Science in the Workplace Student Pack

This pack is aimed for students who require in depth information for course work and also for teachers to aid in their visit to Colchester Zoo.

COLCHESTER ZOO
Action for the Wild

Contents

Science Used at Colchester Zoo

Colchester Zoo uses science and research to help improve and develop care for the animals kept at Colchester Zoo as well as improving the day out for the visitors and help with the development of the infrastructure and what is offered to the visitor.

Science is used at Colchester Zoo to:

- Monitor animal health and welfare
- Assist conservation work
- Manage breeding programmes
- Assess visitor enjoyment

Research allows Colchester Zoo to gather information and use it to assess, review, adapt and improve all aspects of the Zoo to ensure the animals are kept to the highest standards of health and welfare, the visitors have a safe and enjoyable day at the zoo and receive education to a high standard.

Science allows Colchester Zoo to build better enclosures using new techniques of animal management and new building techniques and materials.

Colchester Zoo activity works to be as green as possible and works to ensure the Zoo's impact on the environment is as minimal as possible. This is done by reducing waste, reusing as much as possible and recycling.

Previously the bin bags were emptied and sorted at the local Colchester Skip Hire site, with the remaining waste going to landfill. However work is being done to reduce waste going to landfill.

The main route for waste disposal in the UK has traditionally been landfill. However the waste is segregated and sorting for recycling, the zoo waste is goes to go to produce energy-from-waste (EfW). Energy-from-waste is a form of energy recovery, where the waste is burnt at high temperatures to reduce its volume and to create heat energy from the incineration of the waste source. This heat energy is then converted into electrical power.

In waste to energy technologies, nearly all of the carbon content in the waste is emitted as carbon dioxide to the atmosphere. If the waste went to landfill, the amount of methane generated via decomposition of the biodegradable part of the waste would have a higher global warming potential than the carbon dioxide produced by this combustion.

Colchester Zoo has installed solar panels to reduce the mains electricity that is used and also uses rain water collectors to reduce the amount of mains water being used. Biomass boilers are used to produce heat for the enclosures and buildings around the zoo; this removes the need to use oil or gas.

Animal waste from the Zoo's herbivores is used as fertiliser by local famers for their crops.

Roles of Zoos in the 21st Century

Zoo are now more than just a good day out to see animals, zoo have a role to play in education, conservation and research.

There are over seven billion people on the plant and 1 in 10 of those people will visit a zoo or an aquarium. This gives zoo an opportunity to help and improve peoples understanding of the world as well providing support for conservation work.

Colchester Zoo, like other zoos, has four roles:

- A place for recreation
- A place for conservation
- A place for education
- A place for research

Recreation: A day at the zoo should be enjoyable as many zoos, including Colchester Zoo, rely on people visiting as a source of income. Furthermore visitor who enjoy their day will spread the word to others thus increasing the amount people who can be educated and provided more funds to support conservation.

Conservation: Zoos are able to support small, lesser know charities by providing them a platform to promote their work and the zoo can raise money on their behalf. Additionally being active members of breeding programmes and support work in the U.K. as well as across the world.

Education: Raising aware of humans impact on the world as well aiding improving understanding can be done in zoos. It can be done through signage, keeper talks as well as providing schools educational trips to help their studies. It is also a legal requirement in the U.K. to provide education opportunities for visitors.

Research: Zoos offer an opportunities to aid scientists in gaining close and easy access to animals that would be very hard to get to in the wild. Also students are able to complete research papers to aid their studies.

Research Aims and Objectives

In order to make the best possible use of research, it is important to have a clear structure to maintain focus and also to ensure the research gathered is clear and available to as many people and institutes as possible.

To do this Colchester Zoo has aims and objectives for all research conducted. These are:

- Further understanding
- Evaluate visitor perception
- Publish and promote research
- Link with colleges and universities

Research is further broken down into two groups, visitor based research and animal based research.

Visitor based research covers tourism, business, sociology and education.

Animal based research covers welfare, behaviour, biology, ecology and conservation.

All animal-based research undertaken at Colchester Zoo is non-invasive and mostly conducted through observation of the animals in their captive environment.

Who Uses Science?

Science is used everyday by everyone who works at Colchester Zoo ranging from recording animal behaviour to collecting data.

