# Zoo Nutrition News

July 1999

Contents

SPECIAL ISSUE 1



## First European Zoo Nutrition Meeting

# From the Organising Committee

Dear member,

Providing a good diet, which fulfils as many aspects of a natural diet as possible, is an essential consideration in improving the welfare of zoo animals. Although some research has already been conducted in the field of zoo animal nutrition and more is ongoing, there is still a great need for further investigation. Exchange of ideas, information and results is vital when developing zoo animal diets.

On this premise we began to organise a conference focussed on zoo animal nutrition that eventually became the First European Zoo Nutrition Meeting, held in Rotterdam, the Netherlands from 9-11 January 1999. The conference was organised by the EAZA Research Committee, the Veterinary Faculty of Utrecht and Rotterdam Zoo.

When Jean-Michel Hatt (Veterinary Faculty of Zurich) and I started planning the conference at the beginning of 1998, we anticipated and would have been more than happy to welcome approximately 80 participants. So we were surprised and extremely pleased to have more then 180 delegates from 29 countries attend the conference. Most were European, however participants also travelled from the Republic of China, New Zealand, Bahrain, USA and Canada. Congress participants represented not only zoos but also the zoo animal food industry and nutrition research institutes.

We never expected such a great response to this meeting. It can only mean that zoo animal nutrition is indeed an important issue within the zoo world. Steps should be taken to provide continued means of discussing and disseminating information relating to zoo animal nutrition. An open session was held at the end of the conference and a questionnaire was sent to all participants, asking how this should be done in Europe in the future.

All the conference participants received a set of abstracts from all of the presented talks and posters, more than 40 in total. More information on how to obtain a copy of the abstracts can be found on page 20 of this EAZA News special on Zoo Nutrition. All conference participants will, free of charge, receive a copy of the conference proceedings to be published at the end of this year. Details of how to obtain the conference proceedings can also be found on page 20.

Some talks contained general information about zoo animal nutrition, which will be useful for all zoos. Therefore we decided to produce this special EAZA News focussing on the nutrition conference. Perhaps the most appropriate way to start this EAZA News special on Zoo Nutrition is with a current review of the status of zoo nutrition in Europe. Following that as a contrast, and perhaps a model of how European zoos should coordinate their nutrition information and research, the role of Nutrition Advisory Group of AZA is described. Throughout this newsletter and at every nutrition meeting there is always a call for more research. The article Zoo Nutrition Research describes the particular problems of the zoo nutritionist when designing research protocols. Two pages are devoted the Zootrition software, what is sure to become an essential tool for every zoo nutritionist. Basic guidelines on how to establish a zoo nutrition service follow. Information about the conference programme can be found in the centre of this issue.

The idea of a centralised kitchen is common in North American zoos but unusual in Europe. Emmen Zoo, however, uses this system and describes how it works. A related article follows on the importance of food safety, an often overlooked issue. The importance of communication between zoo nutritionist and pathologist also receives attention in this EAZA News special on Zoo Nutrition. Commonly observed diet-related illnesses in birds are described, followed by an article with methods and tips on how to transfer birds to pellet feed. The final article relates to food presentation, another very important consideration when designing zoo diets.

Many thanks to the EAZA Executive Office for their assistance and especially to Andrea Fidgett for English editing and Sofie van Wees, guest editor of this issue. Of course, it would not have been possible to publish this newsletter without the assistance of our sponsors, information about whom is also displayed in this special issue.

I sincerely hope that this EAZA News special on Zoo Nutrition contributes to improving zoo animal nutrition – because our animals *deserve* better diets!

Joeke Nijboer
Nutritionist Rotterdam Zoo
Member of Organising Committee of the First European Zoo Nutrition Conference

# Contents






COLOPHON

EAZA News is the quarterly magazine of The European Association of Zoos and Aquaria (EAZA)

This special issue of EAZA News is dedicated to Zoo Nutrition and was compiled as a result of the First European Zoo Nutrition Meeting held in Rotterdam, The Netherlands, in January 1999.

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*Printed on paper bleached without chlorine*

# Current status in Europe

## Nutrition in zoos, research institutions and food industry

by Sofie van Wees, Rotterdam Zoo, The Netherlands

*To compile an inventory of the current status of zoo nutrition in Europe a survey was conducted among European zoos, research institutions and food companies, the purpose being to make recommendations for improving zoo nutrition in Europe and to aid better communication between zoos, research and food industry. Questionnaires were sent to 177 zoos, 64 research institutions and 48 food manufacturers over 30 European countries in total. Almost 50% of the zoo-questionnaires, 11% of the research-questionnaires and 13% of the food industry-questionnaires were returned.*

*The participants were asked to respond to a variety of questions that can be assigned to five categories:*
- *General questions*
- *General aspects of zoo nutrition*
- *Specific problems involving zoo nutrition*
- *Research relating to zoo nutrition*
- *Information and communication*

*In this article the most important survey results are presented.*

An animal nutritionist is employed in only 20% of the European zoos. Partly due to the lack of nutritional knowledge, but probably also because of a lack of facilities, the percentage of European zoos which conduct nutritional research is low (28%). Since these percentages have changed little since a similar study was conducted five years ago, it is unrealistic to expect the situation will change in the near future.

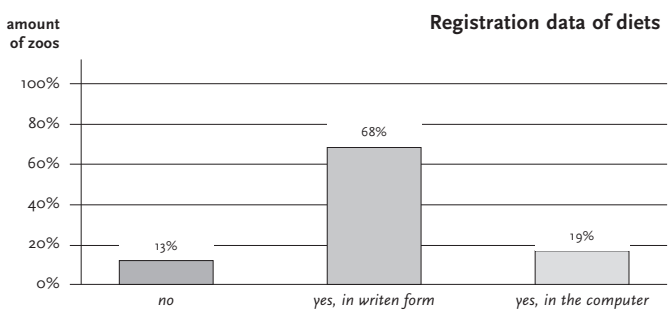
On the other hand, approximately three-quarters of the participating zoos think that some diseases may have been caused by inadequate diets. A logical deduction from this point is that many zoos will also agree that additional research is needed in the field of zoo animal nutrition. Indeed, the majority of zoos surveyed think that more research is still required. This perceived need for additional research increases (from 69% to 83%) in comparison with the survey conducted five years ago.

The low percentages of animal nutritionists employed and nutritional research conducted contrast sharply with the high occurrence of diet-related diseases and the demand for additional research. However, the responses from zoos, research institutions and food industry provided a variety of potential answers to solve the conflict.

| | | | |
|---|---|---|---|
| 20% | Employment of zoo animal nutritionists ↓ | Nutritional research in zoos | 28% |
| | SHARPLY CONTRAST | | |
| 75% | Nutritional problems and diseases ↑ | Need for additional research | 83% |

### Communication

Many zoos record their diet information and that data is readily accessible. However the actual exchange of data lags behind. An explanation for why the information exchange does not take place lies in the method of recording diets. Most of the time, diet notes are in paper form only, which restricts their distribution. Computerised diet notes in a standardised format would be much easier to exchange, especially now that many zoos have access to computers and to the Internet in particular. In addition to agreeing on a standardised format, in order that nutrition software could be synchronised across many countries it is possible that newsgroups and regular meetings would also promote communication. The main objective in establishing these lines of communication would be to prevent people from 're-inventing the wheel' – resources are often already limited. Therefore when a zoo in Spain for instance, has problems with a certain diet, it is often more simple and efficient to ask colleagues around Europe what their experiences are with the diet in question, than to try to find the answers all by yourself.



