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Zoo Research Guidelines

Nutrition and Diet Evaluation

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Zoo Research Guidelines:
Nutrition and Diet Evaluation

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Introduction to Nutrition and Diet Evaluation Guidelines

Effective management of species in zoos and aquariums requires considerable knowledge of the biology of each species including reproduction, behaviour, group dynamics, husbandry, nutrition, medical needs and so forth. Scientific investigations are the basis for understanding the animals in a zoo and assessing the way they are cared for. Through careful observations and well-planned studies, much can be learned about, for example, reproductive and social behaviour, growth and development, and interactions with the physical environment.

These guidelines form part of a series designed to clarify the series of steps that are usually involved in developing a research project in a zoo environment. They discuss challenges which are characteristic for zoo research projects which may differ from those encountered in laboratory or field studies. Rather than repeat relevant advice offered elsewhere, the authors suggest reading this document in conjunction with others from the series, specifically: Project Planning and Behavioural Observations (Wehnelt *et al*., 2003); Research by questionnaire (Plowman *et al*., 2006); Research using Zoo Records (Fidgett *et al*., 2008).

Non-invasive techniques of diet evaluation can be successfully employed in the absence of specific nutritional expertise or laboratory analytical facilities, to provide information leading to the improvement of diets fed to zoo animals. These guidelines focus on methods that can be undertaken without specialist knowledge or equipment as we assume that this will be the situation for most readers, and are thus aimed at those who may be relatively new to this field. The chapter 'Feeding and Nutrition' (Hosey *et al*., 2009) is also useful background reading before any further investigation.

The Nutrition and Diet Evaluation Guidelines are divided into the following headings and it is useful to read all sections before beginning a project:

1. What do we mean by Nutrition and Diet Evaluation?

Diet is the usual food of an animal, nutrition is the process by which a living organism assimilates that food and uses it for growth and for replacement of tissues. One of the challenges which zoological institutions face when housing and maintaining exotic animals is providing them with a diet adequate for achieving optimal nutrition.

There are a number of factors that need to be taken into account when designing diets. These include: knowledge of the animal's diet composition and foraging behaviour in the wild, knowledge of the functional anatomy of its digestive tract, knowledge of dental morphology and adaptation to the natural diet, knowledge of the bases on which animals select particular food items, and an understanding of the implications that foraging and diet selection have for social behaviour. This is a tall order, given our lack of knowledge about many exotic species. It is compounded by the fact that even when these factors are known, devising suitable substitutes for a wild diet is hard. For example, we may know that 75% of a wild primate's diet is fruit, yet feeding 75% fruit in captivity may provide a very different intake in terms of nutrients, since fruits produced commercially for consumption by humans (and thus readily available as components of zoo diets) are so different from wild fruits (see O'Brien *et al.*, 1998).

The goal of zoo feeding programmes must be to provide nutritional support for all stages of life, including egg development, gestation, lactation, and early post-natal growth. Dietary deficiencies may result in increased

susceptibility to disease, reduced fertility, reduced neonate viability, sub-optimal yolk or milk production, retarded growth and physical deformities. Deficiencies in diet presentation may result in obesity, stereotypies, or increased aggression. It is clear that an understanding of the nutrition of exotic animals is vital to their well-being and our ability to maintain them successfully in captivity, yet animal nutrition is a new and relatively unexplored field. Part of the problem is a lack of facilities in zoological institutions and a lack of expertise. There is, thus, a strong need to develop nutritional studies and departments in zoological institutions.

Research on nutrition is carried out both as a problem-solving exercise (in relation to ill-health or apparent infertility) and as part of ongoing programmes to improve animal husbandry. Studies carried out to solve problems tend to focus on assessing the nutrient quality of the diet, whereas the husbandry work is more oriented to food presentation methods and behavioural and environmental enrichment involving food, and feeding and foraging techniques. The aims are to enhance nutritional quality and palatability and to stimulate natural foraging behaviour. The emphasis is on non-invasive research methods. The ideal situation for diet evaluation would be to monitor the intake of individual animals. However, for the evaluation to be valid it is essential that the animals are behaving normally and separating animals for the purpose of a study would likely cause stress, which in turn may affect appetite and hence intake. Therefore, animals should not be separated from their usual social groupings, normal routines disturbed as little as possible, and most assessments can be done indirectly through weighing food remains or analysing faeces.

