I completed an internship within the Aviculture Department at the Cincinnati Zoo and Botanical Garden. My primary responsibilities included the care of penguins and their exhibits, while simultaneously gaining experience in the care of various other species of birds. In addition to my zoo-keeping responsibilities, I was given the task of conducting a daily educational talk to the zoo visitors about penguins. I also participated in three research projects being conducted at the zoo. My involvement with these research projects, allowed me to critically evaluate the processes and procedures associated with conducting research in a zoo setting.
REPORT OF AN INTERNSHIP WITH THE CINCINNATI ZOO
AND BOTANICAL GARDEN

An Internship

Submitted to the
Faculty of Miami University
in partial fulfillment of the requirements for the degree of
Master of Environmental Science, Institute of Environmental Sciences

by

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INTRODUCTION

The Institute of Environmental Sciences (IES) at Miami University offers a Master of Environmental Science (M. En.) degree. This professional degree emphasizes the importance of teamwork and problem solving, while demonstrating the complexity of environmental problems. The degree requirements include the completion of the core curriculum, additional area of concentration courses, a comprehensive examination, a public service project, and a research requirement in the form of a thesis, practicum or internship. This program prepares students to be productive environmental professionals. I feel that this program sufficiently prepared me for my internship at the Cincinnati Zoo and Botanical Garden (CZBG).

As a second year student in the IES program, I have continued to pursue my lifelong ambition to study Antarctic penguins in the wild. During my time as an IES student, I discovered a prospective internship assisting a team of researchers studying Adélie penguins. In order to gain relevant experience for this type of internship, my advisor suggested that I complete an independent study at the Cincinnati Zoo where other Antarctic penguins are maintained and periodically studied. David Jenike, the Director of Education at the Cincinnati Zoo, and former IES student, arranged an unpaid-internship opportunity for me, working in the Aviculture Department at the Zoo. After four months of interning at the bird house, the Curator of Birds at the Cincinnati Zoo hired me as a temporary keeper for an additional three months.

The internship at the Cincinnati Zoo encompassed various aspects of animal care, as well as animal research. This position allowed me to gain hands-on experience working with not only penguins, but over fifty species of birds. Working on numerous projects allowed me to gain an understanding of, and respect for, the important role zoos play in the conservation of species. Although I was given physically demanding responsibilities, the rewards were extremely gratifying, as I came to know the different birds and their personalities.
THE HISTORY OF ZOOS

The earliest records of animal collections date as far back as 2500 B.C. These were private collections acquired by royalty and nobility, and were seen as symbols of power and prestige (Kisling, 2001). From the ancient Egyptians to the Roman Empire, nobility sought out rare animals to add to their collections of prized possessions. Exotic animals were even given as diplomatic gifts amongst royalty and heads of state.

These early animal collections evolved into menageries, with the opening of the first modern zoo in 1765 in Vienna (Sonquist, 1995). During the mid-late 1800s, zoos became more common with several zoos opening in Europe and the U.S. These menageries were opened to the public for viewing and consisted of animals in cages positioned throughout a garden setting. During this time period, zoos were seen as places of public entertainment and recreation. The animal caregivers generally had little comprehension of the dietary, social, physical, or emotional needs of the animals (Sonquist, 1995).

During the mid-late 20th century, zoos began to focus more towards animal welfare, education, research and conservation. With advancements in veterinary science, animal health increased and captive animal breeding was finally successful. Since then, the public has been enthralled with the results of these advancements: zoo babies. The physical appearance of zoos began to change from the original barred cages, to the more naturalistic exhibits in the 1970-1980s when the welfare of animals in captivity became a highly debated issue (Sonquist, 1995). This has led to the design of elaborate exhibits that mimic the natural habitat of the animals.

