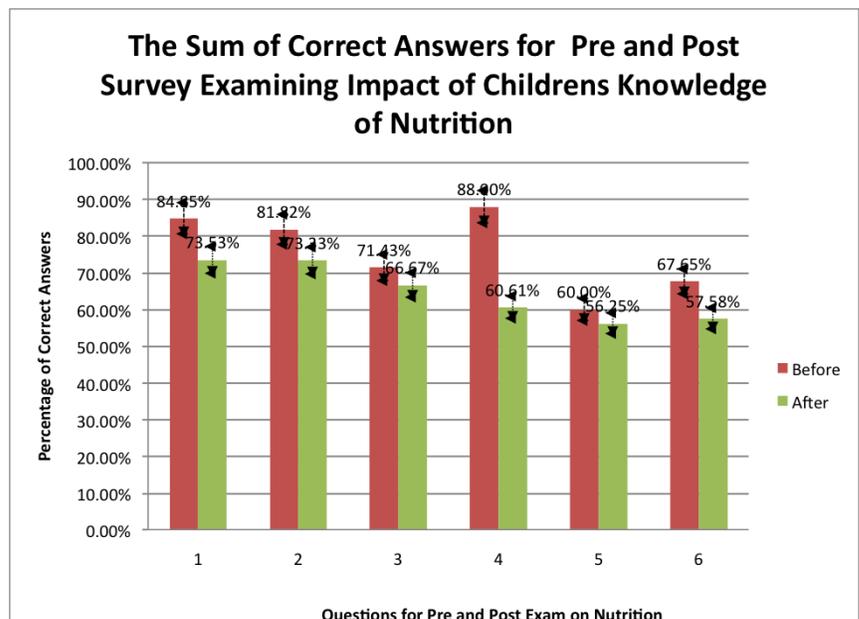
The study will have two parts to it. The first part is where the presenter gives the pre-exam to the children. The children will fill it out and then the presenter will take back the exams

and put it in a pre-exam folder. The presenter will then read the book ABC's of Fruits and Veggies to the children. The presenter will then give the post exam which is the same as the pre-exam. When the children are done the presenter will take back the exams and put them in a post exam folder.

Variables Measured:

The variables that will be measured are:
 The changes of answers and percent-

ages of correct answers chosen in questions 1 through 6; the variables such as mean, median, and mode of age, and gender could not be measured in a T-Test due to lack of subjects and no range in data statistics. Only two classes from Chambers Elementary School, and George Washington Elementary School were measured in the study. The class from George Washington Elementary school had a class of 12 children aged 6-7. There were 5 girls and 7 boys in the class. The class from Chambers



Elementary School had 21 children in the class ranging in ages from 6-7. There were 10 girls, and 11 boys in the class.

Examination of Questions 1, 4, 5, and 6:

Questions 1, 4, 5, and 6 were the best questions to use in order to show the difference in correct answers in the pre and post survey on nutrition. Question 1 asked which of three choices was a fruit; the choices given were ice cream, and apple, and a carrot. Question 4 asked which of three choices was a vegetable; the choices given were a carrot, cake, and an orange. Question 5 asked whether the person taking the test liked vegetables with a yes or no choice. Question 6 gave the person taking the test three choices to choose from as a healthy snack; the choices given were carrot sticks with ranch, a lollipop, and apple slices.

Question 1’s correct answer percentage in the pre survey was 84.85% which the correct answer being an apple. In the post survey the percentage of correct answers given went down to 73.53% with an 11.32% decrease. Question 4’s correct answer percentage in the pre survey was 88% with the correct answer being a carrot. The post survey revealed that the correct answer percentage went down to 60.61% with a 27.39% decrease. Question 5’s correct answer pre survey percentage was 60% with the correct answer being yes. The post survey correct answer percentage for question 5 was 56.25% with a 3.75% decrease. Question 6’s correct answer on the pre survey was 67.65% with the correct answer being either carrot sticks with ranch or apple slices. The post survey correct answer percentage was 57.58% with a 10.07% decrease.

Conclusion and Discussion:

In conclusion, my hypothesis that books positively affected children’s knowledge of nutrition was proven wrong. The percentages of correct answers in the pre and post survey went down significantly. The reason for the percentages dropping may be due to lack of attention from students, and under planned lesson plan. Some other reasons may be lack of a large study group, averages, and different ranges in age, gender, and grade. A better way to help increase the percentages could have been done by creating a much more vigorous lesson plan, and to have used a book with more information on eating a healthy diet and to teach the children the importance of a healthy diet.

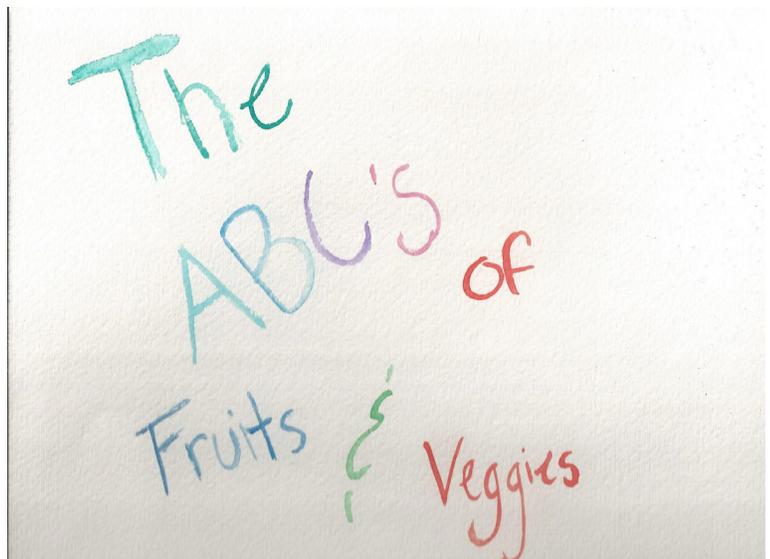
I would like to thank Siobhan Murphy and Clair McAllister for helping to administrate the surveys for the study.