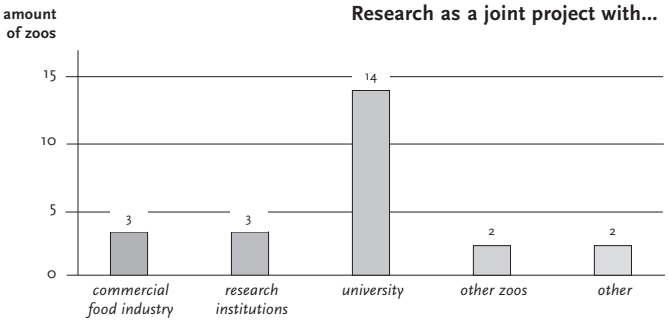
# Current status in Europe

Because specific knowledge on zoo animal nutrition is limited, it would be sensible to make the existing knowledge available in a way that every zoo is able to consult it. So-called 'fact sheets' can be compiled for species or groups of species kept in European zoos. These would form a valuable database that could be consulted by zoos, perhaps over the Internet.

**Cooperation**

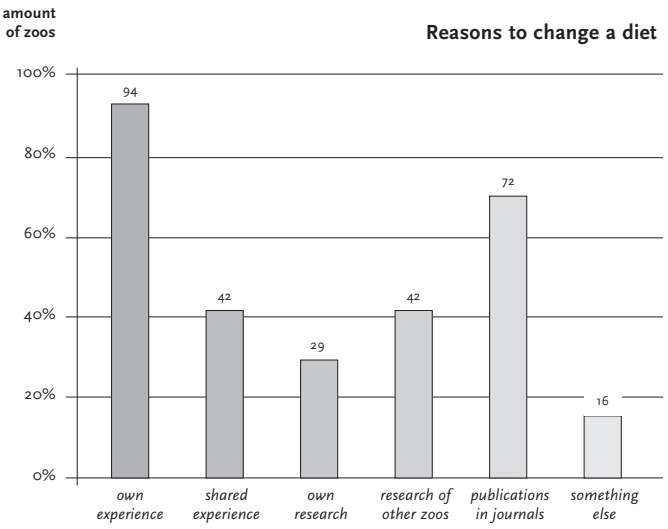
Not all problems can be solved by communication alone – even when all our resources are pooled there are still many nutritional problems left for which no zoo has the answer. Therefore further nutritional research is still required.

As mentioned before, the percentage of zoos that conduct their own research is very low. Comparing this low percentage with the high need for additional research a conflict arises. To resolve this conflict, other ways to meet the need for nutritional research have to be found. From the questionnaires sent to zoos, research institutions and food industry we received feedback that indicates one solution may be to contract out research. Research institutions seem to be willing to cooperate and to exchange their data. As such they are potentially good partners in research. This is reinforced by another result which was found in the zoo-questionnaire, namely the fact that zoos which already have set up nutritional research partnership have done so with a university in most of the cases.




From the questionnaire sent to European research institutions it appears that many research institutions and universities departments conduct most of their nutritional research with domestic animals and pets. That is not to say however, that that they would not be interested in zoo animal nutrition. A survey of 'supply and demand' could be set up, whereby demand is defined as the nutritional problems in zoos that need to be investigated, and supply provides a review of research institutions, their specialists and research-interests. Such a survey would promote communication between zoos and research institutions, which in turn could increase the percentage of joint research-projects.

Another response in favour of contracting out research is that a very high percentage of zoos indicated that changes to their diets resulted from nutritional publications in journals. Therefore, when research is contracted out, publication of the results should be encouraged in order that the impact of the research is maximised.




Food manufacturers, in contrast with the research institutions, are not so willing to exchange data, probably to protect their commercial interests. But since food manufacturers often have a great deal of experience in the area of (zoo) animal nutrition it would be a waste if this knowledge could not be used towards improving zoo nutrition. Food manufacturers do not seem favourably disposed towards joint research projects. However if some arrangements could be made between zoos and the company involved, regarding how and where results are published, then collaborations may yet take place. Specific diets for difficult-to-feed animals are an example of where fruitful collaborations could occur.

*It is only 30 years ago that 25% of the animals in zoos died because of inadequate nutrition. Although knowledge about diets for zoo animals have improved, it is still possible that zoo animals die because of nutritional disorders. While all zoos would most likely wish to improve their diets, relatively few actually target zoo animal nutrition as an area for development. Until this situation changes we will have to rely on promoting communication and the exchange of data to improve the diets of the animals in our care.*

## The formation of the NAG for the American Zoo and Aquarium Association

by Susan D. Crissey, Brookfield Zoo, USA

*In 1994 the American Zoo and Aquarium Association (AZA) Nutrition Advisory Group (NAG) was formed. The mission is to promote the welfare of animals in captivity by incorporating the science of nutrition into their husbandry.*

*The goals are to:*
- *Identify nutritional and dietary problems in zoos and facilitate their resolution.*
- *Establish a mechanism for the review of nutritional and dietary information provided by AZA committees and subgroups.*
- *Coordinate acquisition and dissemination of information regarding nutrition.*
- *Encourage and coordinate nutrition-related investigations among zoos and collaborating institutions.*

*The purpose of membership in the NAG is to provide service to AZA. The main client of the members is the zoo. The NAG began with nine members and now has over 52 members and affiliates from the zoo community, academia, and industry. There also is a nine member executive committee. This committee works to represent the NAG, and liaise with other groups and organisations on behalf of the NAG, make decisions concerning the NAG and its activities, coordinate and disseminate information, facilitate the performance of action plans, approve and appoint NAG members and advisors, appoint sub-committees and task forces, review or appoint reviewers of publications.*

Members of the NAG can freely join the nutrition Internet discussion group NAGNOTES

Nutrition is a science integral to the good management of zoo animals and must be addressed in a scientific and professional manner. The formation of a NAG gave the discipline, and/or practice of nutrition appropriate recognition. It allows for better communication and coordination among nutritionists and those requiring nutrition information (zoos). It helps provide leverage for accomplishing projects, research and/or dealing with zoo nutrition and industry problems.

However, there is a difference between the discipline of nutrition and the specific role of the NAG. Thus, there are two important aspects: the science of comparative nutrition i.e. understanding the biology/nutrition of the animals; and the practice of zoo nutrition – diet formulation and feeding animals.

It is essential that each interact with the other. Additionally, since its formation there has been some confusion over whether NAG is a professional society and/or a consulting service, neither of which is the intent.

The practical zoo nutrition function includes:
- Development of rational feeding programmes for captive animals that will be based on sound scientific principles.
- Helping advance rational zoo nutrition practices.
- Providing a service to AZA.

We recently reviewed and established our priority issues with respect to nutrition projects and investigation. These issues identify the topics and activities we think are currently important to zoo nutrition and feeding and will serve to guide those interested in conducting research as well as those funding projects. These issues are written simply to provide guidance and do not indicate that there is funding for any of these, there is work underway in these areas or that these projects must be accomplished by the NAG. Priority issues are listed below, followed by criteria for becoming a member of NAG.

### Training

We can not expand and improve the field of zoo nutrition alone. The next generation of zoo nutritionists are extremely important if we wish to build on what we have achieved. To attract students to the field of zoo nutrition and to cultivate them to be successful, we must offer them opportunities to learn and gain experience. Likewise, tenured zoo nutritionists should open themselves to learning from students, embracing new ideas and helping them develop these new ideas and ways of doing things. Thus training goes both ways from the mentor to student and the student to mentor.

*Action:* Information exchange opportunities, e.g. the NAG Conference, through funding for the conference itself and for students to attend the conference. Zoo Nutrition Residency programmes and special projects dedicated for training nutritionists in a zoo setting offers students the opportunity for first hand training. Included here too are research projects where the student is a potential zoo nutritionist and is affiliated with both the university and zoo.

### Physiological data, including body condition indices

To understand whether the nutrition provided to animals is adequate, it is imperative to assess that animal or population with respect to its physiological and nutritional status. This is a key component to any interdisciplinary approach to animal, species, and population well-being and fitness.