In order to ensure consistency and to maintain a focus of a particular area of interest, Colchester Zoo has a **Director of Conservation, Education and Research**. This person is responsible for all research conducted on site and approves or disapprove which research is to take place. They will also coordinate conservation work here at the Zoo as well as the Zoo's private nature reserve in South Africa called Umphafa. This person also oversees the education department and signage that goes up around enclosures.

The **education staff** conduct evaluation on how well visitors learn as well delivering a variety of educational activates, talks and workshops to schools, colleges and other groups to aid teachers and learners with the national curriculum as well as the general visitor. Furthermore they will take part in visitor engagement to raise awareness of conservation work or to offer insight into different aspects of the natural world such as pond dipping.

Animal keepers use a variety of different science fields in their everyday work. Using animal behaviour to highlight any potential issues with the animal or within the group. Animal keepers have to also be aware of animal nutrition to ensure the animals are fed the correct diet. Furthermore the animal keepers will aid in research and do their own research on enrichment and animal care. Animal keepers who manage filter systems and fish tanks conduct water test o ensure the water is good quality and the filter systems are working as they should.

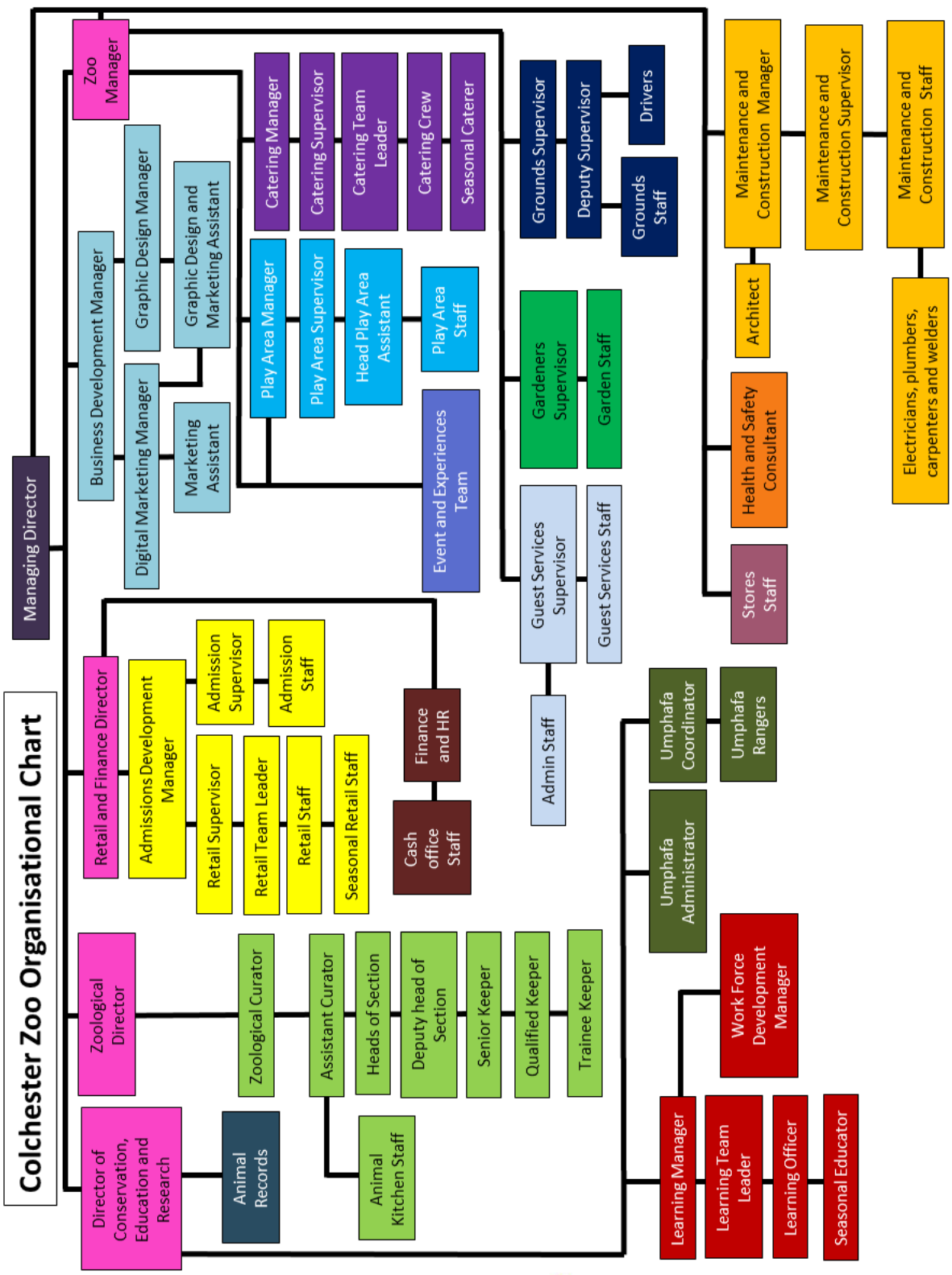
Research is conducted throughout the year and **research students** conduct research to aid their studies. These students can submit request to conduct their own research at Colchester Zoo or choose an area of interest to Colchester Zoo from the priority research list. These studies are observation based and involve data gathering which is then writing up into a paper and sent to Colchester Zoo to keep on record.