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The Sixth Mass Extinction: an Examination of the Characteristics of Each Mass Extinction Compared to Modern Extinction Rates

Alysia Myers

Abstract:

Extinction is a phenomenon that has been affecting the Earth for millions of years. The death of old species leaves room for new species to evolve, adding to Earth’s biodiversity. Greater biodiversity means greater sustainability for all species (Kauffman and Cutler). The background extinction rate has been calculated from the fossil record to be about one species every four years (Leakey and Lewin). This natural balance has been upset several times in Earth’s history by mass extinction events. A mass extinction is a rapid and widespread event that kills off and effects large quantities of life on Earth. There have currently been five mass extinction events determined by fossil evidence. Today, as pollution levels and human population levels increase, the biodiversity of many ecosystems and habitats are negatively affected.

This mass die out we are currently undergoing is significant enough to be characterized as the sixth mass extinction event.

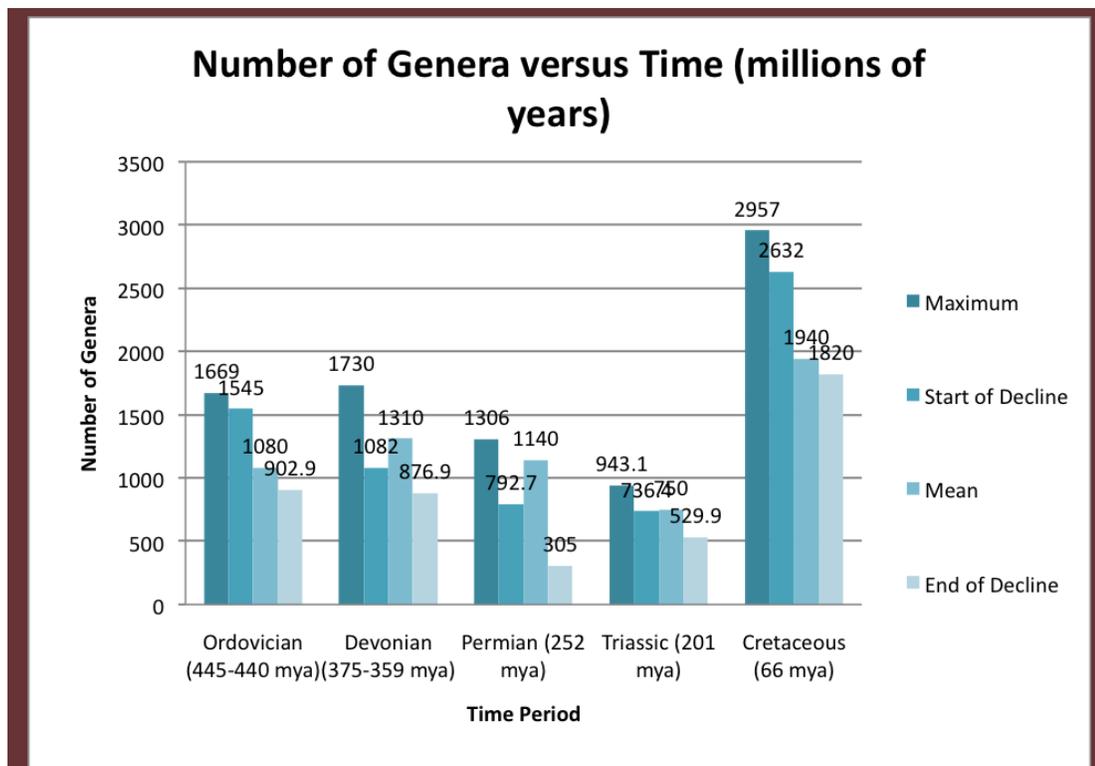
Introduction:

