Zoos Connection to Conservation: An Overview of the Modern Day Zoo's Role in Preserving Animal Species within Zoological Institutions and in the Wild

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Abstract

The modern day zoo is quite different from the menageries of the past. Zoos and Aquariums all over the world are exciting and immersive places for visitors to learn more about the natural world. Several facets of the modern day zoo allow keepers, researchers, and conservationists alike, to learn more about the animals and plants under their care, a benefit that also is passed to zoo guests through educational programs and outreach. Apart from educating the general public, zoos and aquariums primary objectives are to support conservation initiatives "in house" and in the wild. Through the use of ex situ conservation, zoos and wildlife partners develop breeding plans to create matches for zoo animals to ensure success of wild populations. In situ conservation program partnerships are developed through zoos and researchers. These partnerships create successful programs that protect species, and ensure the sustainability of ecosystems all over the world. This lesson plan is for an informal educational setting in that it would be presented to varying audiences, in the hopes to inspire zoo guests to learn about the impact zoos and aquariums are having on conservation efforts.

Instructional Context

For this assignment I would like to create a lesson plan focused on children ages 10-12 that would introduce the modern day zoo's role in biodiversity and species conservation. Informal educational opportunities occur throughout zoos and aquariums via keeper chats, virtual field trips, educational outreach programs and self discovery opportunities through the use of signage and interactive stations. It is hard to narrow down a predicted number of students and ages of participants in any given learning opportunity at a zoo, but for the sake of this project the lesson plan will focus on middle school aged children learning about zoos: animal care and the science behind the modern day zoo.

Since this program will be held on zoo grounds it would be pivotal to pair this lesson plan with in person experiences. Visits to relevant animal exhibits, animal ambassador encounters and behind the scenes tours can be used to enhance the lesson plan information. Immersive experiences that connect higher levels of thought are crucial for creating lasting memories Fischer (2001).

Instructional Input

The lesson plan will be divided into three categories:

1. Why zoos are important
2. In Situ conservation
3. Ex Situ conservation

1. Responsible zoos and aquariums are leading efforts to rebuild the loss of biodiversity on the planet, while at the same time educating and cultivating the world's populations of inspired conservationists. In 2017, U.S. zoos and aquariums provided more than $220 million in financial support to conservation biologists working around the world (Graf, 2019). Zoos with captive breeding programs participate in the American Zoological Association (AZA) Species Survival Plan or SSP. There are over five hundred SSPs active in the United States. All plan participants must follow strict program guidelines. Captive breeding programs have been successful in saving species such as the black-footed ferret, California condor, red wolf, and Arabian oryx from extinction (Graf, 2019). In addition to facilitating breeding programs, zoos are helping to save endangered species through education. In addition to animal information, zoos promote programs that encourage environmentally safe behaviors like "shopping smart" when purchasing palm oil products like halloween candy or researching sustainable seafood options.

   The daily husbandry of the animals under human care provides critical information on species specific behaviors. This valuable information from non-wild populations housed in zoos, can ensure better understanding of wild populations. Factors that influence longevity, health, and reproduction in zoo populations can be applied to wild populations which ultimately will provide better understanding for wild population needs (Cameron, 2016).

2. Zoos and aquariums contribute considerable resources to in situ conservation projects world wide using revenue from visitor attendance. Zoos with many different types of animals, especially large animals, achieve higher numbers of visitors and contribute to more in situ

conservation projects, especially if they look different than other institutions. However, there is a trade off between housing large, charismatic species over smaller animals: cost.
Collectively, the global zoo and aquarium community attracts greater than 700 million visitors every year and invests over $350 million in wildlife conservation in situ (Mooney, 2020). The in situ conservation activities are primarily funded by paying visitors and the popularity of institutional collections is positively correlated with attendance.
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Through the funding of conservation projects, zoos can bring to attention the plight of the ecosystems they are supporting through their in situ conservation programs. In situ, latin for “in the original place”, refers to conservation work happening in native habitats. An example can be seen in Uganda. The Uganda Wildlife Education Centre (UWEC) has been implementing the Biodiversity Conservation and Promotion of Eco Tourism project at Makanaga Wetland System in Uganda since 2014 (Musingo, 2018). The Makanaga wetland is a species rich area important for biodiversity as well as the local community. The Makanaga wetland system before intervention, was threatened by human encroachment and exploitation. Despite the high biodiversity of the site, little was being done for wildlife conservation, environment management and livelihood improvement. Uganda Wildlife Education Centre (UWEC) also known as the Entebbe Zoo carries out wildlife conservation education awareness to the Ugandan public as well as facilitates wildlife rescues and rehabilitation of injured and confiscated wildlife. UWEC funds their conservation efforts through support of patrons to the Entebbe Zoo with a diverse collection of animals and natural looking exhibits that emulate the ecosystems of Uganda (Musingo, 2018).