All animals have to be put on international databased that records the animals health, who the parents are and any births as well as deaths. Behaviour is also recorded and any veterinary treatment is as well. It is the animal keepers who provide the information and it is the **Animal Records Keeper** who updates the international databased as well as maintaining the Zoo's own records.

Additional information on how to enquire about conducting research at Colchester Zoo can be found at http://www.colchester-zoo.com/conservation/research

Staff Structure

Below is the organisation chart for the staff at Colchester Zoo showing who reports to whom and which departments people are responsible for. The job roles highlighted in pink are the main management team who are responsible for multiple department and are able to cover other departments if necessary.



Research Within a Zoo

Research is important in any field of animal care. Research can highlight problems and help resolve issues and can be laboratory based, in the field or in a captive environment such as a zoo.

At Colchester Zoo, research and science is used throughout the daily routine to aid in improving the care and welfare of the animals.

Behaviour
It is the keepers' responsibility to record daily behaviours in order to get a record of behaviour for that individual. This aids in noticing a change in behaviour quickly which will allow the keepers to deal with a potential issue quickly. For example if an animal is becoming ill, treatment can be done earlier.

Nutrition
An animal's diet should reflect what the species eats in the wild. By looking at the foods eaten in the wild and then comparing these foods to food grown in the U.K., nutritionists can work out exactly what the individual should consume in order for it to meet its energy requirements. Consideration needs to be taken into account of animals which may be pregnant, lactating (feeding young), young or old as energy requirements differ.

Disease
Improving the methods of disease prevention is vital to ensure the health of the animals as well as for the staff and visitors.

Reproduction
Ensuring the animal is in the correct environment as well as in the right social setting is important to increase the chances of breeding and then rearing of the young. Enclosure design and how the keepers manage the animals is an important part to encourage breeding.

Research Within a Zoo

Ecology
Understanding of the natural environment as to where the species come from is important in order to provide them with a suitable captive environment which meets their behavioural and physical needs.

Physiology
Research on how animals move as well as how their bodies function ensures the correct environment and diet are provided .

Genetics
It is important all zoo collections are aware of the genetics of their animals. Zoos do not want to breed between two related individuals. This also aids in finding the best mate possible.

Husbandry
Research is undertaken to address the way animals are managed. Investigations take place to ensure welfare needs are met; as such research is published, which allows all zoo collections to benefit and so it raises the standard of welfare which one can achieve.

With all research undertaken at the Colchester Zoo, it needs to be achieved in a way in which can it can be written up as a research document and be easily repeated by other institutes. To ensure this can be done, the data collected needs to be valid and reliable with no bias incorporated.

Past projects completed at Colchester Zoo can be found via the link below.