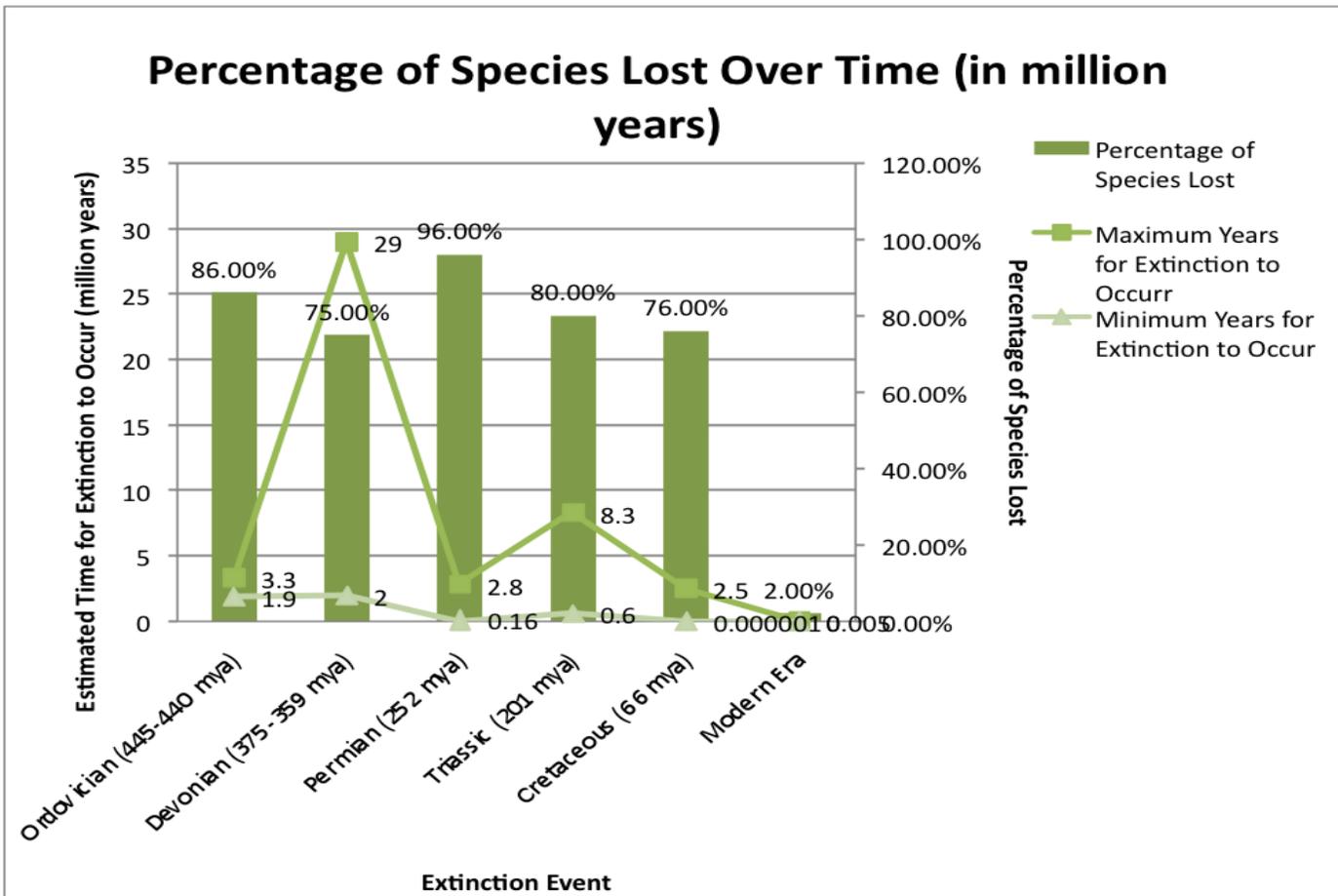
When on the topic of mass extinction, one usually thinks of the death of dinosaurs and woolly mammoths. What people do not think about is the modern era, and the large loss of biodiversity that accelerated extinction creates. Biodiversity can be defined as the variety of life in a habitat or an ecosystem, and is more important than most people are aware of. Each species of animal, plant, and microorganism has a role to play in maintaining the Earth. For example, greater biodiversity means greater sustainability for all species (Kaufmann and Cleveland). This paper will take a closer look at whether or not we are entering a sixth mass

extinction by examining the criteria that categorizes the five previous mass die outs.

A large threat to biodiversity is mass extinction. Extinction is a natural process where a species dies out completely. More than ninety percent of all organisms that have lived on this planet have died out. This means that current living species represent only a small fraction of all life that has ever existed, between two and four percent. Mass extinction is a rapid and widespread extinction event that kills off and effects large quantities of life on Earth. This does not mean that entire species die out in a day, but a species can die out in the blink of a geological eye. Each species has its own background extinction rate; the natural rate of extinction over geological time is measured from the fossil record and is

independent of human influence (Proenca and Pereira 167). Background extinction rate does not take into consideration the fact that not every animal becomes fossilized. Therefore we do not know how many life forms have existed on the Earth before humans could document them. Extinction cannot be avoided completely and is necessary for the evolution of species. Mass extinction is not a new phenomenon, but has occurred several times in Earth’s history. There have been a total of five extinction events that





were significant enough to be labeled as 'mass extinctions'. The first major extinction event happened during the end- Ordovician period. Then the late Devonian extinction event happened, followed by the end- Permian, end- Triassic, and the end-Cretaceous.

The End-Ordovician extinction event occurred between about 445-440 million years ago, possibly in two parts. None of the major groups of animals were completely lost, but marine animals suffered heavy losses. Twenty-six percent of all marine families went extinct, meanwhile sixty percent of all genera and about eighty-two to eighty-eight percent of all species also died out. Although it is difficult to say exactly what caused these events, scientists speculate that the location of super-continent Gondwana over the southern pole sent the world into and a major ice age. Due to the formation of large ice sheets, sea levels fell drastically, which strongly affected

corals and bryozoans that lived in shallow inland seas. Species adapted for warm weather had nowhere to migrate to. Then, about one million years later, these conditions ended abruptly. Sea levels rose, deep oceans waters stagnated, and poorly oxygenated water blanketed shallow marine habitats, leading to a second attack on the marine life that had survived the first one (Natural History Museum: Ordovician).

After the end of the Ordovician extinction an increase in diversity occurred. On land, the first early forests developed as well as insects and the ancestors of amphibians. In the sea, fish became the most common animal. Then once again, the world began to change. The late Devonian mass extinction occurred between about 379-359 million years ago. Research suggests that this extinction event also occurred in two main phases; the first phase lasting about two million years

and the latter phase lasting about one million years. Some scientists, however, say that the event happened in several phases spread across 15-20 million years. Although the cause of this extinction remains uncertain, we do know that the earth was undergoing major environmental changes. The first phase has been connected with anoxia combined with the rising sea levels and global cooling. Anoxia, which can be defined as a lack of oxygen in the ocean, is thought to be caused by new root systems that increased soil formation and weathering of rocks which causes nutrients to be released into the ocean, stimulating the growth of algae which used up vast quantities of oxygen in the water. Global cooling is thought to have been caused by the photosynthesizing of plants and the weathering of silicate rocks which led to a reduction in amount of carbon dioxide in the atmosphere. Massive volcanic eruptions also could have played a part in climate changes.

Most marine group suffered significant losses while plants and insects suffered very few losses. One group that was drastically affected was the armored fish, such as Dunkleosteus, which died out completely. Reef ecosystems also ceased to exist for millions of years (Natural History Museum: Late Devonian).

