Nutrition and Zoo Animals
Nutrition

All animals need nutrition to survive. Nutrition can have a large effect on basic health as well as physical and mental development, ability to reproduce, emotions and mortality. Individual nutritional requirements include proteins for structural and hormonal development, a good balance of all vitamins for general health and wellbeing, and minerals for metabolic function, skeletal structure and many other functions.

Feeding Types

Evolution has equipped animals with physical and behavioural adaptations to survive in the wild and that includes finding the right food. There are a range of feeding types. Broadly these include animals that eat other animals (carnivores), those that eat only vegetation (herbivores) and those animals that have a varied diet, eating both plant and animal food (omnivores). There are of course many specific feeding types within these groups, for example animals that eat only fish (piscivores) or that eat only insects (insectivores). Some species are feeding specialists with highly restricted diets, for example pandas that only eat bamboo, or Iberian lynx that only eat rabbits. Other species have a highly varied diet and some can be described as generalist feeders.

Dentition of a gorilla (left) and a serval cat (right) exhibiting a variety of tooth types. Gorillas are primarily herbivores (although they will eat ants and termites), and serval cats are carnivores.

All animals have their own physical features which help them to find and eat their food. Lions, examples of carnivores, have to catch prey, and so have large claws, a powerful muscle structure and a dentition made up of canines and carnassial teeth designed for slicing through meat. Herbivorous species have different dentition, with flat molars designed to grind up vegetation. All of these features are specialisms which have developed for food processing before it is swallowed.
Different species also vary in their digestive systems. For example, there is large variation in gastrointestinal tract (GI) structure and function, particularly between species which are carnivorous to those which are herbivorous. In vertebrate species, the GI tract is made up of a long tube with a stomach at the start. In general, a carnivore has a shorter GI tract than a herbivore.

Ruminant herbivores (e.g. species of deer, giraffe, cows) have a particularly complex digestive system, with a stomach made up of several compartments, all with a different function. It is these animals which eat fast, swallowing their food mostly un-chewed. When the largest part of their stomach (the rumen) is almost full, the animal will rest and regurgitate the food, which it will then chew and swallow, returning it to the bottom of the rumen where it is then broken down.

Even though there is a broad knowledge of the types of food animals eat, little is still know about the specifics. Most animals are selective about what they eat and will not eat all acceptable foods they come across. Animals may be able to detect the nutritional contents of foods – although it is more likely they select a variety and may have different preferences.

Camels are ruminant herbivores

It may be that animals just prefer foods that taste nice to them, it may be these foods that are the most nutritious, and it could be that evolution has developed these preferences. Of course, the selection of certain foods may also be through learned behaviour, e.g. from parent to offspring.

Zoo Nutrition

Although a critical part of animal management nutrition has, in comparison to other areas of expertise, received insufficient attention, and so animal nutrition remains a new and relatively unexplored field. Commonly, nutritional studies may have been initiated in response to specific health problems. Now, basic nutritional research forms an essential part of animal welfare.

It was not recognised until 1960s/70s that nutrient deficiencies may be widespread within zoo animals, and that reproductive potential may be affected by diet. Zoos have progressed considerably in terms of animal nutrition and welfare. Nutritional research may however still be lacking for many species which are generally not well studied. Of course, knowledge of food and its composition in the wild is helpful, but it is not sufficient for accurate dietary formulation in captivity.
It may be that the required items to match wild diets are unavailable or simply not feasible. These problems can be overcome by targeting the level of nutrients rather than the specific foodstuffs. It is specific nutrients that are required for a healthy diet, but the physical form of food and its presentation can provide enrichment and promote normal feeding behaviour.

Captive animals are now part of a self-sustaining population, with no immigration from the wild. Only in extreme circumstances are animals captured in the wild (e.g. in response to a disproportionate threat likely to cause imminent extinction). It is, therefore, vital that there is specific and accurate nutritional support throughout an animal’s life. Nutritional requirements are also changeable, and animals’ lifetimes may include important stages such as gestation, birth, lactation and, of course, aging.

The decision about what to feed animals, and how to present it may lie with a number of people: keepers, curators and veterinarians. Commonly there is no one person responsible for animal diet and as a result, animal health problems may then appear.

Providing the Optimum

Dietary evaluation is not easy. It takes a long time and involves detailed analysis of food intakes and nutritional contents. There are many factors to establish, including animal morphology and feeding traits in the wild, as well as digestive anatomy and process. There also needs to be a measure of how much energy is required for an animal to maintain its metabolism, plus energy for activity. In addition, the amount of food given is also assessed against an animal’s level of activity and whether it is solitary or social. Also required is an accurate measure of an individual animal’s weight, which can itself be challenging. There may be much training required to achieve an individual animal standing on a scale.

Continuous monitoring plays a large part, with nutrition being consistently assessed, for example in response to changes in weight and activity. Even when all of this information is in place, it is potentially very difficult to devise optimum diets or to substitute wild ones.
The aims of nutritional research are to enhance nutritional quality while maintaining palatability and also encouraging natural foraging behaviour. There are a number of techniques which can be used to evaluate diet.

Intake studies involve weighing the total food offered, then weighing what has been left behind in order to assess the level of intake. Some measure of moisture loss needs to be carried out and the end weights adjusted to account for this. For some species, the volume of food would make this method impractical, and for social groups it may be difficult to assess individual intake.

Another way is to physically observe an animal eating and count the number of bites or the number of food items eaten. Of course, the size of each piece of food needs to be standardised, and its nutritional contents known for an accurate analysis. This method is advantageous as it focuses on an individual, but it can be time consuming.

Diet analysis can also be undertaken chemically, by analysing both the food itself and an animal's dung. By analysing dung, it is also possible to assess digestibility (or bio-availability) of certain foods and their nutrients, particularly for animals where it is not possible to supply their 'natural' food.

By carrying out dietary evaluation, it is possible to create diets which are the most nutritionally appropriate for a species and ultimately enhance animal health and welfare in captivity.

**Summary**

- Nutrition can have a large impact on the physical and mental health of animals.
- Animals are adapted to consume certain food types.
- Zoo nutrition is a growing science and is an essential part of animal welfare.
- Monitoring animals and their diet is an essential part of providing optimal nutrition.

**References and Nutrition Resources**

- [www.biaza.org.uk](http://www.biaza.org.uk)
- [www.nagonline.net](http://www.nagonline.net)
- [www.eaza.net](http://www.eaza.net)