At Omaha’s Henry Doorly Zoo and Aquarium (OHDZA), an example of in situ conservation is seen in Madagascar. Dr. Ed Lewis and his team work with the Malagasy people to find sustainable solutions to combat severe poverty and the over exploitation of forest resources, a resource crucial for the survivability of many lemur species (Manjaribe, 2013). The Madagascar Biodiversity Partnership (MBP) promotes the education of sustainable farming and forestry practices and encourages the native population to promote ecotourism over slash and burn agriculture.

Seedlings collected from the feces of Black and White Lemurs are planted to restore the rainforest cover of the mountainous Kianjavato region of Madagascar. Contracts between individuals and government officials outline the boundaries of reforested areas and define the ownership of forest products to help address any future concerns that may arise relating to ownership of the forest. The development of business plans concerning harvesting, marketing, and distribution of timber intends to keep this reforestation model economically and financially viable for participating communities. Malagasy communities are unable to rely on government assistance, emphasizing the relationship the communities have with the land. This project promotes protection of resources and provides income via responsible long-term agricultural practices (Manjaribe, 2013).

3. When habitats are so severely threatened, fragmented or lost, the outlook may look bleak for many of the species that reside in these areas and in situ conservation may not provide enough aid. Institutions like the International Union for Conservation of Nature (IUCN) and the U.S. Endangered Species Act recognizes that in situ conservation actions will need to be combined with ex situ approaches, such as captive breeding in zoos and aquariums. Ex situ conservation, latin for “off site”, uses scientific research of genetic matches to sustain healthy populations of animals under human care. Through the use of ex situ conservation, zoos and wildlife partners develop breeding plans to create matches for zoo animals to ensure genetic variation and survivability of the species. Breeding under human care has recovered 17 species in the past century. Examples being Przewalski's wild horse, black-footed ferret, and the California condor . Captive breeding helps maintain target populations as an “insurance policy” against disease or pressure from nonnative species. An increase in amphibian exhibits in zoos is an example of ex situ conservation. The fungal infection, chytridiomycosis, severely threatened most amphibian species, and in response zoos and aquariums put effort into propagating and relocating millions of amphibians (Conde, 2011).

Captive breeding for population management has its challenges including political and cultural obstacles when reintroducing species back into native habitat. Poaching is still a

dominant threat to many species world wide. An example of this can be seen in the reintroduction of Arabian oryx (*Oryx leucoryx*) in central Oman. Locals were insufficiently involved in the conservation efforts and unable to grasp the importance of the oryx's presence back into the environment (Conde, 2011).

Captive breeding is also very costly, and technical difficulties can arise such as hybridization. Efforts to breed the threatened African dwarf crocodile (genus Osteolaemus) have been hampered by the discovery of subspecies bred independently throughout zoological institutions in North American and Europe (Schmidt, 2015).

The Zoological Information Management System (ZIMS) database estimates the number of threatened species already held in zoological institutions. ZIMS is an organization that holds the most comprehensive information on animals held in zoos and aquariums worldwide, with records of ~2.6 million individuals shared among ~800 member institutions (Conde, 2011).

> "One-quarter of the world's bird species and almost 20% of the mammal species are housed in zoos. Only 12% of known reptile species are represented and 4% of amphibians. Estimations of only one-quarter of threatened and Near-Threatened species are represented in zoos. With the exception of critically endangered species, which only have a 9% representation, the picture is similar for birds. For amphibians, the representation of threatened species is much lower (~3%); this is of importance as amphibians are indicator species for their ecosystems (Conde, 2011).

Overall, zoos and aquariums hold roughly one in seven threatened species (15%). Individual zoos contribute to conservation more effectively by specializing in breeding a few at-risk targeted species. At Omaha's Henry Doorly Zoo and Aquarium, specialization in large cat breeding, with the expertise of Dr. Jason Herrick and the animal care experts have led to the success of the cheetah and amur tiger breeding programs in North America.

> "The Reproductive Sciences Department, in collaboration with Omaha's Henry Doorly Zoo and Aquarium's veterinary and animal crews, has developed techniques

> such as artificial insemination and in vitro fertilization for many species and maintains a bank of more than 20,000 samples of frozen reproductive cells from over 50 species. This exceptional program helped produce the first test tube gaur and gorilla, and the first artificially inseminated and test tube tigers. Currently, the program is working in conjunction with the University of Nebraska Medical Center to develop recombinant tiger hormones to increase the efficiency of these procedures in endangered felid species" (Omaha's Henry Doorly Zoo and Aquarium, 2020).