2. Dietary evaluation

Currently in the UK, the Secretary of State's Standards for Modern Zoo Practice (2004) are designed to ensure that the welfare of animals in zoos is protected, that zoos are safe places for the public to visit and, that zoos participate in appropriate conservation and public education measures. The Standards recommend best practice by which zoos are inspected and granted licenses by local authorities. The Standards consider food and water as basic needs and recommends the frequency of feeds and their nutritional balance be taken into account. It states "Food should be presented in a manner and frequency commensurate with the natural behaviour of the species, as well as its nutritional requirements, which may vary according to season." This statement is expanded to a series of more specific recommendations, including "A record of all diets must be maintained."

For many zoos, diets are recorded on kitchen whiteboards, a practical solution to keep all keepers informed and easily allow for changes as species or numbers of animals change. However useful, they only form a starting point since they often lack sufficient detail about the feeds and quantities used, data which are necessary for properly evaluating the efficacy of a diet.

a. Diet evaluation by weighing feeds and remains

The most commonly used means of diet evaluation involves weighing feeds and remains. Also termed an intake study, it is relatively simple but can be time-consuming. The purpose is to determine the actual amount of food fed to and consumed by an animal or group of animals in an enclosure. Because some diet components may be offered but not consumed, an evaluation of the feeds actually consumed can provide considerably more information and thus allow for a more accurate assessment of the diet than simple evaluation of the diet offered. **There is a step-by-step guide to conducting an intake study in Appendix I.**

Intake studies are run over a period of time, during which all the food items offered to the study animals are weighed at the time of preparation. All food remaining at the end of a feeding period is carefully collected and also weighed. Some means of adjusting for changes in moisture content of the uneaten food should be used, and this is achieved either by drying feed and remains samples to a constant weight in a drying oven or through the use of a dummy or control dish to assess changes in moisture content in the actual climatic conditions experienced. Although the first method is more accurate, it can often prove impractical for large volumes of food. Adjusted weights of remains, subtracted from original weights fed, produce an estimate of feed intake. These values are then averaged over the length of the diet trial. The nutritional composition of the diet is typically estimated from data on the nutrient composition of individual items in the diet and is therefore only as accurate as the data upon which the estimate is based. Hence from weighing feeds and collection of remains and the use of food tables/diet management software it is possible to arrive at an estimate of nutrient composition.

Care must be taken to ensure the correct units are used, particularly when the use of a conversion factor is required. Comparisons between the intakes of different groups are best made on the basis of total group body weight, rather than by the number of animals in each group.

The data provide estimates of what is fed, and more importantly, what is being consumed. Comparing these data sets may reveal whether nutritional inadequacies apparent in the diet consumed are due to the animals' choice of food items, or because the diet provided is inadequate. A simple index of preference is also useful, whereby food items are categorized into low, neutral or high palatability according to the percentage eaten.

b. Diet evaluation by focal animal observations

While attending to the animals' welfare, evaluating the diets of species in their natural groupings is an unreliable means of estimating their individual intakes. It relies on the assumption that every animal in a group eats an identical amount and that no single animal eats all of one food item. Factors such as age, sex, grouping, dominance status and breeding origin may affect food choices made by individuals and direct behavioural observations made at feeding times can provide valuable information about these choices.

To calculate individual feed intake through direct observation it is necessary to know the average piece size of each food type and then to count how many pieces of each food are consumed. This is relatively straightforward for some species e.g. macaques that are fed discrete food items, such as pellets and pieces of fruit or vegetables, which can be easily weighed (e.g. see Plowman, 2008). However, for other animals that are provided with large or non-discrete items, such as browse or exudates, or have access to paddock grazing/browsing in their enclosure it is necessary to estimate bite size. For browsers, average bite size can be determined by providing a known-weight of browse, counting the number of bites taken then removing the browse and re-weighing. This is likely to be affected by type of browse, relative leaf/twig ratio (e.g. Shipley *et al*.,1999) and individual animal (especially size) so average bite size needs to be determined over a range of these conditions and preferably for each individual animal if feasible. For grazers, bite size determination is also affected by sward type and structure (e.g. Burlinson *et al*., 1991) and ideally should be estimated in a similar fashion for browsers (above) using a sward sample in a movable container. If this is not feasible it can be estimated by the hand-plucking method (e.g. Vries, 1995).