*Action:* Continuing research and assessment to address specific issues with regard to identified nutrients (e.g. vitamin E) as well as establishing a databank for distribution of published information. Also, the assessment of healthy animals to establish normal reference values in addition to assessing the debilitated animal (and populations) both in the field and in captivity.

# Nutrition Advisory Group

**Vitamins and minerals; investigation of deficiencies, toxicities, and requirements**

Because of animal welfare issues, philosophical issues, limited animal numbers, and/or lack of support, 'classic' deficiency, toxicity, and requirement studies are often not performed in a zoo setting. However, much of the information we require in this area remains completely unknown and there is a dire need to acquire such data.

*Action:* Research into delineation of vitamin and mineral deficiencies, toxicities, and requirements, e.g vitamin D work in primates and reptiles, and iron storage disease work in a number of species must continue. NRC/CAN projects to outline the nutritional requirements of groups of species (i.e.: Non-human primates) are also important. This category is deliberately broad in order to include emergent issues and any vitamin and/or mineral research that provides improves our knowledge of exotic species requirements. This information is inclusive for taxonomic, feeding strategy, age and sex categories, (i.e. insects to mammals; carnivores to herbivores; infant to aged; male/female), and includes establishing appropriate animal models for closely related species.

**Food composition**

To understand whether the nutrition provided to animals is adequate, it is imperative to determine the nutrient composition of the foods. This applies to foods consumed in the wild, determining the nutrients which are 'bioavailable' to the animal and similar studies of food items used to feed their captive counterparts.

*Action:* Determining nutrients in items such as 'browse' fed to many herbivorous animals in zoos, as well as secondary plant compounds that may be present in such items. This data will be relevant for identifying feeding strategies. Collaborations between field conservation and field investigators, as well as the feeds database industry, are to be encouraged.

**Food and feed quality and sanitation**

It is imperative that captive animals be fed a diet (food) that is wholesome and nutritious. The safety and health of the animals is dependent on the quality of food the animals are offered. It is not enough to assume appropriate quality and collect information on the nutrient content of food offered to animals; nutrient content and wholesomeness must be assured.

*Action:* Investigation into the processing of foods and feeds including manufactured items, fish and forage. Processing includes at least: manufacture, shipping, procurement, handling and testing of any type of foods and feeds. Investigation comprises inspection as well as research that may include surveys, sampling, etc. Any quality control testing and setting specifications and appropriate Standard Operating Procedures to ensure or improve wholesomeness and/or nutritional value of foods fits in this category, as does development of better products. Priority is given to high-risk products (raw meat fish/seafood, eggs, etc.).

***In situ* projects**

It becomes obvious that the research, data, and information identified above as being required for captive animals, in many instances is best determined from free-ranging animals. This requirement for *in situ* research can only contribute conservation of species in the wild.

*Actions:* Any *in situ* project that helps train nutritionists, adds to the physiological nutritional assessment, vitamin and minerals deficiency, toxicity, and requirement data, as well as food composition and food quality work is included.

**Criteria for AZA Nutrition Advisory Group (NAG) Membership**

**Demonstrated interest and commitment to zoo animal nutrition (as evidenced by):**

- Designation as a nutritionist in a zoo
- Regular attendance at nutrition meetings
- Provision of nutritional advice to zoos/ collaboration on projects with zoos

**Expertise in nutrition/diet management:**

- Advanced degree in nutrition
- Demonstrated expertise in zoo or wildlife nutrition/dietary husbandry/feeding management
- No substantial financial interest in zoo food purchasing/diet management

Individuals who may possess financial interests, i.e. who perform consulting for zoos and/or product manufacturers, will be considered for membership on a case by case basis as to the extent of their financial interest.

- Approved by the Executive Committee of NAG

Those not meeting membership criteria, including students with an interest in the field, or have limited time to commit, are eligible for Affiliate status.

*Please communicate your interest through written application, with any comments, questions, or concerns to any member of the Nomination Subcommittee:*

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# Zoo Nutrition Research

## Some considerations on the design of research projects

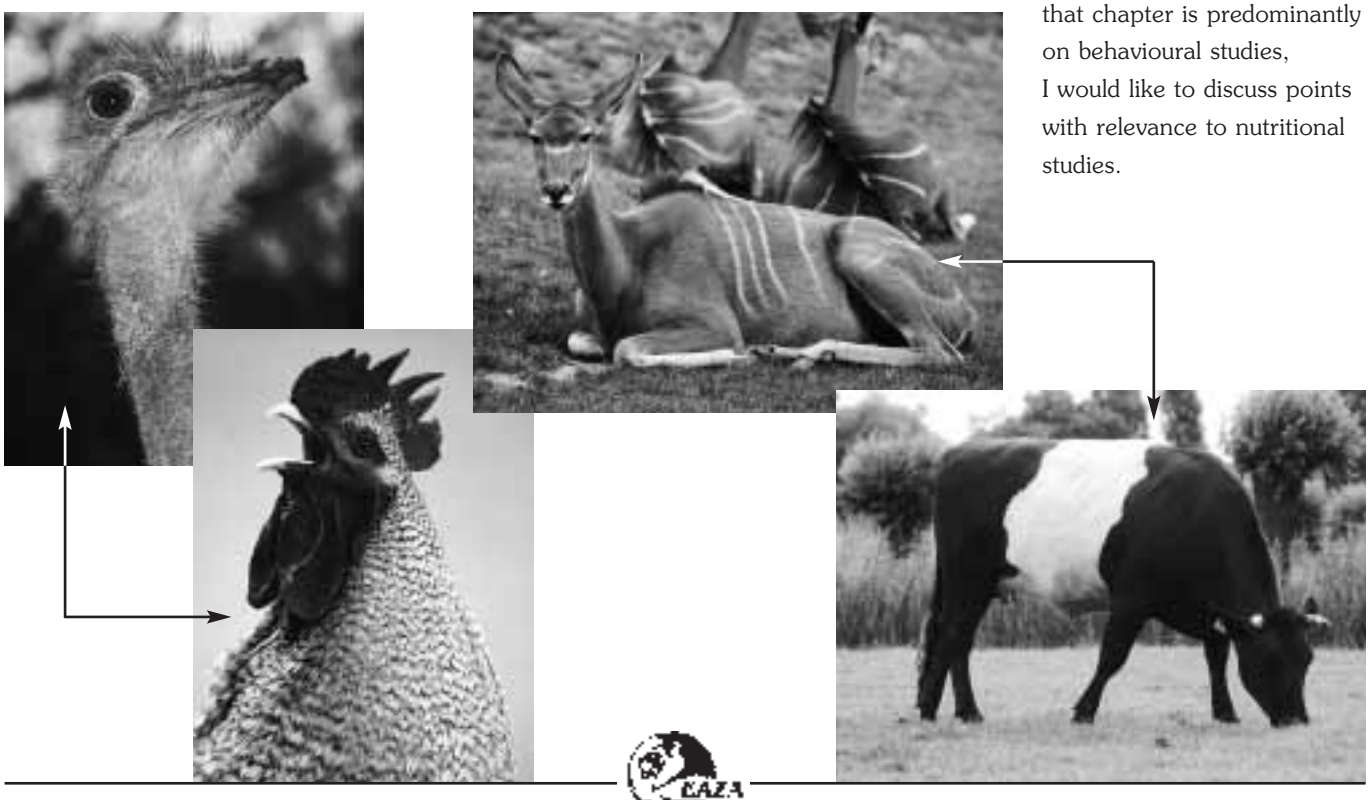
by Jean-Michel Hatt,
University of Zurich, Switzerland

The diet of a zoo animal is rarely identical to what the species would eat in its natural habitat. Generally a substitute diet has been formulated. At present, in most cases these diets are based on tradition. Animals survive, and in many cases may even reproduce on these diets. However, diet-related diseases still occur frequently in zoo animals. The improvement of substitute diets for better health and longevity depends on a more detailed knowledge of the requirements of the species. Such knowledge may be gained by 'trial and error' studies or through systematic scientific studies on the digestive strategies and physiology of the species. The increasing importance for research into appropriate nutrition of zoo animals is supported by the increasing involvement of zoos in conservation issues. To lose animals due to improper feeding is unacceptable nowadays, both from an ethical and a conservation standpoint. The limits of extrapolating nutrient requirements derived from domestic animals for the design of zoo animal diets are becoming more and more obvious. From a nutritional point of view, an elephant is not a horse, a kudu is not a cow, and an ostrich is not a chicken!