In the millions of years following the End-Permian mass extinction, life on Earth flourished. Only one continent existed at the time, a landmass called Pangaea, which stretched from pole to pole. The Permian saw the appearance of amphibians, along with the first reptiles, and sharks became top predators in the oceans. At the end of the Permian era a great dying occurred, approximately 252 million years ago. Intense global temperatures put all land and marine species at risk, but the main cause of this mass extinction was one of the biggest volcanic eruptions ever. Basalt lava poured out, covering the land, as massive gas clouds emitted by the volcano led to increased acid rain and global cooling. Eventually temperatures increased again as carbon dioxide was emitted into the atmosphere. Methane



was also released as oceans heated up and frozen methane deposits defrosted, causing global temperatures to increase even more. Environmental changes caused an oxygen deficit in the oceans leading to widespread extinction due to unstable food chains. Approximately ninety-three to ninety-seven percent of all species on Earth died out during this event. The end-Permian mass extinction is the first mass die out we can see in the fossil record in which insects are seriously affected, in contrast to marine animals which are usually drastically affected. Anoxic water conditions resulted in the permanent loss of trilobites, bringing an end to their 270 million year reign, as well as the loss of scorpion-like eurypterids and reef-building corals. Land species were also majorly affected; where we can see forests virtually disappear. Approximately ninety-three to ninety-seven percent of all species on Earth died out during this event (Natural History Museum: Permian).

After the devastation of the end-Permian extinction event, it took millions of years for the Earth to recover its diversity. When life did return to normal, however, we are able to see some of the most interesting creatures that have inhabited this Earth. Mammal-like reptiles flourished, sharks and fish diversified, and giant reptiles became abundant in the sea and on land. One of the most iconic prehistoric creatures, dinosaurs, developed from small, dog-sized ancestors and into majestic behemoths. Then, about 201 million years ago, all of this began to drastically change. Once again, the seas were devastated. Ammonites, brachiopods, conodonts, and bivalves were majorly affected. Most mammal-like reptiles and large amphibians disappeared, as well as many dinosaur groups. An estimated seventy-six to eighty-four percent of all species on Earth were lost. Of the five big mass extinctions, the cause of the end-Permian is the least understood. This is because of the lack of accessible sediments that are available to study. Some theorize that the main reason was the fall and then

rise of the seas due to the beginning of a volcanic rift formation. As the seas fell, reefs died out and competition increased for all marine organisms that were forced to share a smaller space. More marine organisms were killed off as the poorly oxygenated sea began to rise again. At the end of the Triassic, eruptions from the rift zone changed the environment and increased the strain on the life on Earth (Natural History Museum: Triassic).

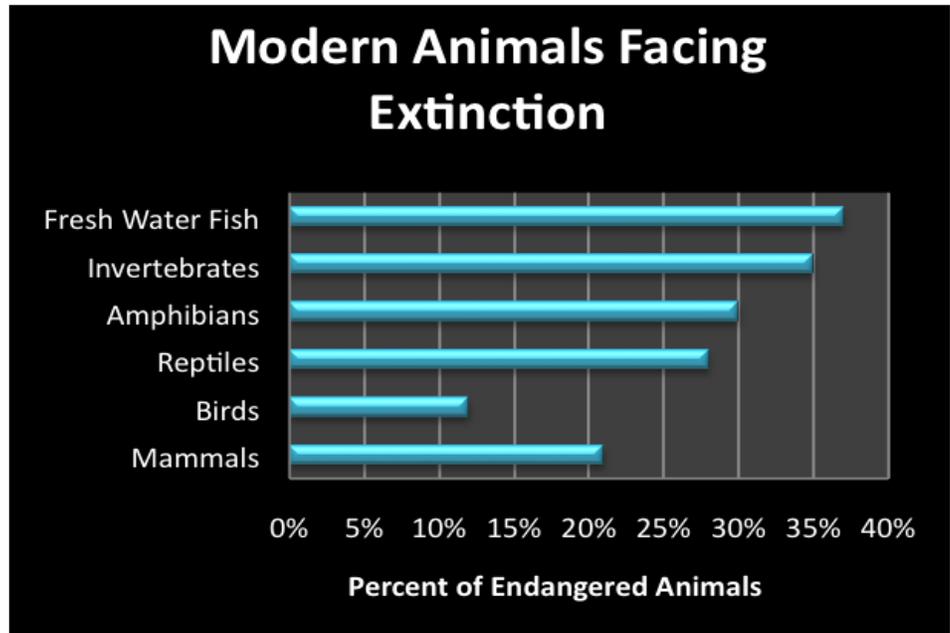
After the end-Triassic extinction event, the loss of large amphibians and mammal-like reptiles created an opportunity for dinosaurs to flourish, becoming the most abundant land animal; meanwhile massive reptiles called ichthyosaurs, mosasaurs, and plesiosaurs dominated the seas, and flying reptiles called pterosaurs dominated the skies. Other new species include flowering plants and the earliest birds. Then, about 66 million years ago, the reign of dinosaurs was ended by our most recent mass extinction event, the end-Cretaceous. The cause of this extinction event is hotly debated by geologists and biologists alike. The most famous theory is that the event was triggered by an asteroid impact, but it is unknown whether or not this alone led the event or if it was just a contribution. Many paleontologists believe that the story is much more complex. This was a time of drastic change for the Earth. Continents were in the process of separating from the land mass known as Pangaea, while ocean currents and climates changed. Then, for reasons unknown, sea levels dropped significantly, reducing large inland seas, with a major effect to land habitats. At the end of the Cretaceous, Earth was abundant with volcanic activity. Eruptions emitted ash and toxic gases, such as carbon dioxide, into the atmosphere causing acid rain and drastically decreased temperatures. Scientists also theorize that the acidification of ocean water killed the phytoplankton that larger marine mammals rely on. Because they remove carbon dioxide from the atmosphere,