This type of study provides much more detailed information about individual food preferences and consumption than can normally be obtained by an intake study (a. above). However it is extremely time-consuming; observing only one animal per feeding session will require a long period of time over

which to establish a reliable data set if group size is large. Nevertheless it is important to consider this type of diet evaluation in situations where there may be strong social effects in group-living species, leading to monopolization of palatable food items by one or a small number of dominant individuals. Attempts to ensure equal access of all individuals to all food types include feeding groups more food than is actually required (these can lead to dominant individuals becoming overweight), and providing food in more than one location. However, short of separating animals at feeding times it is extremely difficult to guarantee that every animal will obtain its 'fair' share.

Evaluation by this method also allows the determination of the contribution of enclosure vegetation to the diet. Zoo enclosures are becoming increasingly more naturalistic and contain more vegetation than in the past. Some of this vegetation may have been chosen deliberately because it is palatable to the animals and some deliberately because it is not palatable. If animals eat significant amounts of enclosure vegetation this will have an impact on the nutrient composition of their diet and also needs to be taken into account. There is no way to do this other than by focal animal observation and even then it is still difficult to reliably estimate weight of food eaten due to variation in bite size (see above).

c. Diet evaluation by survey and review

This technique is increasingly used by EEPs/TAGs to gather diet data for a single species across a range of zoos. If done well it can provide good information on nutrient contents of diets which can be compared with breeding and health records across institutions. Given the lack of data on wild diets for many exotic species this is often the only way to determine dietary recommendations (see section 5 below) However, this method has major limitations in that the quality of data returned is usually not good enough to do anything with at all. This is largely due to poor survey methods which do not make clear what information is required; but also because to provide the level of information needed requires quite a lot of effort on the part of the respondent.

To be of any real use, diet survey respondents must give the weight of each individual food item offered to the animal/group of animals each day over a period of time. This period should be long enough to incorporate all the regular variations in the daily diet – typically a week in many zoos. Other

information required includes the numbers, sexes and ages of animals in the group and their weights if known. The manufacturer and product name of any manufactured feeds must be included. To ensure that all this information is received the surveyor must ensure that the questionnaire they send out is very precise, clear, and easy to complete (see Zoo Research Guidelines: Questionnaires for further advice on how to conduct research by questionnaire). An example of a good diet survey questionnaire is included in Appendix II.

Even if a large number of institutions respond to a survey with excellent information it must be remembered that, unlike the above methods, this technique only tells us the diet actually offered - not what is actually consumed. As previously stated, these can differ quite substantially but it is unrealistic to expect many zoos to provide accurate actual consumption data. The best way to acquire these data from many zoos is to actually visit them and collect it yourself.

3. Feed composition and nutrient calculation tools

Having recorded the ingredients in a diet, along with quantities fed and consumed, these data must then be combined with information about the nutrient composition of each ingredient to provide a nutritional summary of the diet. Various food tables are available in print and online, from which the relevant nutrient values can be extracted and copied into a spreadsheet to perform the calculations. Alternatively, Zootrition software is a comprehensive electronic database with the facility to compare nutritional content of specific food items and calculate overall nutritional composition of diets.

Table 1 Common zoo feed categories and the best sources of composition information

	Fruit, Veg, Nuts, Seeds	Forage	Whole prey	Prepared feeds / supplements
AZA's Nutrition Advisory Group (NAG) website		✓[1]	✓[2]	
Manufacturer's Guaranteed Analysis				✓
McCance & Widdowsons' Composition of Foods	✓		✓[3]	
Peer-reviewed literature	✓	✓		
USDA Nutrient Database	✓		✓[3]	
ZOOTRITION™	✓	✓	✓	✓

[1]See NAG Technical Paper 6: Hay and pellet ratios: considerations in feeding ungulates. [2]See USDA Publication "Nutrient composition of whole vertebrate prey (excluding fish) fed in zoos". [3]Contains data for meat, fish and shellfish products as used for human consumption (e.g. fish fillets, rather than whole fish).

The Royal Society of Chemistry publishes "McCance and Widdowsons' *The Composition of Foods* (2002), now in its 6th Summary Edition. This is a revised and updated set of official UK food tables, covering more than 1100 different types of food. The nutrient coverage of this edition has been extended to include selenium, manganese, iodine and fatty acids. The text also covers proximates, vitamins, inorganics and lists scientific names for foods.