www.colchester-zoo.com/conservation/research

Case Study: Health and Welfare

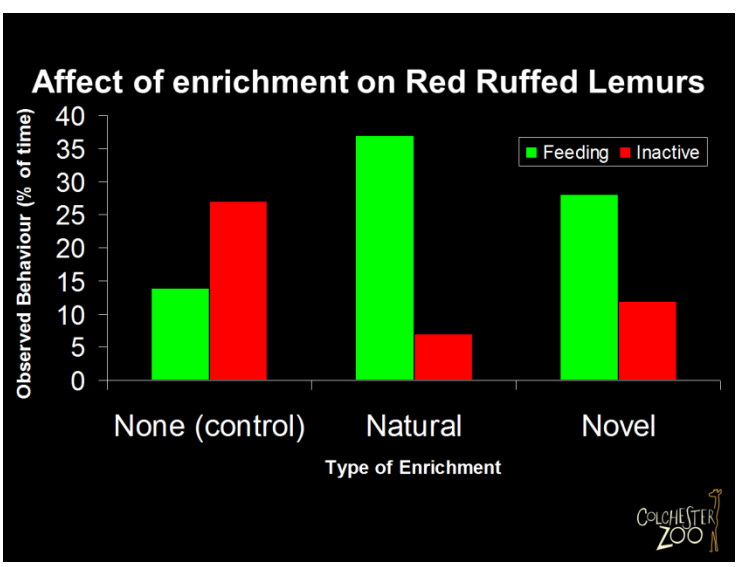
The following is an example of research completed at Colchester Zoo which looked at the effects of environment enrichment on red ruffed lemurs.

The aim of the study was to increase the level of forage behaviours in the red ruffed lemurs by using a items to encourage natural feeding behaviours and a puzzle feeder providing novel feeding behaviours.

The novel feeder was food hidden in hanging tennis balls, which simulated feeding from branches high up in the trees. The puzzle feeder required the lemurs to work out how to get the food out of the feeder.

The puzzle feeder was a ker-plunk style design (pictured below) and in order to get the food to fall out the lemurs had to remove the sticks or shake the puzzle.

The result from the study can be seen in the graph below and the conclusion was; enrichment encourage foraging behaviours and lemurs are able to manipulate feeding puzzles to gain food.



Cases Study: Conservation

The following is an example of research completed at Colchester Zoo which looked at the Amur leopards heart beat pattern. There are only 60 Amur leopards left in the wild and part of the Conservation work involves catching the leopards to perform health checks on them to ensure the wild population is healthy. After the checks the leopards are free to go. However the vets preforming the health checks were find very leopard had an irregular heat beat and itwas conclude it could be due to two possible reasons:

- .It is a congenital heart condition that is present in the population and normal for the Amur leopard to have.
- .The anaesthetic being used was causing the irregular heart beats and potentially harming the leopard.

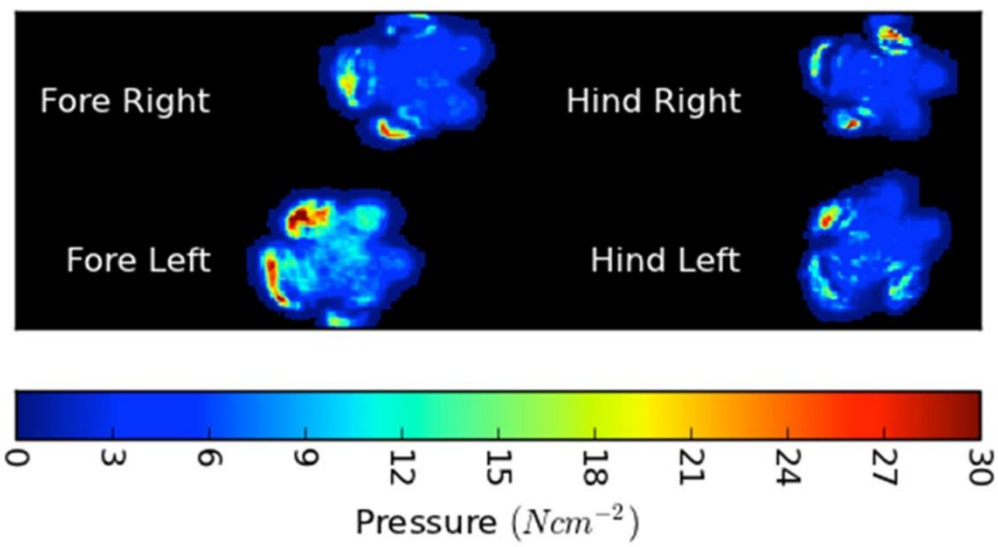
In order to find out which it was the vets needed to hear the heart beat of a non-sedated leopard. To do this the vets turned to Colchester Zoo to train the Amur leopards at Colchester Zoo to accept a stethoscope whilst conscious.

The training of the leopards was successful and the vets were able to listen to the heart beat of the leopard whilst it was still conscious. The vet discovered that the captive leopards also had the irregular heart beat and thus it was concluded it is a congenital heart condition naturally found within the population.