As zoos began to increase their numbers of endangered animals, more emphasis was placed on conservation and research efforts. Communication between zoos became increasingly important after the establishment of the Species Survival Plan (SSP) program by the American Zoo and Aquarium Association (AZA). This program was started as a way to minimize inbreeding, while saving endangered species from extinction through captive breeding (Sonquist, 1995). Zoos were able to swap animals in order to increase the genetic diversity of
their captive populations. This plan, however, has not been without problems. In order to form viable breeding pools, many more animals are needed, which is not always plausible with the large animals that need large spaces, like tigers and elephants. Another problem that accompanied the larger breeding pool was the question of what to do with surplus animals. Nature is not always predictable, so for example, if the SSP calls for a pair to produce two female offspring, it may take several tries, resulting in several males, before the desired amount of females are produced. Zoos have limited space, and surplus animals take up that precious space needed for animals in the SSP breeding populations.

Realizing that further steps need to be taken in order to protect endangered wildlife, zoos are now focusing more on field conservation, research, and education. Michael Hutchins, director for conservation and science at the AZA, sums up this new trend by stating, “Zoos are becoming protectors rather than collectors of wildlife” (Sonquist, 1995). Today, zoos are making an effort to educate their visitors about their conservation programs in the animals’ natural habitats. With the use of advanced technology, new funding sources, and an increasing knowledge base, zoos are becoming state of the art conservation centers.

THE CINCINNATI ZOO AND BOTANICAL GARDEN

Following an outbreak of caterpillars in the Cincinnati area in 1872, the Society for the Acclimatization of Birds was formed to import insect-eating birds from Europe. After this goal had been met, the Society shifted their cause to focus on the establishment of a zoo. Their efforts culminated in the opening of the Cincinnati Zoo on September 18, 1875, which was only the second zoo in the United States (Ehrlinger, 1993). Designed with German influences, the Zoo still has three original buildings including the Reptile House, which is the oldest zoo building in North America. The Cincinnati Zoo has long been known for its extensive animal collection, as well as its unique architecture and entertainment.

Since opening its gates in 1875, the Cincinnati Zoo has also had a reputation as being one of the biggest and most complete zoos in the country. Among the various milestones that have occurred at the Zoo, some of the most well known include the death of the last
Passenger Pigeon in 1914 and the death of the last Carolina Parakeet in 1918. Recent innovative research at the Zoo’s impressive Center for Reproduction of Endangered Wildlife (CREW) has led to many technological breakthroughs in embryo transfer, cryopreservation, and other reproductive technologies. CREW has had many successes, including the birth of the world’s first in-vitro gorilla in 1995.

The Cincinnati Zoo is also dedicated to education and conservation in addition to its many research projects. The Zoo supports numerous field conservation efforts that are underway in places all over the world helping to protect the dwindling natural habitats of wildlife. In the future, the Cincinnati Zoo is determined to continue its mission of education, research, and conservation.

**INTERNSHIP**

When I first began my internship in the bird house, I was primarily interested in working with their penguins, which include eight rockhoppers, twenty little blues, six kings, two magellanic, and three black-footed. During the course of the internship, however, I developed a fond respect for all birds and enjoyed having the opportunity to work with all the unique species at the Cincinnati Zoo. Working as an animal keeper, I quickly learned that this type of job entails much more than the stereotypical duties of feeding and cleaning up after animals. Although a large portion of my time was spent preparing the animal diets and cleaning exhibits, I had other responsibilities as well. These responsibilities included interacting with the public, watching animal behavior, dispensing enrichment items to the animals, and helping to conduct three different research projects.

While in the bird house, I worked for the curator of birds, David Oehler, and under the supervision of Steve Malowski, head keeper. The bird house staff consisted of seven full-time keepers, four volunteers, and seasonal interns. During each school year, about a dozen Zoo School students rotate through the bird house and take on minor responsibilities. The Zoo School is a vocational high school program that began in 1975, which emphasizes animal care and natural resource management (Ehrlinger, 1993). Students attending the school work at the
Zoo for part of their day. When I began working as a keeper, I often had to supervise the responsibilities of the interns and students.