While In situ conservation is important, adequate data from natural environments are often unavailable, especially for threatened species. The zoo network has large long-term data sets, including average litter/clutch sizes, intervals between successive litters, and age of maturity, which could be used to fill these knowledge gaps.

Ultimately, "the success of conservation actions depends on the extent to which birth and death rates permit populations to survive in the wild" (Conde, 2011). Through the actions of the modern day zoo, crucial information is being gathered, either through the interactions between animals under human care and their caretakers, the scientists and animal care experts breeding at-risk species within institutions, and the dedicated researchers performing "boots on the ground" conservation actions to save species in the wild. Without the modern day zoo, wildlife conservation would be severely threatened.

Lesson Plan

Grade: 4th and 5th Topic: Zoos and Conservation

Student Objectives: Students will be able to explain the role of the modern day zoo by identifying conservation projects that play a significant role in the survival of animal and plant species and their environment.

Learning Outcomes:

1. Recognize zoo standards in animal care
2. Understand the definition of species survival plans (SSPs)
3. Compare in situ and ex situ conservation
4. Identify a OHDZA conservation project

Driving Questions:

What are the main sources of biodiversity loss on the island of Madagascar? What animals and plants are affected by these sources? How do zoos like OHDZA help prevent biodiversity loss?

Prior Student Knowledge:

Students should be familiar with a basic understanding of genetics.

Possible Preconceptions/Misconceptions:

Zoos hold animals captive for money. Little or no research is done and no help is given to "true" wildlife.

Multiple Means of Engagement (How are you going to engage and motivate your students?):

Connect students with issues of biodiversity, animal care, genetics and conservation by relating to their own lives. Utilize advanced inquiry practices by having students ask questions to a keeper during a keeper chat. Keeper will present the basics of animal keeping (natural history review, animal welfare, enrichment, and training)- provide similarities with taking care of a pet.

Use an interactive powerpoint presentation to engage students in the theory of in situ and ex situ by playing a conservation project matching game. Explore the Expedition Madagascar building and introduce the work of Dr. Ed Lewis, conservation genetics chair of OHDZA, who is working with the Malagasy people of Madagascar to replant the deforested areas of the island, a crucial resource for the endemic lemur species.

Multiple Means of Representation (How are you going to present your content so it meets the needs of all students): Conservation powerpoint, biofacts including Madagascar seed pods, rocket stove, lemur pictures, and a tour to an a behind the scenes animal area as well as walk through the Expedition Madagascar building to talk about lemurs and conservation. Presenting information in many different ways will cater to different learning styles.

Multiple Means of Expression (How do students demonstrate what they have learned): Students will work in small groups to practice setting up an animal enclosure, see a training session or feed out to learn more about how zoo staff take care of the animals. Students will be given a chance to ask keepers questions or provide observations. A matchmaker game will help introduce the ideas of conservation genetics and tie in the importance of species survival plans. Lastly, students will solidify their understanding of in situ and ex situ conservation by playing a conservation project matching game.

Academic Language:

In Situ Conservation: On site conservation work happening in native habitats. Habitat restoration, community outreach and education.

Ex Situ Conservation: Off site conservation work happening in research labs, zoos and aquariums. Species genetic preservation, breeding programs and reintroduction efforts.

Species Survival Plan (SSPs): Programs that maintain healthy and genetically diverse animal populations. Partners involved in SSP programs cooperate to manage populations and conservation efforts that include research, public education, reintroduction, and *in situ* or field

conservation projects. There are currently 172 species covered by 116 SSP programs in North America.

Operant Conditioning: Operant conditioning is a method of learning that occurs through rewards and punishments for behavior. Through operant conditioning, an individual makes an association between a particular behavior and a consequence (Skinner, 1938). Keepers train using positive reinforcement, where an animal receives a reward (usually food) after completing a behavior the keeper has asked for. Animals are never punished.

Enrichment: Opportunities for animals under human care to engage in learning, exercise, and novel experiences in the efforts to improve overall welfare.

Madagascar Biodiversity Partnership (MBP): A partnership with Dr. Ed Louis from OHDZA and local Malagasy communities. The MBP promotes the education of sustainable farming and forestry practices and encourages the native population to promote ecotourism over slash and burn agriculture.

<u>5 E Model:</u>

ENGAGE: Opening Activity- Ask students why zoos are important, generate discussion and thought trees.

EXPLORE: Introduce zoos connections to conservation and biodiversity preservation with powerpoint. In situ, ex situ and OHDZA projects presented.

EXPLAIN: Have students play a matchmaker game (link 1). Create the best match for a female gorilla from a list of "suitors". Ask students why they made the match they did and dive deeper into Species Survival Plans (SSPs).