the loss of phytoplankton led to an increase in greenhouse gas that gets emitted into the atmosphere which then led to a drastic increase in global temperatures. With the end-Cretaceous we see the extinction of all non-avian dinosaurs and other large reptiles such as pterosaurs, mosasaurs, and plesiosaurs. An approximate seventy-one to eighty-one percent of all species on Earth were lost during this event (Natural History Museum: Cretaceous). Over the millions of years since the last mass extinction event, Earth has evolved thousands of new species to replace the ones that have been lost. Now, in the Modern Era, we are faced with a new problem. Species are dying out on a large scale all over the globe. The rapid pace at which diversity is being lost is far from the one species per million species year that is expected. Some of the main contributors to this increased rate of extinction are pollution, habitat devastation, and global warming. With that in mind, we can conclude that we are headed towards a sixth mass extinction. This lack of biodiversity brings up major problems for our stability as a species. With decreased biodiversity we see a destabilization of our natural environments which provide natural resources, renewable resources, and food; not to mention the main source for filtering out pollution.

Methods:

The data was collected systematically from populations of species, genera, and phyla in the fossil record to determine correlations between the five known mass extinctions and modern extinction rates.

Fig. A is a graphic comparison of the differences in genera at the maximum, minimum, mean, and the start of the decline during each period. The information for this graph was collected from data mining search sites, (such as the site wolfram alpha). It is difficult to compare this information to modern extinction levels because it is uncertain



how many species are undiscovered. Also, it is difficult to say exactly how long each of the five previous mass extinctions took to occur because of limited fossil evidence and unclear data. With this in mind, fig. B shows the time span in which the extinction event could have occurred, while the bar graph in the background shows what percentage of species was lost during each extinction event. All of the data pertaining to previous mass extinctions was taken from the fossil record.

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Will Altering Feeding Practices in Juvenile Hatchery Raised Fish Increase Their Survival Rate When Reintroduced Into the Wild?

Angelica Owen

Introduction

The survival of a species is based highly upon their ability to adapt in a rapidly changing environment. Any body of water is especially susceptible to these changes, due to the influence of the human species; this creates a continually changing habitat for fish species. According to the Zoological Society of London (ZSL) 76% of fish species listed as critically endangered are from fresh water as opposed to saltwater. The causes for the sudden decline in populations are due to pollution, damming and draining of waterways, and the effect of invasive species. All of these factors require the fish to have a rapid ability to adapt, yet hatchery raised fish never develop these skills. Removed from all variables, these fish are raised in monitored waterways, which could resemble large pools, and are hand fed. They lack the opportunity to develop necessary cognitive skills to survive in their natural habitats. In this experiment White Nile Tilapia were raised and after

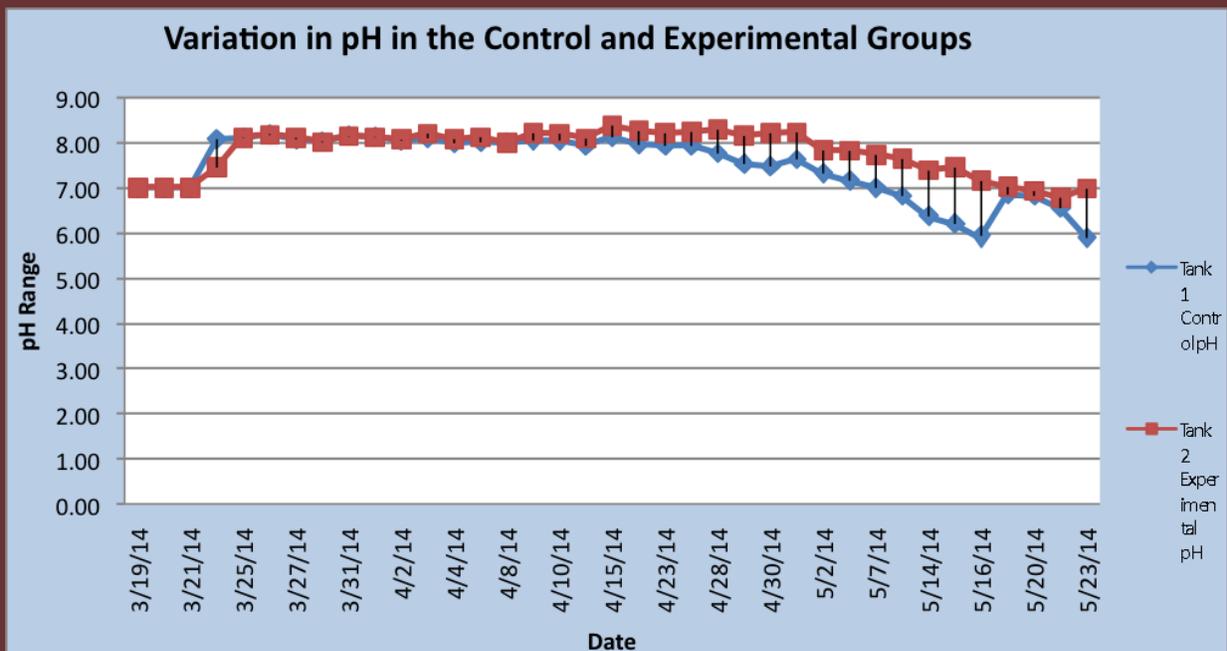
a period of about 6 weeks the fish experienced a sudden change in their feeding habits. Twenty-three fish had search for their food placed in one of four containers for 3 weeks. They were tested before and after the experiment began and compared to a group of fish that remained to be hand fed throughout the time period.