Due to the large number of tasks that must be completed each day by the bird house staff, I quickly learned the vital importance of teamwork. Without the cooperation of all the employees, the bird house would not run smoothly. Within the bird house, work is divided up into five sections, each with their own set of duties (Table 1). I had the opportunity to work in all the sections; however, most of my time at the zoo was spent in the Aquatics section, alternating between inside and outside duties.

| Table 1: Sections and corresponding responsibilities within the Aviculture Department. |
|---|---|---|---|---|
| A | B | C | Aquatics: Inside | Aquatics: Outside |
| South America | Swamp | Australasia | Penguins | Flight cage |
| Nursery | Montane | Microhabitats | Puffins | Little penguins |
| Feed Preparation | Grassland | Holding 2 and 3 | Auklets | Flamingos |
| Pull Plates | Holding 1 and 4 | Jungle Trails | Alcid Holding | Eagle Eyre |
| Incubation | Waterfowl | | Filter room | Macaw Moat |
| | | | Penguin Encounter | Cranes |
| | | | | Kookaburra |
| | | | | Swan Lake |

My general daily responsibilities included cleaning, feed preparation, and other relevant animal care duties. The cleaning of exhibits usually included thoroughly hosing down the exhibits without too much disruption to the animals. Exhibits were disinfected and pools were drained and bleached on a weekly basis. Other general duties included washing dishes, changing filter bags, helping administer medication, and aiding in the capture of escaped or injured birds. In addition to these duties, I was responsible for preparing and distributing enrichment items a few days per week. Enrichment items are given to captive animals to increase their overall well-being, by promoting naturalistic behaviors (Markowitz, 1982).
Enrichment items at the Cincinnati Zoo have to be approved by the enrichment committee before being given to the animals. Some of the enrichment items that I prepared and distributed included cups of live crickets given to the hornbills, live fish released in the penguin pools, and grapes placed on vines within the South America exhibit. These general duties were accompanied by additional responsibilities during the breeding season.

The preparation and distribution of food is one of the most important responsibilities in animal care. Food preparation in the bird house ranged from chopping fruit and mice, to thawing fish and krill. With the wide range of species in the bird house, it is only logical that there is a wide range of requirements in dietary needs. Most days I dealt with the process of thawing fish for the penguins. Working with all the birds at one time or another, meant I had to quickly master the task of knowing which birds ate what food. Most of the birds ate off plates we placed in their exhibit or cage. Some of the penguins however, had difficulties eating off plates due to the shape of their beaks, and were hand-fed instead. When I first started working in the bird house, one young rockhopper, all the king penguins and all the little blue penguins had to be hand fed. This was extremely time consuming, and during the months of my internship, I watched as all but the king penguins and three little blue penguins learned to eat off plates.

Unlike the collection of penguins at the Cincinnati Zoo, there are 17 different species of penguins in the wild, all of which live in the Southern Hemisphere. Most penguin diets consist of small fish and krill, which they forage for in the ocean. Penguins are known as flightless birds, however, they are well adapted to ‘flying’ underwater in pursuit of their prey. Penguins spend most of their lives swimming in the waters around their colonies. Some penguins can remain underwater for as long as 18 minutes at a time. Currently, several species of penguins are endangered due to the impacts of oil spills, over fishing of the oceans, and loss of habitat, on their populations (Schafer, 2000).

The most rewarding aspect of my job was definitely interacting with the animals. In addition to the penguins, some of my favorite birds that I cared for included the flamingos, eagles, macaws and kookaburras. Learning the name and personality of each individual bird was
an enjoyable, and sometimes painful process. I quickly learned to tell the difference between which penguins bit and which penguins were friendly enough to pet. Working with five species of penguins, it was interesting to observe differences and similarities between the species. It was also interesting to watch their behaviors change as breeding season came into full swing in May.

With the start of breeding season, came my additional responsibilities. I continually had to watch for newly laid eggs in all the exhibits, in order to keep accurate records of breeding behaviors. I also had to watch out for unfit parents who either stopped sitting on their eggs, or kicked the eggs out of their nests. Some eggs were pulled as soon as they were laid due to the parents having a long history of such behaviors. When eggs were pulled from the nests, they were put into one of three incubators, and checked for fertility periodically. Once parents were sitting on eggs, I had to watch for and record any new hatchings. When birds hatched I had to identify the parentage of the new birds, which did not always prove to be an easy task. All the birds are eventually made identifiable with colored bands placed around their leg or wing. With the hatchings of penguin chicks, came the responsibility of weighing the chicks every morning in order to ensure proper weight gain. Watching the baby birds grow and develop personalities of their own was an incredible process.