Case Study: Improving Understanding

The following is an example of research completed at Colchester Zoo which looked at how white rhinos, which weigh over 2 tonnes are able to stand and walk on small feet. Understanding how they are able to move with these small feet despite their weight would allow improvements in robot technology and engineering but also to allow improvements in the foot care provided in captivity.

The rhinos were trained to walk over pressure pads and images were then taken to see how the weight of the rhino was being disrupted. The image below shows the pressure point of the rhino feet.



The image show rhinos put most of the presser on the inner edge of the foot and in effect walk on the inside of their feet.

With this information the foot care was improved and more preventive care could be taken as the keepers had a better understanding of where future problems could occur. Below is a picture of an elderly rhino receiving foot care.

Social Science

On average 900,000 people visit Colchester Zoo each year, 70% of them are families, including grandparents visiting with grand-children. 10% are adults visiting with no children, 9% are schools, including colleges and university and 7% are groups such as cubs and youth groups.

As a private zoo that has no financial support from council, government or charity body, all of Colchester Zoo's income comes from people visiting. To ensure visitors have a good day out to ensure they return again and tell friends and family to visit the zoo, research is done to ascertain if visitors are enjoying their day and allow the zoo to develop and improve.

One way Colchester Zoo can get information to develop and improve is by conducting customer research. There are two areas research can done, primary research and secondary research. Primary research is new data and there is no information so it must be investigated to gain that data. Secondary research is data that is already present and allow that data to be analysed to discover trends.

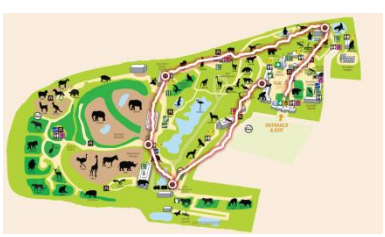
Primary Research at Colchester Zoo

- **Surveys:** Surveys are used to ask any question where the business will benefit. Questions need to be clear and appropriate so all visitors are able to understand.
- **Observations:** Used for general observations to see how visitors use the zoo grounds and interact with the displays.
- **Website:** The website is used to generate ideas and as a forum to ask visitor views and opinions. Facebook and twitter are used as a platform to engage with visitors. In the past they have been used to generate ideas for naming an enclosure as well as being used for feedback.

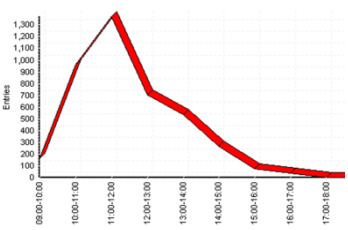
Secondary Research at Colchester Zoo

- **Ticket Sales:** Ticket sales are analysed to generate a breakdown of the type of visitor that enters the Colchester Zoo i.e. adult, child, OAP, disabled. These sales are also used to identify the busy seasons and also when the zoo entrance is the busiest.
- **Till Sales:** Till sales are used to identify the best selling and also the least selling product. It also gives an idea of how much money visitors are likely to spend in the retail outlets which highlights which products can be developed.
- **Competitors:** The marketing team regularly investigate what other zoos and family entertainment business are doing in terms of activities and prices.

Feed back using Facebook



A flow analyse of the main route visitors take



Graph of ticket sales through the day

National and International Groups

Many zoos in the U.K. are members of national and international groups. Below are the groups Colchester Zoo are members of. These groups coordinate conservation work, education, research and breeding programmes as well as promote high standards of animal care.

BIAZA

BRITISH & IRISH ASSOCIATION OF ZOOS & AQUARIUMS

BIAZA is a conservation, education and scientific wildlife charity, that ensure the principles and practices of animal management are practiced at a high standard. Also aids in increasing knowledge with in the zoological community.

http://www.biaza.org.uk/

EUROPEAN ASSOCIATION OF ZOOS AND AQUARIA

EAZA

EAZA coordinate conservation work and breeding programmes across Europe. Also aids in increasing knowledge with in the zoological community.

http://www.eaza.net/

World Association of Zoos and Aquariums | WAZA

United for Conservation

WAZA provide leadership and support for zoos, aquariums, and partner organisations of the world in animal care and welfare, conservation of biodiversity, environmental education and global sustainability.

http://www.waza.org/en/site/home

Collection Planning

Many animals are now kept in captivity not only because they are threatened, but also to ensure we have a genetically viable population in case species go extinct in the wild. EAZA (European Association of Zoos and Aquarium) has Regional Collection Plans to help decide which zoos should house which animals; and also, which of these species should be placed onto a breeding programmes. To decide which zoos should be doing what, the following factors are addressed:

The status of the species in the wild
Species that critically endangered or have a low population number may be given a higher priority over an animal that already have several successful breeding groups in captivity.