ELABORATE: Take the group to the Expedition Madagascar building where they will take a tour with a keeper. Keeper should introduce new terms like positive reinforcement training, enrichment and care plans, but also revisit terms like biodiversity, SSPs and in/ex situ conservation. Students will help set up an animal enclosure: providing food, water, safe spaces

to eat and sleep, and enrichment to solidify the importance of proper animal care. After the behind the scenes tour, students will gather in the Madagascar building's public space. Instructor will hand out biofacts like seed pods from Madagascar (figure 1) and a rocket stove (figure 2) in front of the various lemur species exhibits. Explain more about the Madagascar Biodiversity Partnership (MBP)- an in situ conservation program-and how saving Madagascar's Forest is saving the endemic lemur species, only achievable by working with the local people.

EVALUATE: Return to the classroom after the Madagascar Building tour. Set up the in situ and ex situ sorting game. Give students a piece of paper with a OHDZA conservation project description (List 1). Divide the room and have the students pick if the project is in situ or ex situ, have them explain their choices. End the day by talking about the Southern Sportive Lemur. One of the most endangered primates on earth. The lemur only lives in one area of Madagascar. Without the help of conservation efforts, this species will surely go extinct.

Reflection

Upon completion of the lesson plan, as I have never attempted compiling a lesson plan nor am I a certified teacher, I have concluded that a lot more goes into the creation of curriculum. While I always have respected educators, I have a higher level appreciation for their work. I have not yet implemented the lesson plan at Omaha's Henry Doorly Zoo and Aquarium (OHDZA) but I think I would find this a daunting task. There is a lot of scientific material to cover with this particular lesson plan and I think I would need to research state and federal standards of education to determine the science background most students entering the lesson would have. After talking with a few classmates and educators I decided to pair down my focus to the island of Madagascar. By focusing on one area of conservation work might help students understand the primary objectives of this lesson plan.

After reviewing the lesson plan, I think where I will connect with most students is in the animal care section of the plan. Many students can relate to taking care of a pet at home. A key concept that will be harder to identify with, especially for younger students, is the practical application of

in situ wildlife conservation. Many conservation projects funded by zoos and aquariums are multifaceted, many with a human element associated with it. Concepts that may be overwhelming for middle schoolers. This lesson plan can certainly be tailored towards older audiences, in fact high school aged and older students might benefit more from the discussions on animal genetics management and ex situ conservation.

The next step in this teaching sequence would be the introduction of specific conservation programs that OHDZA is involved in. Currently OHDZA is involved in several international programs, ranging from lemur conservation and forest restoration in Madagascar, amphibian repopulation efforts in Puerto Rico and Panama and the reintroduction of native fern species in Hawaii. Closer to home, OHDZA is involved with Salt Creek Tiger Beetle reintroduction in Lincoln, Nebraska.

Technology could be implemented throughout these lesson plans in several ways. A virtual tour or map of the world where different conservation projects are highlighted would be a very immersive experience. Videos of local success stories and animal training techniques might also add to the lesson plan. Inquiry based learning might also be an avenue worth trying this informal education lesson plan.

Appendix


Figure 1: Madagascar Palm seed pod

Gorilla Connection Matchmaking Game Link 1: Matching Making Game


Figure 2: Rocket Stove

List 1:OHDZA Conservation Projects:

I. North America
   A. Nebraska
      1. Great Plains ladies tresses orchid propagation and reintroduction
      2. Salt Creek tiger beetle reintroduction
      3. Tiger assisted reproduction
      4. Gaur assisted reproduction
      5. Tiger Salamander citizen science project
      6. Monarch Tagging citizen science project
   B. Wyoming
      1. Wyoming toad propagation and reintroduction
   C. Mississippi
      1. Mississippi gopher frog propagation and reintroduction
II. Africa
   A. Madagascar
      1. Kianjavato
         a) Aye-Aye research project
         b) Greater Bamboo lemur monitoring

c) Black and White Ruffed Lemur monitoring
d) Education Promoting Reforestation Project
e) Conservation Credit Program

2. Antsiranana
   a) Northern Sportive Lemur Project
   b) Rocket Stove Project
   c) Aquaponics pilot program
3. Lavavolo
   a) Radiated tortoise project
   b) Ring-tailed lemur project
4. Ranomafana National Park
   a) Malagasy orchids

B. Kenya
   1. Disease management in Cape Buffalo through assisted reproduction

III. South America

A. Costa Rica
   1. Costa Rican crested toad propagation and reintroduction
B. Panama
   1. Panamanian golden frog propagation and reintroduction
C. Bermuda
   1. Bermuda Fern propagation and eco-rehabilitation
D. Caribbean
   1. Caribbean elkhorn and staghorn coral propagation and ecosystem rehabilitation

In situ conservation efforts
Ex situ conservation efforts

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