The United States Department of Agriculture (USDA) are responsible for compiling equivalent food tables in North America and their Nutrient Database is available to search online. The web address is for the home page of their Agriculture Research Service Nutrient Data Laboratory, which has other useful information in addition to the Nutrient Database link. (www.nal.usda.gov/fnic/foodcomp/)

ZOOTRITION features:

- Over 3000 feedstuffs with published nutrient values, many unique to zoo and wildlife species.
- Comprehensive information covering nutrient recommendations for US domestic and zoo species, the latter largely based on AZA Species Survival Plan and Taxon Advisory Group nutrient specifications and

recommendations for several species are from international husbandry guidelines.
- Energetics calculator to estimate energy needs based on animal taxonomy, food habits, physiological stage, and activity levels.
- Only data from peer-reviewed sources are considered for inclusion in the 'locked' global database embedded within Zootrition. However, most of the information on feedstuffs and nutrient recommendations is still of North American origin.

When using either published tables or software programmes as nutrient calculation tools, be aware the final nutrient values are calculated, not measured. In all instances, missing data (indicated by a dash '-') do not indicate the nutrient is not present. It simply means the specific content for the feed was not assayed and there are no available data. Thus totals for a diet or combination of feeds should be indicated as minimum calculated values only.

4. Chemical analysis of foodstuffs and faeces

Chemical analysis of faeces and foodstuffs is a non-invasive technique because it does not directly involve the animal. Most zoos do not have the facilities to do these analyses so must rely on external collaborations. Chemical analysis of foodstuffs is important for food types which do not appear in existing databases or which might be very variable depending on region, storage, growth conditions etc. Chemical analysis of faeces allows the determination of the apparent digestibility of nutrients from the diet. It is often important to analyse the digestibility for species for which it is difficult to provide food in its natural form.

The chemical analysis of a food gives us values for the total amounts of particular nutrients that are present. Commonly, when a food is to be analyzed, it is first treated with a strong acid, or an enzyme, that breaks up complex materials into simpler, soluble products. This mimics digestion, which is essentially the breaking down of feed items – or rather their chemical constituents (carbohydrates, fats, proteins etc.) - in the body, into a form that can be absorbed by the blood stream. Digestion involves physical, chemical and enzymatic processes all along the gastrointestinal tract, so digestibility can be considered a measure of how well this works. There may be other chemicals in food items which are not nutrients (e.g. tannins); these

may be toxic or reduce the consumption or digestion of those nutrients which are present.

However, it is important to differentiate between chemical analysis of feed or faeces, and how much a digestive system will be able to extract in a form that can be absorbed into the bloodstream. The term 'digestibility' may be used to designate this, but depending on the nutrient in question, the term 'bioavailability' may be more appropriate and the final measure of bioavailability must therefore be some overall response of the subject to a test dose of the food in question. Specialist expertise may be required to assist with the interpretation of the data generated.

5. Dietary standards and recommendations

Having collected data on what is being fed, how much is being fed, and then calculating or measuring the nutritional content, the final consideration is which standards to use for assessing the adequacy of a diet.

A preferable situation is when comparisons can be made between captive diets and data collected from animals in the wild. The majority of field studies of feeding ecology have tended to focus on the proportion of time that animals spend feeding on different food types, rather than their actual intake rates because the latter are often very difficult or impossible to obtain. In addition, it is only rarely that food samples are collected and analysed for actual nutrient content. Sterling [1993] was able to collect these data for aye-ayes, mainly because of the low dietary diversity of the species in the wild.

In the absence of data from the wild, dietary standards can sometimes be developed from captive situations where the animals are healthy and breed well. Often well-studied nearest-relative domestic species are used as nutritional models for exotic species. However this is not always a good technique since taxonomic closeness does not always confer similar foraging habits and nutritional requirements.

National Academies web page (www.nationalacademies.org)

The National Research Council Committee on Animal Nutrition produces a series of reports on the 'Nutrient Requirements of Domestic Animals'. This includes publications on laboratory animals, poultry, swine, cats, horses, non-human primates etc. To find out more about these publications look on the National Academies web page (www.nationalacademies.org/). Use

SEARCH, and look for 'Nutrient Requirements of Domestic Animals: Report Series' in 'The National Academies Only'.