Fish populations are continually decreasing at a rapid rate due to the waterways constantly being tampered with. Pollution, the damming and draining of waterways, and newly introduced invasive species are the major causes for the sudden decline. In an attempt to “help” fish populations hatcheries tend to raise multiple species of fish and dumb them into rivers or streams. These species are invasive and tend take over the entire waterway destroying the natural ecosystem. Hatcheries also practice the method of reintroduction and due to the absence of natural selection they negatively affect

the environment when placed into the natural habitat. This experiment tests the abilities of fish to adapt to constantly changing habitats and through extensive processes the hypothesis will be tested. Altering feeding practices in juvenile hatchery raised fish will increase their survival rate when reintroduced into the wild.

Materials and Methods

Fifty White Nile Tilapia were purchased for this experiment, which were then all placed in a single tank. These fish were hand-fed twice a day at the front end of the tank. Once they matured to about two months of age, half of the fish were randomly selected to be placed in the second tank. The first tank was the control group and the second was the experimental group. The pH of both tanks were monitored and recorded before the fish had even arrived, along with the water level and temperature of the tanks. Both tanks were kept at the high 70s to low 80s range to provide the

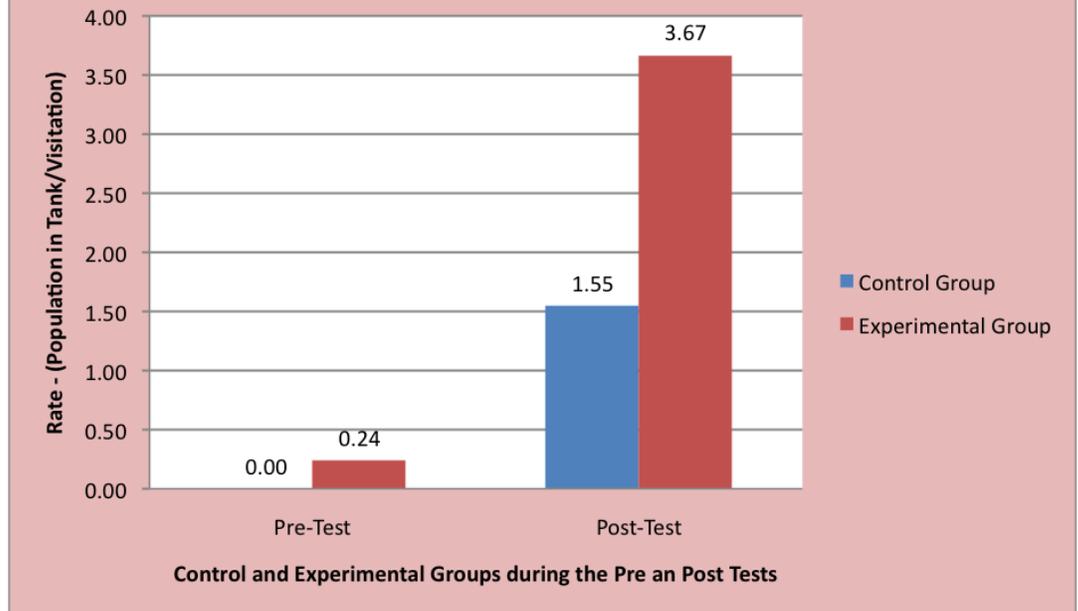


best environment for the fish. The pH range of the tank fluctuated so drastically due to the nitrites and nitrates within the water.

Two tests were conducted on both groups of fish to test their abilities to locate food within the tank. For the pre-test two small plastic containers were used. A hole, about an inch in diameter was cut into the bottom of both of the containers as well as an archway shaped hole along the side. The lid to the container was attached, and a tube was placed in the inch wide hole along the top. The tube was long enough to protrude out of the water by about five inches. One container was placed at the front of the tank while the other was placed at the back-end of it. Food was sent down the tube of the container located at the back of the tank. The fish were timed for ten minutes and a tally was taken of the number of times the containers were "visited." This same method of testing was conducted in the experimental group.

For a time period of about two weeks the fish in the experimental tank were "trained." Four of the containers with the same holes as those from the test were placed at each of the corners of the second tank. Two were simply weighted down, while two had tubes placed in them. Food was sent down one of the tubes into the container at the bottom of the tank twice a day. The food was dropped at a different container clockwise to the previous. The tubes had to be

Rate of Visitation per Fish within a 10 minute Period



relocated to the containers that were weighted down and the weights were placed on the other two containers. No other method of feeding occurred in the tank while the control group continued to be hand-fed at the front of the tank.

Another test was conducted at the end of the training period. The post-test went on for the same time and the pre-test, ten minutes. Two containers were used and food was placed in the tube of the container located at the far-end of the tank.

Data

For the pre-test, zero fish from the control group visited either of the test apparatuses. Yet in the experimental group, the food container experienced five visitations. The container without the

food remained untouched by the fish. During the post-test the container with food in the control tank had 34 visitations while the "other" container experienced none. For the experimental group a total of 77



visitations occurred and the “other” tank had five.

To clearly show the results from either test the rate of visitation was calculated and re-graphed. The rate of visitation for the pre-test for the control group is 0.00 while the experimental group is 0.24. As for the post-test, the rate of visitation for the control tank is 1.55 and the experimental tank is 3.67. The rate is the number of visitations to the container divided by the population of fish in each tank. Tank one contained 22 fish while tank two contained 21 fish.