The news that research with captive non-domestic animals is increasing should be welcomed. Unfortunately, research projects on zoo animal nutrition and diets are still rare. Donna Hardy (1996) reviewed current research activities in zoos. She cites the American Association of Zoological Parks and Aquariums (AAZPA), which listed in its Annual Report on Conservation and Science 1991-1992, 302 projects with mammals in 40 zoos (Wiese *et al.* 1992). Sadly, of this total only 3.3% were studies relating to nutrition and diet; the vast majority of the research was on behavioural ecology and reproductive physiology.

Unfortunately, in the scientific community, studies conducted with zoo animals in general are often perceived as not being 'good science'. This is especially true for zoo animal nutrition studies and the significance of results obtained is often doubted. One reason may be the fact that zoos rarely employ trained scientists. Another reason is that the study subjects are not maintained in controlled conditions like laboratory animals. The number of study animals is generally small, there is often a high degree of variability between individuals and the environment is difficult to control. Therefore, a major problem in zoo animal research is the low level of standardisation.

The purpose of this paper is to highlight some of the important aspects to consider when designing a research project. The topics discussed are based on aspects that Carolyn Crockett (1996) described in her chapter on 'Data collection in the zoo setting'. But where the emphasis in that chapter is predominantly on behavioural studies, I would like to discuss points with relevance to nutritional studies.



# Zoo Nutrition Research



**Formulating a problem**

The ultimate aim of nutrition research studies is to develop requirements and standards for the diet of the species concerned and therefore improve its quality of life. However, often projects are initiated from a vaguely defined question; for example, when there is no clear outcome from the post-mortem report, resulting in the conclusion that it might be a nutrition problem. As a result, a non-specific question will result in a non-specific answer. With all the difficulties that are already inherent in zoo animal research, it is vital to describe the problem in the most specific terms.

**Developing a research design**

The major constraint in developing a research protocol is the many variables that are inherent to research studies in zoo animals. The subjects, i.e. the animals that are being used for the project, are not standardised, as is the case with laboratory animals. In general only small numbers may be used. If you want to do a research project with giraffes for instance, you will rarely get more than four animals in a zoo. The animals will be of different sex, age, and origin.

Extraneous variables have to be controlled for unambiguous interpretation of the data. In a zoo situation maintaining adequate control over the course of a study may be difficult. Variables such as the weather, the animal's health, seasonal changes that may influence diet intake (eg. oestrus, climate), or digestibility, have to be anticipated if possible. As a result it is advisable to perform preliminary analyses before finalising the data collection design.

Furthermore, an important aspect in zoo animal research is that in most cases invasive procedures are not possible or, depending on the zoo's policy, might not be allowed. Even permission to take a single blood sample might be difficult to obtain. In nutritional studies the most readily accessible samples are faeces, urine, and food. Therefore, the information that may be gained from these samples has to be optimised. The use of internal and external markers in dietary studies is certainly an important tool in nutrition studies. There are a vast number of possibilities that range from the feeding of little plastic beads, to identifying faeces from different animals, to the analysis of internal markers (e.g. wax compounds) for the identification of specific diet components. The choice of markers will depend on the species involved and the question to be answered. While it may be possible to feed a marker to one species, the same marker might not be appropriate for another.

**Set out alternative hypothesis**

Research in zoo animals is usually descriptive, which means we do not know what is going on and what we expect to find. Often researchers in zoos forget to describe alternative hypotheses. Both the null hypothesis (the one we want to reject) and the alternative hypothesis (the one we predict or expect to be true) should be specified in advance, in order to decide upon the best means of statistical analysis. Behaviour and biological characteristics may nullify the results of many research projects and researchers should be prepared for several modifications of the experimental design.

**Appropriate sampling and data collection techniques**

In general, data collection techniques should be kept simple, with the principal aim of collecting unbiased data. Some data, e.g. weight or nutrient intake, are relatively easy to collect. Collection of individual faecal samples might be more difficult and so is the collection of urine. While some species, such as New World Monkeys or elephants may be trained to urinate under certain circumstances, this might not be possible with other species. Some animals might

be dangerous and sample collection only possible when the animal is separated from its companions. Sampling intervals will depend largely on the species. Studies on digesta passage rate might be relatively easy in giant tortoises where it is enough to collect samples once a day, since the transit time takes more than two weeks. In smaller mammals however, samples may have to be collected every hour over 24 hours thus disturbing the animal much more.

At this point the importance of using the input of universities should be emphasised. Such institutes very often have more experience in knowing which method is better suited to obtaining particular data. On the other hand, the zoo person's knowledge will be invaluable in deciding what might be feasible for a species and what is not.

**Data analysis**

When planning research, data analysis should be considered at an early stage. The type of analysis selected will influence data collection, protocols etc. It is advisable to start analysing the data while collection is in process. One might already recognise certain trends or discover discrepancies.

The use of parametric or non-parametric statistical tests, such as ANOVA or t-test, requires a large number of points to be significant. In many instances there may not be enough data to satisfy the criteria for performing these tests. It might therefore be necessary to repeat experiments with the same subjects in order to obtain sufficient data points, which raises additional analytical problems. Nevertheless we must always be self-critical of our results.

*Some data, like weight for example, are relatively easy to collect.*

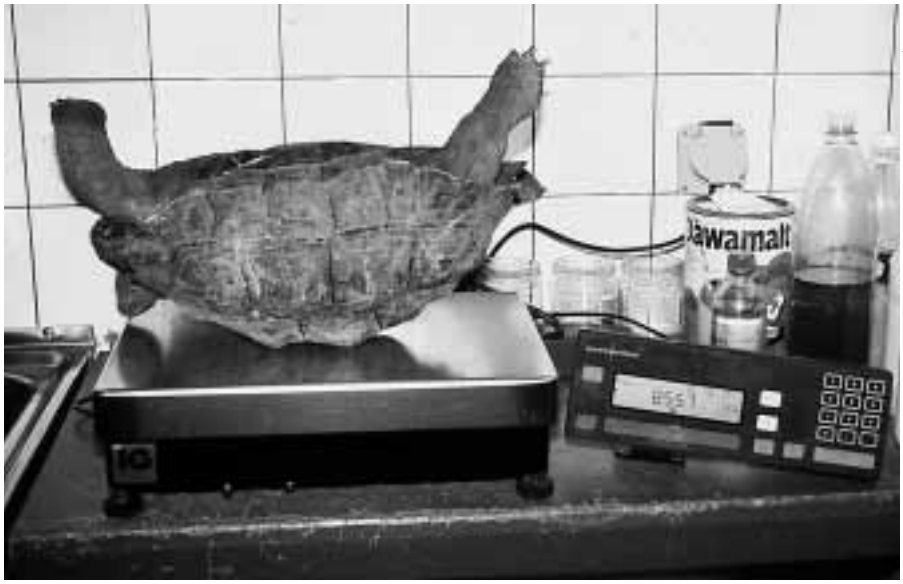


Photo: Jean-Michel Hatt

*There is no doubt that research into the nutrition of zoo animals is becoming ever more important. The increasing number of organised meetings that are very well-attended reflect this tendency. This is to be welcomed, especially when considering the difficulties that such research projects will often face. In contrast to studies with laboratory animals, zoo animals are more unpredictable subjects. The degree of standardisation is low and therefore the variability of the results may be high. The design of rigorous scientific projects, which take into account the aspects described above, is crucial to the meaningfulness of the data. The fact that there are relatively few trained scientists working in zoos will probably not change in the near future. A possible key to productive research activities will lie in the close cooperation of zoos with universities or similar institutions. And last but not least, it should be emphasised that the best research is of limited use to the wider community if it is not published in a scientific journal.*