During breeding season, the Zoo sponsors the annual event “Zoo Babies.” This event showcases the Zoo’s newest residents. This year, the bird house had many births including eight flamingos, a tri-colored heron, a rhinoceros hornbill, a kookaburra, a little blue penguin, and a king penguin. This event always coincides with an increase in visitors, so it is during this time that the Zoo offers many animal encounters, where the public can interact with a keeper. In the bird house, I was responsible for the Penguin Encounter, which occurred every morning at ten o’clock in front of the indoor penguin exhibit. This animal encounter ranged in topic. Sometimes I would feed the penguins for the public to see, and then answer any questions they had. However, as we began caring for the little blue penguin chick, I would take “Oreo” to the front of the penguin exhibit for the public to see. Interacting with the public and answering their many questions was very satisfying. To see the excitement and amazement on children’s faces from their encounter with a baby penguin was touching. I was able to convey to them my knowledge of penguins and educate them on the problems these animals are facing, such as loss
of habitat and human over-consumption of fish. This experience taught me how powerful animals are in educating and motivating the public. I was amazed by how little the visitors knew about penguins, and felt gratified that I was able to increase their knowledge and understanding of these unique species.

RESEARCH IN ZOOS

Zoos pose as a unique locale for scientists to research animals without having to travel to exotic locations. Zoos are typically underrated as research resources, although the amount of research conducted at zoos has increased over the past twenty years (FRG, 2002; Stoinski, 1998). The majority of research completed within zoos is normally conducted by outside scientists and students; however curators, keepers, and designated research staff are also involved in zoo research efforts (Stoinski, 1998). Research can be beneficial to zoos by discovering ways to improve animal management, nutrition, husbandry, breeding etc. Zoo research can also contribute to the conservation of animals in situ. Conducting research in a zoo has many advantages over field research. By conducting research in zoos, researchers are able to: study animals closely, have control over environmental or social variables, work with a variety of different species, and save money by not incurring the great amount of costs associated with field research (Hosey, 1997; Stoinski et al., 1998).

Although there are many advantages to conducting research at zoos, there are several challenges associated with zoo research projects. Zoo animals are seen as abnormal populations, which scarcely resemble wild populations due to their age and sex compositions (Hosey, 1997). This makes it difficult for researchers to compare captive and wild populations. Other disadvantages include the fact that zoo animals live in artificial environments, and often develop unusual behaviors such as self-mutilation, and habituation towards feeding schedules. Methodologically, it is difficult for researchers to conduct statistical analyses on data obtained from zoo populations, due to small sample sizes of each species (Hosey, 1997). In addition to these disadvantages, outside scientists must also consider the challenges that are associated with working and conducting research in cooperation with zoo staff. Researchers must work closely with keepers in order to successfully complete research projects. Research schedules are often
planned around the keepers’ duties and routines in order to decrease the chance of conflict. Unfortunately, researchers have to be prepared to deal with keepers who, for various reasons, intentionally try to sabotage their research efforts. This is why outside scientists must always remember that zoo workers deserve respect due to their ability to enhance or destroy ongoing research projects (Markowitz, 1982). All of these factors must be considered for researchers to appropriately design their study, as not all research is best suited for a zoo environment.

RESEARCH AT THE CINCINNATI ZOO

The Cincinnati Zoo and Botanical Garden has a reputation for having one of the best research programs in the country (Stoinski, 1998). The Cincinnati Zoo is home to the Center for Reproduction of Endangered Wildlife (CREW), which opened in 1991. This state-of-the-art research facility is dedicated to using science to help save endangered species from extinction. The Cincinnati Zoo employs 10 full-time scientists to conduct research at the CREW facility (CZBG, 2003). It is extremely rare for a zoo to have such a high-tech research facility because most zoos lack the manpower and financial resources required to conduct extensive research (Margodt, 2000). The research conducted at CREW is focused mostly on reproduction, cryopreservation and the use of biotechnology to increase the propagation and management of endangered species.