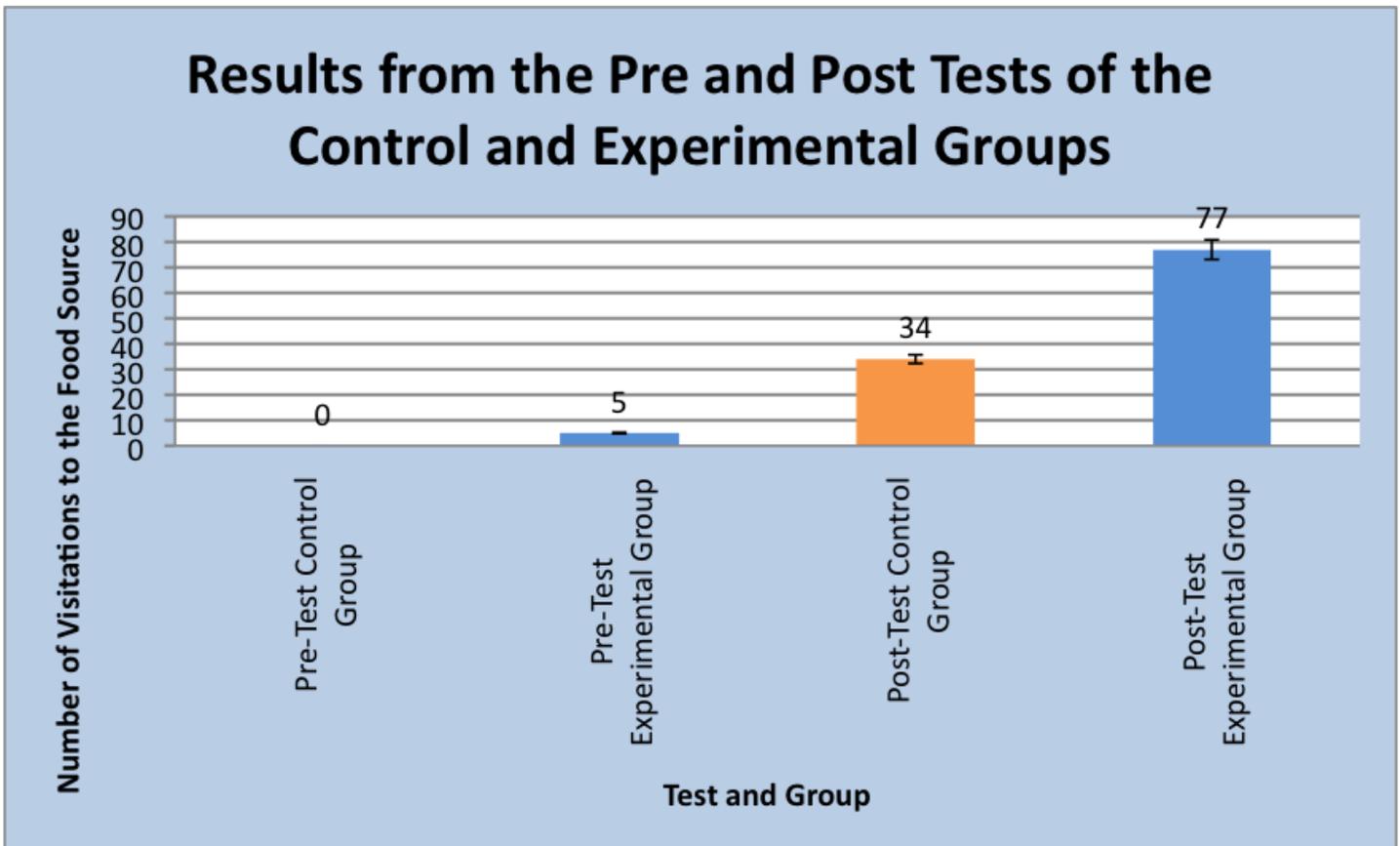
Standard deviations were not calculated due to the drastic separation in numbers when both tests are compared. The pre-test was taken as a means for comparison with the post-test. Even with five visitations occurring in the pre-test the results from the post-test support the hypothesis. By altering the feeding practices in tank two the fish were able to adapt to a rapidly changing

environment and when tested again more fish were able to locate the food and feed. The experimental group was able to provide some evidence that changing feeding methods in juvenile fish will increase their survival rate.

If the test was to be re-conducted the time a few changes the methodology of raising the fish should occur. The fish should be raised in separate tanks, throughout the experiment certain fish fought for dominance in each tank. They would protect the food and fight other fish when they felt “threatened.” Before the pre-test was taken an attempt to test the fish individually was made. A single fish was placed in a smaller clear tank. The smaller tank was exactly the same as the pre-test with the location of the two containers, just on a smaller scale. Due to the movement of the fish from one tank to another it experienced shock and remained still for the better half of 10 minutes. Once the fish came

out of shock, the reflection of the fish on the glass tank seemed to put the fish in distress. He began to swim to the sides of the tank and throw himself at the wall. Another fish was placed in another tank with the same setup in an attempt to conduct a pre-test but it was the same outcome. Both fish became distressed and ignored the food that had been placed in the container.

The ammonia, nitrite and nitrate levels within the tank became a major problem. The different levels would alter the pH of the water creating an “unfriendly” environment for the fish within the tanks. The water became very cloudy and a putrid odor was emitted. At one point the water was almost completely removed and replaced from tank one in an attempt to keep the levels of ammonia, nitrite and nitrate down. A better method of removing these harmful substances should’ve been used instead of just simply removing the water





and disturbing the fish.

Why do we care?