**References**

*Data collection in the zoo setting, emphasizing behaviour*
C.M. Crockett (1996)
In: Wild Mammals in Captivity
(eds. D.G. Kleiman, M.E. Allen, K.V. Thompson and S. Lumpkin)
The University of Chicago Press, Chicago, pp. 545-565

*Current research activities in zoos*
D.F. Hardy (1996)
In: Wild Mammals in Captivity
(eds. D.G. Kleiman, M.E. Allen, K.V. Thompson and S. Lumpkin)
The University of Chicago Press, Chicago, pp. 531-536

*AAZPA Annual Report on Conservation and Science*
R.J. Wiese, M. Hutchins, K. Willis and S. Becker (1992)
Bethesda, American Association of Zoological Parks and Aquariums

## Windows compatible dietary management software

by Wendy S. Graffam and Ellen S. Dierenfeld,
Wildlife Conservation Society, Bronx, USA

Zootrition dietary management software was recently completed by the Wildlife Conservation Society's Department of Wildlife Nutrition, working with a local computer programming firm. Six years in development, Zootrition was initiated with a Federal grant from the Institute of Museum and Library Services. The programme's content and design incorporated suggestions from zoo nutritionists, curators, and keepers, while nutrition scientists from five countries fine-tuned the working version. Zootrition provides a critical tool for evaluating nutritional quality, and standardizing dietary records in zoo feeding operations. Essentially a programme of linked databases, Zootrition combines published information on foodstuffs not found in human nutrition tables (for example, mice and rats, whole fish rather than filets, tree branches and leaves, and fruits with peels and seeds included), with dietary nutrient recommendations from American Zoo and Aquarium (AZA) SSP (Species Survival Plan) and TAG (Taxon Advisory Group) Nutrition Advisors, as well as domestic animals and livestock, to readily evaluate diets fed to a variety of species. Other unique functions of the software include: maximal record storage capacity for chemical composition of feeds, diets and species requirements; global and local feedstuff directories that allow data updates without overwriting the user's locally entered feedstuffs; flexible measurement units; customizable nutrient screens; printout options on most screens; and the ability to save a diet as a feedstuff ('in-house mix') with the original ingredients intact. Feeding tools allow the user to summarize diets into groups from which specialized reports total ingredient amounts for all diets in the group, along with costs, for designated time periods, to provide readily-available ordering, delivery, and economic summaries. Rapid advances in computer technologies have allowed us to create a programme much more sophisticated than originally envisioned, with the potential for new modules to be added as funding and information becomes available.

**To order Zootrition:**
Contact the Wildlife Conservation Society Nutrition Department
E-mail: edierenfeld@wcs.org
Fax: +1 718-220-7126
Or check our website for an order form:
www.islandbusinessgroup.com/zootrition.htm


**Image 1**: The feeds tab in Zootrition. The functions on this tab include: viewing the nutrient composition of a feed, adding a feed or feed category to the database, copy an existing global feed to allow the user to make changes, sort feeds by any designated nutrient, and a feeds comparison report. Zootrition comes with a database of feeds already included. The user may have additional feeds that need to be added – these are added as 'local feeds'. In other words, anything that is added by the user will not be overwritten when an update is installed and will, therefore, not have to be reentered. A date is automatically added to all feeds which indicates when they were created and when they were last updated, allowing the user to view which is most current.

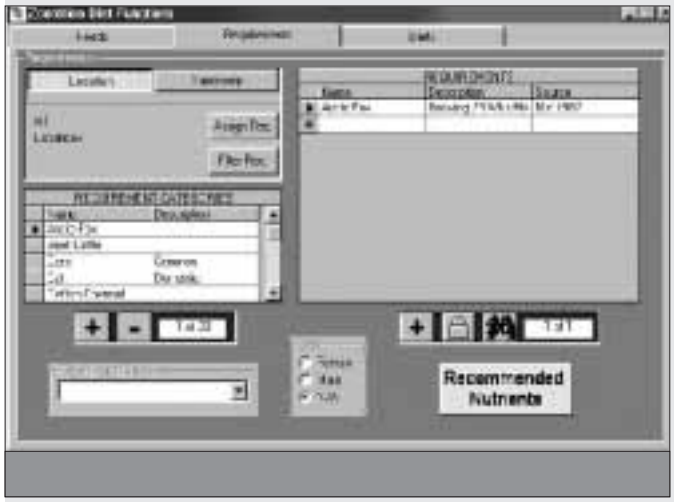



**Image 2**: The requirements screen. As with the feeds, Zootrition comes preloaded with many published requirements commonly used in the USA. Requirements can be added to the database, or an existing requirement can be copied so that modifications to the data can be made. The requirements are all on a dry matter concentration basis at this time.

**Image 3**: The diets tab, clearly the major crux of this programme. From this screen, the user can create a diet by typing in a name and then selecting feeds from the list. A window automatically pops up when a feed is added (using the arrow button) that asks for the amount of that feed to be added to the diet. Several different units are available if desired. If a feed is added incorrectly, that feed can be easily deleted or the amount corrected without having to add and delete the feed again. Once a diet is created or selected, the user can view the diet analysis or compare it to any of the requirements from the previous tab. A graphical view is available on screen, or exact values can be printed. The animal information button allows the user to select the species of animal, the location of that animal, the preferred requirements for comparison and other relevant animal information. The print icon contains the feeds breakdown, diet sheet and diet cards.

**Image 5**: An example of the diet analysis screen. Notice that the 'selected' tab is chosen – this displays the nutrients that the user has selected in the units that they have chosen for their defaults. A summary report and a detailed report are available from this screen also. Dry matter and As Fed basis can be changed from this screen if desired. The optional windows tool bar is also displayed on the left hand side of this image.

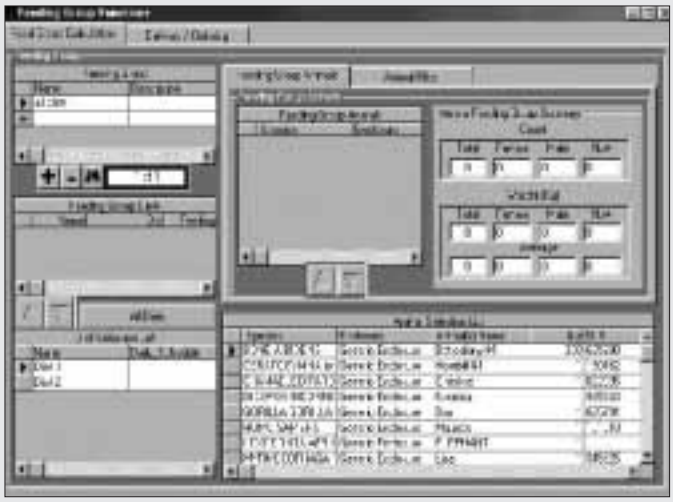


**Image 4**: The Feeding Groups functions. In this screen, a user can create any group of diets that might belong together. This grouping can then be used in the Delivery/Ordering tab to sum up the amount of food required for that group of diets over a chosen number of days. For example, if the user wants to see how much food the gorillas consume in one year, they can select the appropriate diets, put them in a feeding group, and have Zootrition calculate the total amount of each diet ingredient for 365 days.