AZA Nutrition Advisory Group (www.nagonline.net)

AZA formed a scientific advisory group, the Nutrition Advisory Group (NAG), giving the discipline, and/or practice of nutrition appropriate recognition. The NAG facilitates improved communication and coordination among nutritionists and those requiring nutrition information (i.e., AZA management groups, AZA member institutions). The website is excellent, featuring information and papers freely available to download for all. Nutrition Chapters from published Husbandry Manuals: many Taxon Advisory Groups (TAGs) or Species Survival Plans (SSPs) publish manuals of information on their species of interest. The website lists those that have provided information to the NAG about their husbandry manuals. Links allow the user to view or download the chapter for use. NAG also produces an ongoing series of technical papers and these are:

1 - Hay quality evaluation
2 - Vitamin D and ultraviolet radiation: meeting lighting needs for captive animals
3 - Feeding captive insectivorous animals: nutritional aspects of insects as food
4 - Elephants: nutrition and dietary husbandry
5 - Feeding captive piscivorous animals: nutritional aspects of fish as food.
6 - Hay and pellet ratios: considerations in feeding ungulates
7 - Leaf-eating primates: nutrition and dietary husbandry
8 - Assessment of nutritional status of captive and free-ranging animals
9 - Micronesian kingfishers: nutrition and dietary husbandry
10 - Quality control of feedstuffs: nutrient analyses
11 - Asian small-clawed otters: nutrition and dietary husbandry
12 - Penguins: nutrition and dietary husbandry
13 - Callitrichids: nutrition and dietary husbandry

EAZA Nutrition Group (www.eaza.net)

EAZA is the European Association of Zoos and Aquariums and also has a Nutrition Group (ENG), with an online library of materials located on the main EAZA website. Fewer husbandry guidelines have been written, nonetheless, materials from numerous nutrition conferences are freely available for download.

6. Final considerations

These guidelines focus on diet evaluation in terms of nutrient quality. However, devising a diet of optimum nutrient content is of little benefit if the animals do not eat it and thus palatability is another important consideration. But providing a good diet that is readily eaten by the animals is not sufficient if distribution or social effects inhibit or limit adequate intake by certain individuals. Although not covered in these guidelines, the presentation and distribution of food needs to be considered in parallel with diet formulation, to ensure that all individuals have equal, or near equal, access to food resources, and that monopolization of feeding sites or preferred food items does not occur. Finally, since finding and consuming food may occupy a substantial proportion of daily activity in the wild, simply providing a good diet, well distributed to ensure equal access to all, may still not be sufficient if the animals consume their daily energy intake in an extremely short time period. Thus behavioural and environmental enrichment is an extremely important component of providing captive exotics with appropriate nutrition.

Many of the diets fed to exotic animals in captivity have been devised from 'lore' handed down, based on the belief that diets of the approximate foods eaten in the wild will be adequate for the majority of zoo animals - "Monkeys have been fed fruits and vegetables, carnivores slabs of meat, and insectivores trays of mealworms without regard to nutritional composition" [Oftedal & Allen, 1996, p.109]. However, dietary evaluation often presents a very different picture, and assessing actual nutrient quality allows the formulation of diets which are more nutritionally appropriate for the species in question. Since an increasing number of exotic animals are also of conservation concern, a greater understanding of wild animal nutrition will enhance our ability to care for them appropriately in captivity. The field of exotic animal nutrition is thus an important growth area for the future, and one in which zoological institutions can play a leading role.

7. Further reading and other resources

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www.nagonline.net (Nutrition Advisory Group)

www.cnsweb.org (Comparative Nutrition Society)

www.usda.gov (United States Department of Agriculture)

www.eaza.net (European Association of Zoos and Aquaria)

Appendix I

Conducting an Intake Study

Ideally the study involves five (5) consecutive days of measuring individual diet components both offered and remaining. To approximate a normal diet schedule, collection during the five-day study period should ideally be performed by the primary keepers for the animals.

- All feed items must be weighed individually before feeding.
- Items may be mixed after they have been weighed.
- A desiccation dish must be set up separately from the main feed, to measure the amount of water lost to the air. This dish should be placed in an area as similar as possible to the exhibit being evaluated, but with no animal access.
- All items must be separated after animals have been fed. Each item must again be weighed separately and recorded. If this is not possible due to items being mixed into a 'porridge' the total amount remaining should be weighed and the amounts of each food type remaining estimated from the relative amounts used to make the mixture.
- Remaining food amounts need to be adjusted using desiccation factors measured from the desiccation dish.

Recording Feed Intake

- Prepare a list of feeds that are included in each animal's diet and note the number of animals in the exhibit.
- Locate and become familiar with the scale that will be used.
- Weigh each item of the diet separately.
- Record individual feed weights for each dish, or the total amount of food being scattered. Be sure to note any supplements. If an in-house mix of ingredients is prepared, the components and recipe will be necessary for full evaluation. Also note ingredient types, brands, and any other specific information available.
- Feed animal.
- After "normal" amount of feeding time (i.e., animal is fed in AM and PM), retrieve feed dishes and/or collect all food items remaining in the exhibit.
- Separate all feed items from each other.
- Weigh each item individually (including discarded items) and record on intake sheet.
- Continue this procedure for 5 consecutive days.