Although CREW faculty conduct most of the research completed at the Cincinnati Zoo, other individuals such as curators, keepers, and scientists and students from academic institutions also conduct research at the Zoo. In order to conduct research at the Cincinnati Zoo, outside scientists from academic institutions must submit a copy of their research proposal to the Zoo, which has to be approved by the head curator. Through my experiences at the Cincinnati Zoo, I have also seen that this process can be bypassed, or proposals can be more readily accepted if the researcher knows the right people within the Zoo. Once a proposal has been approved, it is then the responsibility of the researcher to coordinate with the specific department to determine the research schedule and details.
As part of my internship within the Aviculture department, I was assigned to help assist with three different research projects. Each of the three projects I worked on was unique and gave me an interesting overview of the various types of research conducted at zoos. I had the opportunity to experience a research project conducted by a curator, and another project conducted by a doctoral student. Another doctoral student, who was unable to conduct the research himself, designed the experimental plan for the third research project. Keepers who followed explicit instructions from the primary investigator conducted this research project. Through my experiences with these studies, I made several observations that enabled me to critically evaluate the research process and make suggestions to improve the success of future research conducted at the Cincinnati Zoo.

King Penguin Telemetric Egg

Extensive data on *Aptenodytes patagonicus*, or king penguin, egg incubation has been collected in the wild, however, additional information on captive populations of king penguins would be very useful (Stonehouse, 1960; Handrich, 1989; Adams, 1992; Weimerskirch, 1992; Groscolas, 2000). Research conducted on wild populations of king penguins have shown that incubation temperatures range from 37.2-38.3°C. Studies have also found that the duration of incubation, from the time the egg is laid until it hatches, ranges from 52.3-55.3 days (Table 2). Data could be used from a captive stock to increase the success of artificial incubation techniques of king penguin eggs. Understanding this need to collect data on incubation duration, temperature, rotation, light, and humidity, the Cincinnati Zoo decided to collect data from their king penguins by utilizing telemetric eggs. The goal of this study was to determine the incubation parameters utilized by the Zoo’s king penguins in order to adjust the artificial incubator to mimic the parental-brooding environment. Over the past few years, the Zoo has had a low survival rate for artificially incubated king penguin eggs, which may have been due to slight differences between the artificial and natural incubation parameters.

For three consecutive years, two king penguins incubated telemetric eggs, HOBO data loggers encased in an egg-like structure. Information such as temperature, humidity, light, and rotation were recorded during ten-minute intervals for a total of 64 days during breeding season each year. The telemetric eggs from this study recorded incubation temperatures ranging
from 36.4-37.2°C, which were slightly cooler than the incubation temperatures found in the wild populations (Table 2). As a result, the Aviculture Department was able to redefine their artificial incubation parameters, which may one day be useful if a king penguin egg needs to be artificially incubated.

Table 2: Comparison data on king penguin egg incubation parameters.

<table>
<thead>
<tr>
<th>Location of Colony</th>
<th>Egg Temperature (°C)</th>
<th>Incubation Duration (days)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crozet Island (wild colony)</td>
<td>38.1°</td>
<td>53</td>
</tr>
<tr>
<td>Falkland Islands (wild colony)</td>
<td>37.2-38.8°</td>
<td>54-55</td>
</tr>
<tr>
<td>Marion Island (wild colony)</td>
<td>N/A</td>
<td>54.1</td>
</tr>
<tr>
<td>Possession Island (wild colony)</td>
<td>N/A</td>
<td>53.8+/- 1.5</td>
</tr>
<tr>
<td>Cincinnati Zoo (captive)</td>
<td>36.4-37.2°</td>
<td>N/A</td>
</tr>
</tbody>
</table>

(Sources of data include: Adams, 1992; Handrich, 1989; Stonehouse 1960; Weimerskirch, 1992)

This was the first project I was assigned to work on, and my responsibilities were initially to enter all the parameter data into Statistica (a statistical software program), followed by statistical analyses in order to better interpret the results. Before I entered data, the curator had me read various research articles to provide me with background information on the process of king penguin egg incubation. After two weeks of tedious data entry, I completed this task and was prepared to discuss analyzing the data with the Curator of Birds, David Oehler. However, this project was cut short when the computer crashed, and was in the process of being fixed for the remainder of my time at the Zoo. The data I entered was saved on a disk, and may eventually be analyzed by someone else. Although I was not able to complete this project, I learned a great deal about the complex process of king penguin egg incubation.