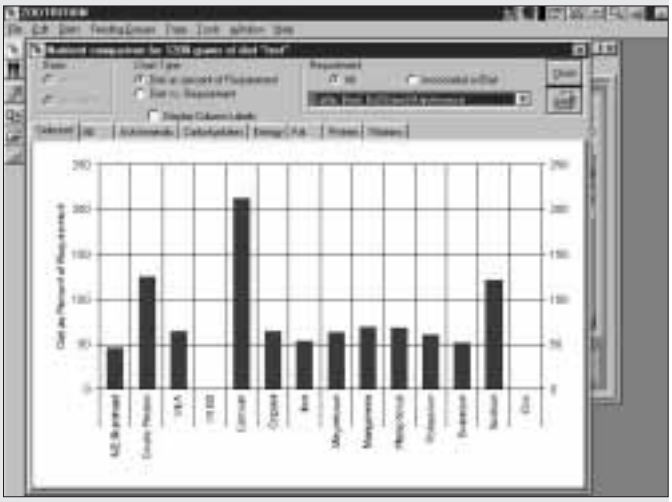


**Image 6**: An example diet as a percent of the selected requirement. As is indicated in the upper right hand corner, we have selected a beef cattle requirement for this comparison. The requirement can be changed easily by the user at this screen if a different comparison is preferred. The diet can also be displayed graphically with the requirement bars immediately next to the diet bars.

## How to build a zoo nutrition service?

by Helena Marquès, Barcelona Zoo, Spain, and Mike Maslanka, Memphis Zoo and Aquarium, USA

When starting to work on nutrition at a zoo, the last thing to be done may be the 'nutrition' itself. One cannot start building a house with the roof. A plan should be defined first, and the foundation and structure of that plan must be created upon which to build a nutrition service. That foundation can begin by demonstrating the need for that service. That 'need' may take the form of evaluating current diet items for quality and/or price, the need to streamline food processing operations, or, most directly, the examination of nutritional/metabolic problems of the animals in the collection. Regardless of how or why the 'need' is expressed, institution-wide support of a nutrition service is imperative to its success. Often, that support is not present at the outset and develops as the benefits of such a service are displayed over time. Once the foundation is set, and receives the appropriate encouragement (moral, financial or both), the service can be developed based on the reasons why it was created. As the benefits are displayed over time, the service will grow further. However, there are always problems that arise which need to be solved gradually in order to be successful on the creation of the nutrition service.

**STEP 1**

### Starting with a Plan

Because nutrition problems are not always detected in a timely fashion (Oftedal & Allen 1996), the advantages of a nutrition service similarly materialize over the long term. For this reason, it may be difficult for the zoo to immediately see the advantages of a nutritionist. Therefore, when building a nutrition service, it may be beneficial to present some of the advantages in order to gain financial and moral support. These advantages can be approached from two perspectives – the animal's and the institution's.

*Advantages for the animal:* A nutritionist can provide the expertise to minimize the incidence of health problems, and improve the animal's quality of life. This can be realized by designing appropriate diets for each animal, not only nutritionally, but also in relation to the animal's physiology and morphology of the digestive tract, its foraging ecology and behaviour, etc. A nutrition service can allow better control over the items, thus the nutrients, assuring that the food offered is of best quality. Moreover, a nutritionist can help to design diets that increase the activity of the animal or group, and minimize or even eliminate stereotypic or aggressive behaviors, contributing to better management of the spatial and temporal distribution of the diet. Additionally, if the diet more closely meets the nutrient requirements of the animal it may increase the reproduction rate (this could also be an advantage for the institution).

### Survey

The first nutritionists associated with North American zoos appeared in the mid- 1970's and in Europe in the 1980's (Oftedal & Allen 1996, Dierenfeld 1996). Since that time, the number of nutritionists working at zoos has slowly increased. Captive animal management has always included nutrition, but in the last 20 years several zoos have built nutrition services and developed those that already existed. In November of 1998, a very short and simple survey was sent to the European and North American zoo nutritionists. We had a response of 70% (16/23) and 57% (8/14) respectively.

From the results, we saw that the incorporation of nutritionists in European zoos has mostly occurred since the beginning of the 1990's and progressed in the last few years. However, the roles of the nutritionist are still very limited, which in part, may be due to the lack of facilities and equipment and to the fact that zoo nutrition is still a very new science. Additionally, slow development may be due to under-developed collaboration between zoos and other institutions.

Almost 70% of the European nutritionists began working as part time nutritionist while doing another role at the zoo. Currently, there is the same number of part time nutritionists as full time nutritionists in Europe (8 vs. 8). In North America, 87.5% of the zoos that answered our survey have full time nutritionists. Hopefully these numbers will increase in the near future, as there is the need to carry out a great number of studies in this field to improve the captive management and well being of the animals in our care.

*Advantages for the institution:*
Although at the beginning the best initial approach may concentrate on the financial aspects, one advantage for the institution should still be to improve the well being of the animal collection in general, by providing adequate diets for their animals. Beyond that, a nutritionist can help ensure that the diet formulated is the diet offered, and determine if the diet offered is the diet consumed. Increased knowledge regarding what and how much the animals eat can allow for better control of expenses in relation to the food item budget. A nutritionist could also provide the expertise to allow for exchanges among food items that may be similar in nutrient content but more affordable. And finally, a nutritionist could contribute valuable information when special animal problems arise (in coordination with keepers, curators, veterinarians, etc.). Improved nutritional status of animals ultimately leads to better health of the animals, potentially minimizing veterinary care and associated costs as well.

**STEP 2**

### Building the Foundation

Before doing anything, it is important to become familiar with the institution's policies: their goals, their organisational structure, how things work in each area, and all of the aspects associated with diet preparation and distribution. It is also basic to listen to staff opinions and experiences. Some changes may have been tried previously, and did not work. Long-time keepers can provide this historical perspective. From this, one can get an idea of what is working well, what can work better with a minor alteration, and what should be changed.

To start, a person can begin working part time on nutrition issues while filling another role at the zoo. As the nutrition aspect of that person's job becomes more important, a nutrition service can be developed and with it the person's full time position.

There are a few prerequisites to develop a nutrition service which begin at a very basic level: a person (more or less qualified), willing to work and learn, with lots of energy, enthusiasm, and patience, and a salary or other financial aid for that person. There are a few other items that would assist the endeavour immensely: tables of requirements and nutrient compositions of foods, a weighing scale and a computer.

**STEP 3**

### Developing the Service

Once the initial investigation process is complete and the foundation has been set, one has some basic skills and knowledge to define the framework and start working. Diet evaluation can be left until later and may not fit into the first steps. If the basic skills are lacking, it is worthless to design well-balanced diets because they will not be utilized.

There are three important aspects to work on: organisation, coordination, and understanding. In order to work on diets and nutrition, it is important to have good organisational skills. If this fails, new diets may fail as well. The commissary must be well organised and trained with respect to food handling and storage. Diet preparation also must be sanitary, detailed and dynamic. The skills of the nutritionist and those of the commissary staff should be established and well coordinated. And also, the schedules of the commissary and the different animal areas should be coordinated to ensure that the commissary actually is a service to the zoo. It also is important that everyone understands the importance of good nutrition, especially the keeper staff. They are often the ones that prepare and offer the diets, so their understanding is crucial for the success of the nutrition service.