Hatcheries across the country attempt to “help” the fish populations by using reintroduction. Reintroduction is the method of capturing native fish, breeding them, and then raising the offspring until they reach a mature age in which they could survive in their natural ecosystems. When fish are reintroduced into the wild, their cognitive abilities are greatly lacking. They are unable to search or hunt for food, or properly mate. Certain studies have been conducted that claim raising fish in hatcheries actually alter their genetic code. Hatcheries lack natural selection, “survival of the fittest” doesn’t exist. The tanks the fish are kept in usually resemble large white pools and hand fed at specific time periods. These fish are neglected, their cognitive abilities are either severely lacking or simply undeveloped all together. When reintroduced into the wild, the offspring of hatchery raised fish have a survival rate of a mere 38%. The hatchery fish that breed with a native fish produce offspring that only have

77% chance of survival. In our attempt to repopulation the native species we actually in the long run cause more damage. By implementing simple methods to alter feeding happens amongst fish being raised in hatcheries we could increase their cognitive skills. By increasing these certain skills we could increase population growth and remove certain species for the endangered list. The experiment may not of tested the survival rate of fish that were reintroduced into the wild after being subjected to different methods of feeding. Yet, it tested the White Nile Tilapia’s ability to adapt to a constantly changing environment. It may not be the big picture but it proves that the possibility to actually “help” fish possible with more tests and proper research.

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Abstract

Alternative means of transportation is becoming necessary as fossil fuels become scarcer, more expensive to obtain, and in turn more expensive to purchase. Using renewable energy and electric vehicles we can have a sustainable transportation system. Previous research shows that plug in electric vehicles (PEVs) were equally as dangerous to the environment as petroleum powered vehicles. The purpose of this study is to analyze the

lead to economic growth for the human race, and better air quality for all life on Earth.

Introduction

Alternative energy has been on the rise for several decades now as people realize Earth's supply of petroleum is limited (GOF 10). It is not only limited, but also becoming scarcer and harder to obtain as our global population continues to grow and industrialize.

alternatives. Plug in electric vehicles are an important step towards sustainability. They can be powered by traditional fossil fuels or highly renewable energies such as solar, wind, hydro, and nuclear power. This will allow them to be used during the big transition in years to come. As long as electricity flows through the grid, regardless of where it comes from, electric cars will be feasible.

Methods

This project is an environmental and economic action plan. The research has been mostly secondary data collection from reliable resources. Many sources were previously written university research papers on this matter. These resources were obtained over the Internet and through literature. Other such resources include the United States Department of Energy, NASA, and the New York State Department of Motor Vehicles.

Results

Driving an electric vehicle does not mean you are emission free or carbon neutral. It takes energy to mine the materials needed for the car and its battery. The most common materials needed include lithium, iron, carbon, and petroleum. Then it takes energy to transport and manipulate these elements into their useable form. Energy is required to make the electricity that powers the car. Initially a PEV emits much more pollution to manufacture than an Internal combustion engine due to battery production (Lee 11). Over the lifetime of the vehicles, the internal combustion engine will surpass the electric vehicle in amount of pollution it emits (GEO 7). Currently in most places though electric cars actually emit more pollution than internal combustion engines. This is because coal is relied on heavily in modern societies for electricity production (IES 10). In countries that rely heavily on coal for electricity, an EV that needs .3kwh/km (Kilowatt hours per Kilometer) will produce 200 grams

Sustainable Transportation for the Future

Saverio Fuoco

feasibility and sustainability of plug in electric vehicles versus internal combustion engines (ICE). The methodology of this paper focuses on secondary data collection from reliable resources. An interesting trait of electric cars is that plug in electric vehicles (PEVs) have no tailpipe emissions. This result indicates that if electric car use becomes more popular that we can reduce our carbon footprint. As well, we can have a more sustainable transportation system for generations to come. In turn this will

Our civilization is in desperate need of a sustainable transportation system that is less harmful to Earth than the current standard of fossil fuel powered vehicles. In the United States we have already passed peak oil production, yet the need for oil continues to grow exponentially (IES 4). This is a system that will not last. To survive as an advanced species, we must use alternative energies and a more sustainable transportation system. We cannot wait until we are out of petroleum to implement these



of CO₂ per kilometer driven (Hawkins 55). In countries where cleaner forms of electricity production are used (hydro, solar, wind, nuclear, and natural gas) and combined with coal and oil, an EV that needs .3kwh/km will produce about 135 grams of CO₂ per kilometer (Hawkins 55). In comparison an internal combustion engine that gets approximately 20 mpg will emit about 224 grams of CO₂ per kilometer on average. While a more efficient 35-40 mpg vehicles will emit approximately 167 grams of CO₂ per kilometer on average (Hawkins 55).

Another major sustainability element is the lithium used in the lithium ion batteries of electric vehicles. These batteries are used to hold the charge, which propels the vehicle. Lithium ion batteries are the most common type of rechargeable battery used in consumer electronics today (IES 12). They are popular due to the large amount of charge they can hold and the large amount of recharge cycles they can handle before becoming unusable. Lithium batteries contain a positive and negative electrode and an electrolyte (Lee 6). The electrolyte contains the lithium and is why these batteries can be dangerous. The electrolyte is highly flammable and poses a serious threat in a car accident if the battery is punctured. The negative electrode is usually made from carbon (Lee 6). The positive electrode is a metal oxide (Lee 6). The metal oxide and carbon are fairly abundant. The lithium is a little harder to come by. There are only a few lithium deposits worth mining across Earth, and fighting over it could become just as big of a problem as oil is currently. Lithium ion batteries are highly recyclable, but it requires energy and in turn carbon pollution to do so (Lee 20).

Discussion/Conclusion

Results show that electric vehicles could be a feasible and sustainable transportation alternative to internal

combustion engines. This is only if the electricity used to propel the electric vehicles comes from a renewable and sustainable source. As well as if battery technology continues to advance, and alternatives to the scarce lithium ion are found. If renewable and sustainable energy sources are used, electric cars are far more environmentally responsible than internal combustion engines. Electric vehicles will also reduce localized pollution and smog due to zero tailpipe emissions. The emissions would be localized to the power plant, or there could be no emissions at all if renewable energy is used. The only emissions would come from manufacturing of the vehicles components, and even these could be produced using renewable energies. If renewable energy was to be implemented from the mining of the raw materials to the production of the electric vehicles itself, EV's could potentially be carbon neutral.

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