Can they be managed?
It is important that the space available in a zoo is assessed, as this will influence numbers of animals kept or if kept at all. Some animals require a large amount of space (i.e. elephants), whereas other need little (i.e. insects). Also zoos will have to be able to have the finances to keep the species long term.

Husbandry expertise
The keeping staff need to have the knowledge to ensure the health and welfare of species is maintained. To do this staff can go to other zoos to gain experience as well as being given bachelor groups of that species before having a breeding group. If it is not possible for staff to gain experience that may affect if the zoo takes on a new species.

The educational value of the species
Species which have an interesting story or are of educational value may be factor in the decision to kept a certain species in a collection.

What are other regions doing?
If another region already has a successful breeding program, then there may be no need to expand this into Europe. Valuable space can then be given to those species that do not have a successful breeding program in place or to allow breeding programs to expand and thus improve them.

The individual zoos also have an Institution Collection Plan. This provides an overview of all the species kept at the zoo as well as highlighting their role, i.e. part of a breeding programmes and finally it is use to help plan for the future.

Captive Breeding Programmes

Captive breeding is essential to maintain the species in captivity as a back up against extinction, and sometimes to provide healthy animals for reintroductions. Breeding programmes are also in place to reduce and prevent inbreeding. There are two types of breeding programmes used in the U.K. the EEP and ESB.

EEP: European Endangered Species Breeding Programme

The EEP is the most intensive type of population management for a species kept in EAZA (European Association of Zoos and Aquaria) zoos. Each EEP has a coordinator (someone with a special interest in and knowledge of the species concerned, who is working in an EAZA zoo or aquarium). They are assisted by a Species Committee.

The coordinator has many tasks to fulfil, such as collecting information on the status of all the individuals of the species which they are responsible for kept in EAZA zoos and aquaria, producing a record of birth and deaths, carrying out demographical and genetic analyses, and producing a plan for the future management of the species.

Together with the Species Committee, recommendations are made each year on which animals should breed or should not breed, which individual animals should go from one zoo to another, and so on.

ESB: European Stud Book

The ESB is less intensive than the EEP programme. Each ESB has a coordinator who is responsible for a certain ESB species collects all the data on births, deaths, transfers from all the EAZA zoos that keep the species in question. This data is entered into a computer software programme, which allows the ESB coordinator to carry out analyses of the population of that species. EAZA zoos may ask the studbook keepers for recommendations on breeding or transfers.

By collecting and analysing all the relevant information on the species, the ESB coordinator can judge if it is doing well in EAZA zoos, or if maybe a more rigid management programmes is needed to maintain a healthy population over the long term. In that case, the ESB coordinator may propose that the species be managed as an EEP programme.

For a full list of species which are part of a breeding program at Colchester Zoo, follow this link: http://www.colchester-zoo.com/conservation/breeding-programmes

Studbooks

Studbooks are a compilation and source of genealogical data of individual animals, which make up a particular captive population.

History
They originated in the management of domestic stock to make selective breeding easier. Since the beginning of domestication, the difference between animals has been noted and often used to selectively improve the stock e.g. improve milk yield. The first official studbook was the “General Studbook for Thoroughbred Horses” set up in England 1771. By the nineteenth century, there was an increase in development of planned breeding of many types of domestic animals with studbooks.

The first studbook for a wild animal in captivity was for the European Bison, published in 1932 by Heinz Heck. It was developed after a meeting at Berlin Zoo in 1923 where it was discovered that the species was close to extinction.

Modern Studbooks
The necessity of co-operative management of captive populations was released after the publication of the Zoological Society of London’s International Zoo Yearbook in 1960. By 1966, there were 9 international studbooks and by1993 there were 121. During the last 20 years, there has been a massive increase in studbooks in response to the increasing number of species becoming threatened in the wild, as well as advances in identification of animals and sex determination, especially in birds and reptiles. The advances in computer software have also assisted record keeping and analysis.