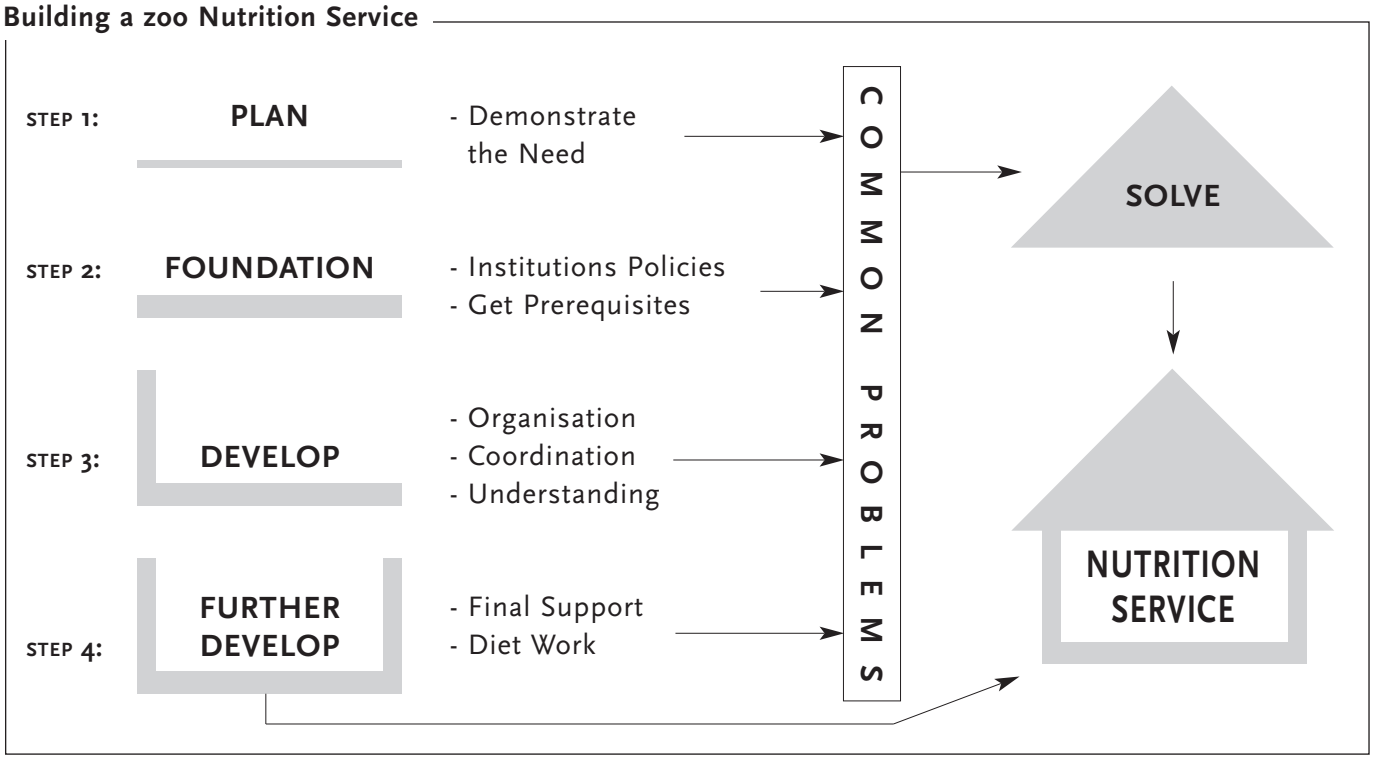
**STEP 4**

### Further Development

When developing a nutrition service, financial support is necessary. At the outset, this may represent a salary from the zoo. However, after a certain point, financial support over and above a salary becomes important. If that support does not come from within the zoo, external support can be sought. This can come from manufacturers, private donors, grant or endowment programmes, etc. and take the form of concrete financial support or the donation of equipment and/or services that may be of assistance to the nutritionist.

When starting to work on diets, one way is to begin working a section at a time and slowly incorporate more areas. Each area has its own special needs and problems, and diet formulation and preparation is sometimes quite different. Another approach is to handle the most pressing problems first, working on additional diets with time (Fidgett & Feistner 1997). Diets not only need to be formulated to meet the needs of the animals, but attention must be paid to ensure that the diets fit well into the commissary routine. So, it is important to design good and balanced diets, even special diets, but we must make sure they are not impossible diets. Finally, it is important to talk with everyone involved (keepers, vets, curators, etc.).

**Building a zoo Nutrition Service**






**Common Problems**

Although every institution is different, there may be some common problems that arise. Many long serving keepers may not have any experience of 'formal' nutrition or a nutritionist. They may not understand some of the changes and why they may be an important consideration for some species or individuals and not others. For these reasons, such staff need to be introduced to the concept of nutrition, educated and motivated as to the goals of a nutrition service and allowed time to adapt to the detailed and meticulous changes that may occur. We can make them aware of how good nutrition may help them to achieve their own goals.

If there is a lack of organisation, changes can be made more complicated or even impossible. In some cases, it is up to the nutritionist to be inventive and find new ways to organize and present information so that it is clear. Being able to track changes (what worked and what did not) is imperative to avoid wasting time and making the same mistake twice.

When animal nutrition is included as part of the curriculum at many universities, very little attention, if any, is paid to wildlife nutrition. For this reason, it is sometimes difficult to get help and it emphasizes the importance of collaborating with other institutions with similar resources. Keep in mind that other nutritionists who may have developed a nutrition service can be of great assistance and provide invaluable advice to someone just starting. Use all of the resources you have available.

The world of zoo nutrition exists on a gradient. From zoo nutrition services which have a staff of 10 people or more, formulate their own pelleted and gel diets, and have well equipped labs to analyze feeds, to a single volunteer working in their spare time to improve diets using tables with nutrient composition and a weighing scale. So, to conclude, when starting a nutrition service, zoos should focus on adapting a nutrition service to the resources and needs of their institution, not a perceived 'ideal'. If the foundation is firm and development takes place in a stepwise fashion, an effective nutrition service can be developed and flourish.

**References**

*Nutritional wisdom: adding the science to the art*
E.S. Dierenfeld (1996)
Zoo Biology 5: 447-448

*Non-invasive methods for nutritional research at the Jersey Wildlife Preservation Trust*
In: Proceedings of the Second Conference of the NAG and the AZA on Zoo and Wildlife Nutrition
A.L. Fidgett, A.T.C. Feistner (1997)
Fort Worth Zoo

*Nutrition and dietary evaluation in zoos*
O.T. Oftedal, M.E. Allen (1996)
In: Wild Mammals in Captivity
(eds. D.G. Kleiman, M.E. Allen, K.V. Thompson and S. Lumpkin)
University of Chicago Press, Chicago

## Third Meeting of the Nutritional Advisory Group

The NAG is holding its third conference on Zoo and Wildlife Nutrition in Columbus, Ohio, USA from Thursday, 14 October through Sunday, 17 October 1999 at the Columbus convention Center/Crown Plaza Hotel. Topic categories for the conference include but are not limited to:

- nutrition in small zoos,
- issues in primate nutrition,
- feed manufacturers and manufacturing issues,
- presentation of scientific papers, and
- miscellaneous topics associated with zoo and wildlife nutrition.

*Additional questions can be directed to Mike Maslanka or Edd Clemens:*

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fax: +1 402-472-6362

For further information you can also have a look on the NAG-homepage, http://www.arizonahealth.com/nag

**ATTENDANCE REGISTRATION FORM**

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OCTOBER 14-17, 1999 COLUMBUS, OHIO

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| ❑ 2. Registration at conference | $ 150 |
| ❑ 3. Single-day registration (session only) | $ 65 |
| ❑ 4. Student, full time (session only) | $ 40 |
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# First European Zoo Nutrition Meeting

## Conference programme

### INTRODUCTION

The application of nutritional science in the feeding of zoo animals
M. Allen

—

The formation of a Nutrition Advisory Group for the American Zoo and Aquarium Association
S. Crissey

—

Current zoo nutrition status in Europe
S. van Wees

### ORGANISM

The structure of the digestive systems and the feeding of mammals – a comparative approach
R. Hofmann

—

Mineral status in ruminants
W. Arnhold

—

Comparative anatomy and ecology of pregnancy and lactation in wild pigs
A. Macdonald

—

Structural flexibility of the intestine of Burmese python (*Python molurus*) in response to feeding
J.M. Starck

—

Examination of the digestibility of calcium, magnesium and phosphorus in captive born juvenile Galapagos giant tortoises
A. Liesegang

—

What can the nutritionist do with the results of the pathologist?
G.M. Dorrestein