Desiccation/Absorption Dish

The purpose is to estimate the amount of moisture lost to (or gained from) the environment of the exhibit while the food sits out. Select a site for this dish that is as similar to the exhibit being measured as possible. Try to select an area that will minimize the amount of loss to rodents and insects.

- Weigh all items into the dish and then leave it out for the same amount of time as the main diet.
- When feed dishes are collected, the desiccation dish can also be evaluated.
- Follow the same procedure as above for measurements; record data on a daily desiccation record sheet.

Calculations

Sample calculations are for one item only. It will be necessary to repeat for each ingredient, on each day of the trial. Numbers in **BOLD** are measured, all others are calculated using the instructions below:

All wts in grams	*A*	*B*	*C*	*D*	*E*	*F*	*G*	*H*
			Desiccation Dish			*Correction*	*Corrected*	
	Offered	*Remains*	*Start*	*End*	*Difference*	*Factor (as %)*	*Remains*	*Eaten*
APPLE	**821**	**54**	**200**	**190**	10	0.05	57	764

- Calculate desiccation *correction factor* (F) by first calculating the difference in weight [C-D = E] in the desiccation dish, then expressing this as a percentage of the initial weight [E/C = F]. In the example above, the correction factor would be reported as 5%, but for calculations in the spreadsheet is expressed as a fraction (0.05).
- Apply correction factor to feed remains then add to feed remains to calculate *corrected remains* [(BxF)+B = G].
- Use corrected remains to calculate how much was *eaten* [A-G = H]. Since original measurements were in whole numbers, it is appropriate to round values accordingly.
- Use columns A and H to describe diets in terms of food quantities offered and eaten. Estimate nutrients offered and consumed using food tables or diet management software.

Suggested formats for data recording sheets

Data recording sheet for intake trial

Intake Trial No.:	*Day:*		*Date:*		*Keeper:*	
Times of food presentation:	*AM:*	*PM:*	*/collection*	*AM:*	*PM:*	
	Dish					
Food Item	1	2	3	4	5	6
Total Weight						

Data recording sheet for correcting wet weight remains from desiccation dish

			Water Loss	
Food Item	A	B	C	%

All weights are in grams, unless stated otherwise

A - Fresh weight of food given at feeding time

B - Wet weight of food remains at time of collecting food

C - Weight difference (A - B)

% - Percentage (C / A)*100

Appendix II
Zoo Diet Questionnaire

FEEDING PROGRAMME AT YOUR ZOO

1. ***Approximately how long has the diet described been in use?***

.....

2. ***Have animals been well maintained while on this diet? (e.g. have the animals bred? Any recurring health problems that may be diet-related? Any concerns for species in general even if not observed in the collection here? Give brief details).***

.....

.....

3. ***Instructions for food preparation (e.g. is fruit chopped (finely/coarsely?) first thing or done the night before and stored in fridge)***

.....

.....

4. ***Are diets being eaten by pest birds, rodents and insects? (Give indication of how much might be eaten by pests and whether a significant problem?)***

.....

.....

5. ***Are there opportunities for 'paddock' feeding? (Do the animals consume plants/insects in their enclosure which are not fed directly?)***

.....

.....

.....

.....

6. ***Are amounts altered on a seasonal basis?*** ***(Brief description changes for breeding diets; conditioning diets; diets for lactating females; medical considerations etc.)***

7. ***Notes and Remarks:*** ***(Include such data as how food is presented; how well food is accepted; which are 'favourite' items; is there a 'pecking order' for access to food? Any other comments that don't apply elsewhere)***

8. ***Reference Material*** ***(Details of most important references relevant to wild or captive diets, including international husbandry manuals if used)***

9. If the diet is the same on daily basis indicate below stating DAILY; if some items are not fed daily please complete table for a full week. Continue on separate sheets if necessary.

How many animals are fed from the diet described below? (males.females.juveniles).

	Weight of feed item offered (grams) and time of day (e.g. am/lunch/pm)*						
*Feed Item***	*Monday*	*Tuesday*	*Wednesday*	*Thursday*	*Friday*	*Saturday*	*Sunday*

* Please provide weights (grams) wherever possible. If not possible please use typical measurement units e.g. 3 carrots, 4 mice, 2 bales

** For any manufactured feeds please provide exact manufacturer & product names + photocopies of the guaranteed analysis label if possible.