This project may have had a different outcome if the data had been better organized, and if the staff working with me on this project had more time to devote to this assignment. The original data I worked with had been sitting for years in piles of disorganized printouts. If this project took priority within the department, I believe data would have been gradually entered into a computer during the time that it unfortunately remained untouched. However, from my experiences working as an intern/keeper, I understand how this project could have been easily overlooked, with the numerous duties and responsibilities that take precedence
over any ‘extra’ projects. In the future, I suggest that a better effort be made to commit to a project before initiating it.

Crested Auklet Behavioral Research

_Aethia cristatella_, or Crested auklets, are a unique species of seabird found on islands in and along the coastline of the Bering Sea (Jones, 1993). These birds produce a unique pungent, citrus-like odorant during breeding season (Douglas et al. 2001). Hector Douglas, a Ph.D. candidate at the Institute of Marine Science at the University of Alaska Fairbanks, has been conducting research on these birds and their unique odorant. In collaboration with the Cincinnati Zoo, Hector Douglas proposed a study on the birds in captivity. Mr. Douglas designed a study to investigate the effect of synthetic constituents of the Crested auklet odorant on courtship activity and sexual displays in the captive group. The goal of this study was to determine if captive Crested auklets increase courtship behaviors when exposed to synthetic constituents of their courtship pheromone. Bird house keepers collected the data during this study, while Hector Douglas continued to study the wild populations of these birds in Alaska.

This study was conducted at the Alcid Holding facilities located in the Primate Center at the Zoo. Two identical taxidermic models of male Crested auklets were placed in the holding facility room on opposite sides of a pool. Synthetic components of the odorant were mixed with ethanol to form a vapor, then poured onto wicks and placed into pipes that passed through the walls directly behind the models. One model was used as a control, with only ethanol placed on the wick, while the other was used as the experimental model with the odorant. While the wicks and models were in place, the Crested auklet behavior toward the models was observed and recorded. This experiment was performed once a week for two months (May-July).

For this experiment my responsibilities included aiding with the mixing of the chemicals, and collecting the data on the animal behavior. Hector Douglas sent the chemicals to the Zoo with strict instructions on how to mix the chemicals to create the chemical cocktail that makes up the Crested auklets’ odorant. Once the chemicals were prepared and placed in the pipes, I began recording the behavior of the Crested auklets, viewing them from a small window.
in a door outside of the room. Every minute for a total of sixty minutes, I recorded how many
Crested auklets came within 1.5 m of either model. I also watched for any breeding behaviors
such as trumpeting display, or mutual courtship. These behaviors were never observed, and I
brought attention to some major design flaws that most likely contributed to these disappointing
results.

One significant problem with the study was that one of the models was placed in a
spot already favored by the auklets. We consistently observed auklets near the model in that area
making it seem like they were attracted to the odorant. Also, food plates were accidentally left in
the room one week and were positioned directly in front of the control model. The Crested
auklets made numerous trips to the feed plates, which had to be recorded as a positive result for
going within 1.5 m of the model. I made sure this error was noted on the data sheet for that day.

Another serious problem with this research project was the lack of appropriate
training and equipment. I felt that the keepers who were in charge of conducting this research
were unqualified. The first time the chemicals were mixed to make the odorant, the keepers
were handling them carelessly even though the toxicity of the chemicals was clearly stated on the
labels. Without the use of gloves or proper ventilation, some of the workers that were exposed to
these chemicals, experienced nose bleeds and minor chemical burns on their skin. Consequently,
after realizing the harmful effects of these chemicals, gloves were used for the remainder of the
experiment, and the chemicals were mixed outside for ventilation. Additionally, when the
chemicals were mixed, the keepers did not take the time to measure out the chemicals as
accurately as possible. In mixing the chemicals, spills were common, and an attitude of ‘close
enough’ was adopted. This might not have been the case if we had had access to additional
equipment, such as more graduated cylinders and beakers.