Using Studbooks
Animals under a studbook are carefully managed and coordinated through EAZA to ensure species are not isolated from other species in other places. EAZA manages the studbooks via the Taxon Advisory Groups (TAG’s). Each group of animals have their own TAG, i.e. The Small Mammal TAG or the Primate TAG. A studbook is assigned to a ‘studbook keeper’ who manages that particular species for the breeding program to best assist the program. The Studbook Keeper is some one who has specialist knowledge of a particular species. The studbook is assigned to a person and not to the zoo.

The above animals are examples of species at Colchester Zoo under an EEP. From left to right: Amur tiger, Komodo dragon, Humboldt's penguin and black and white ruffed lemur**.**

Studbooks

The Role of Studbooks

The key difference between the original studbooks for domestic stock and modern studbooks today, is the maintenance of the maximum genetic diversity of a species, as opposed to the selective breeding that accentuated particular characteristics to the detriment of the species.

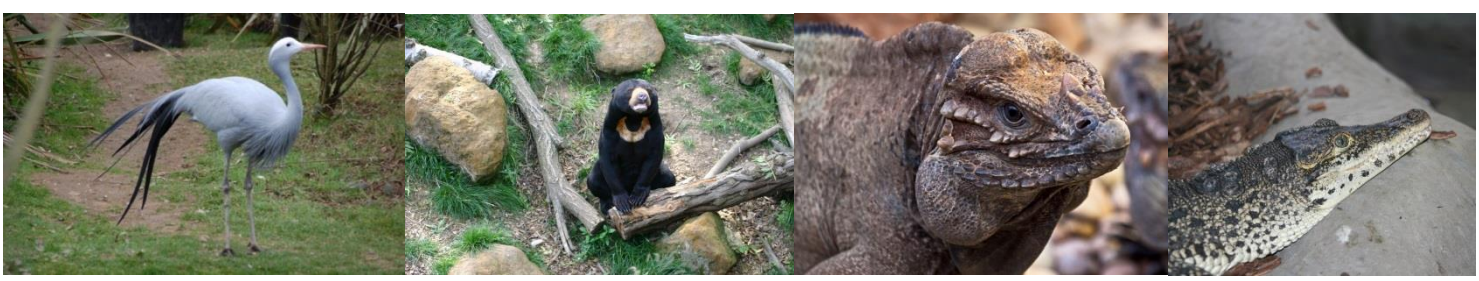
In order to present a comprehensive record of a species the studbook must contain details of every animal, living and dead, starting if possible with the original wild caught founders. This information is collected and collated by the studbook keeper, usually via questionnaires sent to all owners and collections. The complete studbook should be published every 3 years and there should be an annual update.

The type of information requested per animal includes:

- personal history
- scientific name
- individual house name
- sex
- unique studbook number
- identification number
- details of markings and other identification records
- date and place of birth
- date and place of death
- autopsy details
- information on disposal of body
- special medical note
- information on its ancestry and offspring's ancestry is also taken in great detail

The result is a complete history of all the living and dead animals that can be traced back, where possible, to their founders.

The studbook and the studbook keeper play a significant role in determining strategies for maintaining a self-sustaining captive populations of endangered species, which makes the studbook a crucial part of the formation of coordinated management and breeding policies.



The above animals are examples of species at Colchester Zoo under an ESB. From left to right: Blue crane, sun bear, rhinoceros iguana and Cuban crocodile

Artificial Insemination (AI)

Artificial insemination (AI) is the process of manually inseminating a female with sperm from a male. A female needs to be of reproductive age, in good health and have a normal reproductive cycle if artificial insemination is to be used. Keepers can monitor the oestrus cycle of the female via weekly and daily blood draws to monitor hormone levels. Artificial insemination takes place at a time in her oestrus cycle where she would naturally conceive.

Artificial insemination is done for a number of reasons, the biggest advantage to using AI is that AI eliminates the need to transfer males to other zoos, which can be highly costly and stressful to the animal. It also allows the use of old males who may not be able to physically mate due to their age and thus prevent the lose of new genetics entering the population

African Elephants
Colchester Zoo was the first zoo in the UK to use artificial insemination in African elephants as well as the first zoo in the world to achieve this on the first attempt.

This calf is called Kito who was born in December 2002 after his mother, Tanya, conceived through artificial insemination. Tembo, the resident male was the father of Kito yet he showed little interest in mating with Tanya. Efforts were made to encourage the pair to breed naturally to no effect so the decision was made to use artificial insemination.