The problems with this experiment might have been corrected if we had been in
close communication with Hector Douglas. Because he was conducting research in the field, he
was not easily contacted during the time of this experiment. I found that this arrangement was a
disastrous idea, and would not recommend that researchers rely on other people to perform their
projects. Not only was this research a waste of money (the chemicals used were very expensive), it was also a waste of the keepers’ valuable time.

Although there were several problems, this study gave me the opportunity to learn about the complex planning and hard work that goes into any research project. I also learned about the problems that can arise, especially when a researcher relies on other people to perform the study. Having a strong background in science helped me to convey the overall scientific method and experimental design to the people that I worked with on this project. Also, working with a group of people, I was grateful for my experiences with the IES public service project, which taught me how to deal with people from various backgrounds and education.

Penguin Training

Enrichment items are used to increase the well being of captive animals by promoting naturalistic behaviors, and are usually given in the form of a particular feeding item or toy (Markowitz, 1982). In recent years, researchers have also been focusing on captive animal training to improve cooperation between animals and keepers. For example, training a diabetic chimpanzee to willingly cooperate with staff to collect urine and blood samples (Laule et al., 1996). Eduardo Fernandez, a Ph.D. candidate at Indiana University, is studying the effectiveness of training animals to interact with enrichment items. In cooperation with the Cincinnati Zoo, he is currently conducting a study on training penguins to interact with an enrichment item.

Penguins in the wild spend a considerable amount of their lives swimming and foraging for food. The penguins at the Cincinnati Zoo have shown quite the opposite behavior, spending little time in their pool (Kinley, 2000). The goal of this project is to effectively train the penguins to interact with an enrichment item in the water, and increase the amount of time they spend swimming. This would not only increase the well-being of the captive penguins, but could also increase the education and enjoyment of the visitors.

For this research project, six penguins were chosen as the targeted trainees, two of each species in the display (Aptenodytes patagonicus or king, Eudyptes crestat or rockhopper, and Spheniscus magellanicus or magellanic). The enrichment items were composed of two
hamster balls, (one red and one blue) with a floating ball inside each. Data were collected on which penguins touched which balls, and the swimming times of each penguin included in the study. These data collection sessions occurred weekly for one hour at a time. During the course of this study, the penguins were trained to interact with the hamster balls by using fish (smelt) as a reward. The penguins in this display are normally given large plates of smelt from which they can eat; however, on research days, the only fish fed to the penguins were either thrown into the pool or stuck through the holes in the hamster balls. During the hour-long sessions, while the hamster balls were in the water, fish were thrown into the water near the balls. This allowed the penguins to associate the hamster balls with food. Data were collected on how many times certain penguins touched a hamster ball, or grabbed fish that were sticking out of the balls.

For this study I aided in data collection, and occasionally throwing fish into the water near the hamster balls. During the session, data were recorded using Palm Pilots programmed specifically for this research. Watch alarms were set to go off every 15 seconds, which was the signal to record whether or not the penguins I was watching, were swimming. For 20 minutes before and after the training session, data were recorded on the total amount of penguin swim time. Also, during the 20 minute training sessions when the hamster balls were in the water, every time a penguin touched a hamster ball with its beak, we had to record who touched the ball and how many times. This responsibility was not always the easiest of tasks, especially when there were large crowds of visitors admiring the penguins. When my responsibility was to throw fish at the hamster balls, I waited for the signal from Eduardo, and placed the hamster balls in the water, and methodically began throwing smelt at the hamster balls. This was not a difficult task, unless the balls floated to the far side of the pool, which made it more challenging for me to target the balls. After the 20-minute training session, Eduardo signaled for me to take the balls out of the water and leave the exhibit.

Preliminary results from this study showed that the hamster balls significantly increased the amount of time the penguins spent in their pool. The penguins became so familiar with the process, that when the balls were placed in the water, almost all the penguins dove in and began competing with each other for fish. During this study, the penguins also exhibited porpoising, a naturally occurring behavior, which had never previously been demonstrated by
these captive penguins. Being a part of this research was very exciting. The penguins reacted remarkably, and watching them grab fish out of the hamster balls was incredible. This project demonstrated to me that penguins are very curious and smart. This research also showed me how effective enrichment items can be in improving the lives of captive animals, and how important it is for this type of research to continue. It is remarkable to think that a tool as simple as a hamster ball can improve the well-being of penguins. The final results of this on-going study should prove to be very interesting and beneficial for captive penguins, as well as other captive animals.

Overall, this research experience was extremely positive compared to the other projects I assisted with at the Zoo. The goals of this study were so far successfully met, with only one recurring problem. During a few training sessions, there were problems with keepers trying to interfere with the results. On more than one occasion, the penguins were fed plates of fish on research days, when the staff should have been aware that the penguins were only to be fed during the research sessions. Although I believe these actions were intentional, this problem may have been prevented by placing signs on the door to the penguin exhibit on research days, or by posting a schedule. Communication and understanding are extremely important in any research project, and luckily this problem did not end up significantly affecting the outcome of the results. The unique problems associated with this study reemphasized the importance of being flexible, respectful and cautious while conducting research in zoos and working with zoo workers.

SUGGESTIONS

An enormous amount of time, effort, and money go into research projects at zoos, and it should be important for zoos to make an effort to increase their success rate. Through my experiences working on research projects at the Cincinnati Zoo, I have come up with a few suggestions that I think would increase the success rate of research performed by zoo workers or outside scientists. First, I feel that research could be more easily performed if research equipment was more readily available to zoo workers. For example, in the case of the Crested Auklet study, basic laboratory items, such as graduated cylinders, could have helped eliminate spills, and increased accuracy with measurements. If the Zoo had a resource center where any zoo worker could acquire the proper equipment needed to perform research, I believe that workers would be
more willing to conduct research. Another suggestion is to include a research training program for interested workers, where they could learn research techniques as well as the process of the scientific method. By training keepers, this could increase their understanding of the importance of such things as accuracy in any research project, and also their daily duties.

A third suggestion is to employ a zoo research liaison who could encourage the overall success of research projects by acting as a mediator between the outside researcher and the zoo workers. This employee would need to have a science background, and the ability to assist with or conduct the actual research, depending on the situation. Also, by working at the Zoo, this person would be familiar with the zoo-keeping needs of several different animals. This person would be in a position to take on the feeding and cleaning responsibilities of an animal being researched. This would eliminate the chance of keepers interfering with ongoing research. Communication between the researcher and the Zoo could also be greatly increased and clarified, with the liaison actively promoting it. A liaison competent enough to understand the research being conducted at the Zoo, would be able to help if questions arose by the Zoo about the research. Also, by having a fellow zoo employ as the liaison, zoo workers would be more comfortable and trusting dealing with someone familiar.

These suggestions merely point out some of the possible changes that could be made to enhance the process of research conducted at zoos. I fully understand, however, that implementing my suggestions would require a considerable amount of money, which is usually lacking at most zoos. However, with an increasing amount of research being conducted at zoos, these suggestions may prove to be more useful in the future, when the need for change may become more apparent.

CONCLUSION

As an intern at the Cincinnati Zoo and Botanical Garden, I gained valuable experience that will enhance my future career aspirations. My internship helped me see the importance of protecting endangered species, and how zoos are playing a major role in educating the public on such topics. Working as part of a team helped to improve my leadership and
communication skills. I have appreciated the tools that I gained through my various IES core courses. My experiences during the public service project were very applicable to this job, which stresses the need to work as a team, and the importance of clear communication.

Assisting with various projects taught me the importance of research in zoos together with research in the wild. The research projects I worked on were each unique experiences that gave me insight into the complex and sometimes problematic processes of conducting research in a zoo setting. My science background helped me to understand each research project, and to identify problems that were not being addressed during each of the studies. The problem-solving skills that I have acquired through IES courses, enabled me to offer suggestions on how the zoo research process could be enhanced.

Working with the penguins at the Cincinnati Zoo has further validated my passion and desire to continue working with these remarkable birds. I have a newfound commitment to pursuing a career that promotes the conservation and protection of penguins and their environment. Having gained an interdisciplinary outlook of environmental issues through IES, I feel that I am prepared to start in this career path.
REFERENCES


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