White Rhinoceros
Cynthia a female white rhinoceros was also impregnated artificially with sperm from a male rhino that passed away at Colchester Zoo. This male, Simba had never bred making him an important individual to the breeding program of this species. Cynthia was introduced to Simba when he was alive however age induced arthritis prevented him from mounting the female for long enough for conception to occur.

This calf is called Zamba who was born in October 2009 and was the first white rhino born through AI in the U.K. and second in the world.

Conservation Translocations

(Formally known as Reintroduction Programmes)

In 1988 the Species Survival Commission of the IUCN established the Reintroduction Specialist Group (RSG) to join the expertise and information on reintroduction projects worldwide. The RSG stores information and data on hundreds of reintroductions that have taken place over the past 20 years. The process of a species reintroduction is a hard and expensive one and because it is still fairly “new”, it has had some failures, but also some successes. The information collected so far has led to a series of guidelines being drawn up to help prevent these mistakes being repeated. In 2017 the programme was redefined as Conservation Translocations.

What is a Conservation Translocation?

Conservation translocation is the deliberate movement and release of organisms from one location to another. It must result in having conservational benefit to more than just the translocated organism. i.e. restoring ecosystem functions.

Conservation translocations consist of:

- Population restoration which consist of: Reinforcement and Reintroduction, which are within a species’ historical and natural range.
- Conservation introductions, which are the assisted colonisation and ecological replacement, outside of the organisms historical and natural range.

Population Restoration

Reinforcement is the movement and release of an organism into an existing population of the same species. This is sometimes referred to as re-stocking.

The aims of reinforcements is to enhance population viability, which can be done by increasing population size, by increasing genetic diversity, or by increasing the representation of specific groups or life cycle stages.

Reintroduction is the movement and release of an organism inside its historical and natural range from which it has disappeared.

The aims of reintroductions to re-establish a viable population of the species within its historical and natural range.

Conservation Introductions

Conservation introduction is the movement and release of an organism outside its historic and natural range.

There are two types of conservation introduction, assisted colonisation and ecological replacement.

Assisted colonisation is the movement and release of an organism outside its historic and natural range to avoid extinction.

Ecological replacement is the movement and release of an organism outside its historic and natural range to perform a specific ecological function.

This is used to re-establish an ecological function lost through extinction, and will often be the most suitable existing sub-species, or a close relative of the extinct species within the same genus.

Conservation Translocations

(Formally known as Reintroduction Programmes)

Designing Conservation Translocations

A successful conservation translocations involves the following:

- Long term planning.
- The release of a large number of animals.
- The involvement of the local people.

The design of each conservation translocations is unique to each species. For different animals, different approaches are necessary. In general there are two types of releases:

- Hard Release: This is where the animals are released and have to fend for themselves.
- Soft Release: This is a more gradual process. The animals are provided with food and/or shelter until they are able to cope on their own in the wild. This is a more time consuming and expensive process, but usually the most appropriate method of release.

Costs of Conservation Translocations

Conservation translocations can be expensive, due to the conservation translocations doing more than just releasing the animals. For example the release programme for the Golden lion Tamarins in Brazil, the budget not only covered the release but also, education within the local community, management and reforestation, translocation, studies of other flora and fauna of the area, internships for students and other long term field studies of the wild population. Funding for such programmes comes from donations from local and international conservation groups via fund raising, from funding by zoos and also via publicity and the interest generated by this.

How Long does it Take?

A project can be considered successful once a reintroduced population can sustain itself in the wild. It may take several generations until this can be made certain and results do vary between species. Other factors such as securing the land, working with government departments, breeding a healthy release population and raising the funds all adds time to any realise project. Some projects can take over 100 years.

Factors to Consider During a Conservation Translocations

There are many factors that need addressing before a conservation translocations is to take place.

The following are the main factors in the wild that need to be investigated before the conservation translocations is to take place:

- Security: the reason why the animal become extinct in its natural range must be removed and prevented to occur again
- Biology: habitat preference, social and feeding behaviour, home range, predators, disease, migratory areas, what effect the reintroduced animals will have on the ecosystem
- Social economic and legal requirements: long term commitment of financial and political support
- After the conservation translocations has taken place:
- Monitor how well all animals are doing directly or indirectly and also to evaluate the success of the reintroduction and technique used.