—

Iron in the liver of animals in the zoo
G.M. Dorrestein

—

Digestive strategies in meat and fish eating birds
D. Houston

—

Carotenoid metabolism in ornamental fish
R. Obra

### BEHAVIOUR / FEEDING ECOLOGY

Nutritional management of ungulates in captivity – should we learn from natural seasonality of the vegetation?
M. Lechner-Doll

—

Regulation of food intake
T. Lutz

—

Variation in energy intake in Eurasian otters (*Lutra l. lutra*): effects of lactation and seasonal changes
A. Melissen

—

Diet selection and foraging ecology in Macropodidae (kangaroos, wallabies, and rat-kangaroos)
U. Ganslosser

—

A review of foraging niches in rodents and their implication for captive management
M. Jordan

### METHODS

Nutrition research in zoo animals
J.M. Hatt

—

Building a zoo nutrition service
H. Marques

—

Zootrition: Windows compatible dietary management software
W. Graffam

—

Modern information sources for the zoo animal nutritionist
J.D. Kuiper

### APPLICATIONS

Central kitchen and topics in animal nutrition research
C. Berndt

—

Food safety and quality assurance in the zoo
P.G.H. Bijker

—

Intensive culture of artemia as live food for aquarium fish and shrimp
J. Dhont

—

What makes a good egg? Nutritional constraints on egg production
A. Fidgett

—

Primate nutrition – towards an integrated approach
W. Kaumanns

—

Feeding fussy folivores: nutrition of gentle lemurs
A. Feistner

—

Feeding behaviour in two groups of black-and-white ruffed lemurs (*Varecia v. variegata*)
C. Schwitzer

—

Diet composition and digestibility in captive black-and-white ruffed lemurs (*Varecia v. variegata*)
S. Lovric

# First European Zoo Nutrition Meeting

## Conference programme

Diet composition and digestibility in captive emperor tamarins (*Saguinus imperator subgrisecens*)
M.I. Bieleveld

—

Effects of wheat in callitrichid diet
M.A. Gore

—

Effects of dietary changes on the behaviour and fecal consistency of three captive eastern lowland gorillas
T. Savini

—

Diet assimilation and plasma nutrient concentration in three species of captive pteroid bats
E.S. Dierenfeld

—

Nutrient intake of 1-4 week old suckling kittens (*Felis catus*): A model for artificial rearing of young Felidae
S. Wamberg

—

Okapi (*Okapia johnstoni*) feeding in eight European zoos
J. Kanselaar

—

Recommendation for feeding okapi for the EEP and SSP
S. Crissey

—

Supplementing the diet of captive giraffe (*Giraffa camelopardalis*) with linseed extraction chips
M. Clauss

—

Feeding babirusa (*Babyrousa babyrussa*) in captivity
K. Leus

—

Some diet related problems seen in birds
N. Schoemaker

—

Nutrition of crowned pigeons in captivity and in the wild
M. Damen

—

Experiences with the hand feeding of the pheasant pigeon (*Otidiphaps n. nobilis*) squabs at the Prague Zoo
P. Hajkova

—

The influence of the hand feeding formula on the occurrence of health problems in baby parrots
G. Werquin

—

Transferring birds to pellet feeding
P. Ghysels

—

Aspects of feeding reptiles in zoos
P. Zwart

—

The clinical experience with salmon calcitonin in the treatment of fibrous osteodystrophy in a green iguana (*Iguana iguana*)
P. Hajkova

—

Dietary husbandry of commonly exhibited terrestrial invertebrates
E.M. Spevac

### POSTERS

Feed intake and diet digestibility of captive red pandas (*Ailurus fulgens*) at the Toronto Zoo
J. Atkinson

—

Digestibility studies with captive African elephants (*Loxodonta africana*)
J. Atkinson

—

Some aspects of compulsory feeding of reptiles
I.V. Belyakov

—

The use of Lactobacilli from the crop in hand-rearing of pigeons
P.G.H. Bijker

—

Effect of the dietary calcium and phosphorus levels on the metabolic balance of some micro- and some macro-elements in one-humped camels (*Camelus dromedarius*)
J. Böhm

—

The nutrition of Old World fruit bats (Megachiroptera) in captivity
A. Feistner

—

Nutrition research on New World monkeys at Jersey Zoo
A. Feistner

—

Feeding enrichment: a way of stimulating natural behaviour of captive bears?
P.A. Grandia

—

Why do elephants eat soil?
D. Houston

—

Vitamin C-activity in Guinea pig feed
D. Isler

—

An approach towards more specific diets for tropical bear species – a puzzle with a lot of missing elements
L. Kolter

—

Energy and apparent metabolizable energy intake of captive felids on a raw meat-based diet and a canned diet
K.A. Slifka

—

Growth of captive harbour seal (*Phoca vitulina*) pups in relation to the fat content of the milk
M. Ticheler

—

Calcium balance at various calcium intakes in the Drakensberg crag lizard (*Pseudocordylus m. melanotus*)
S.T. van der Wardt

—

Diet composition of a captive colony of woolly monkeys (*Lagothrix lagotricha*)
N.M.C. Witteveen

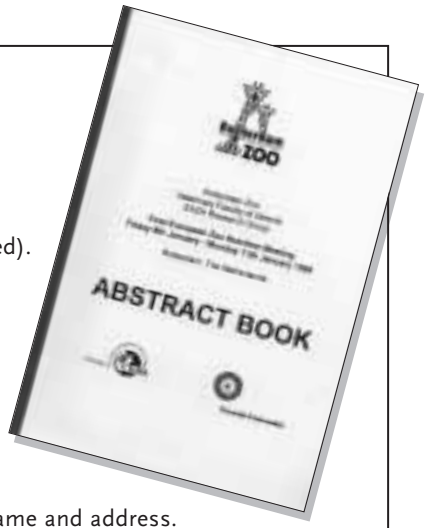
# Abstracts & Proceedings

**First European Zoo Nutrition Meeting**

Friday 8th January /
Monday 11th January 1999
Rotterdam, The Netherlands

*The First European Zoo Nutrition Meeting was held in Rotterdam, The Netherlands. This conference was supported by the EAZA Research Group, The Veterinary Faculty of Utrecht University and Rotterdam Zoo. Rotterdam Zoo extended hospitality to the 184 participants from 29 countries. A total of 61 contributions (45 talks and 16 posters) were presented.*

Universiteit Utrecht




**Abstracts**

The abstract book contains short summaries on all the topics mentioned in the Conference Programme (pp. 18-19).
The abstracts can also be viewed at http://nutrition.cabweb.org/Feature.htm

A copy of the conference abstract book is available for Dfl.35.- [Dutch guilders] (p & p included). Those wishing to purchase a copy should transfer the amount of Dfl.35. [Dutch guilders] to:

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Please send also a copy of the transfer form by e-mail ( j.nijboer@rotterdamzoo.nl ) or by fax (+31 10 4431 414).

**Proceedings**

The main talks of the conference will be included in the conference proceedings to be published by the end of 1999.

The volume Zoo Animal Nutrition (ed. J. Nijboer, J.M. Hatt, *et al.*) is based on contributions to the First European Zoo Nutrition Meeting and covers all major subjects needed to properly feed zoo animals. Subjects range from functional morphology of digestive systems to behavioural ecology of feeding; from behavioural implications of food presentation to mineral status, and from lactation and egg production to pathological aspects. Amongst the taxa included were fish, snakes, tortoises, several groups of birds, macropod marsupials, chiroptera, primates and ungulates.

The book draws upon the expertise of veterinarians, nutritionists, behavioural biologists, ecologists and zoo managers to provide an interdisciplinary overview of the field of zoo and wild animal nutrition. Thus it is of importance not only for captive propagation and zoo biology but also for a better understanding of the food-related dimensions of niche dynamics.

Those wishing to purchase the conference proceedings can use the order form below. Participants of the conference will get a copy for free.

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# Internet

## General Zoo and Animal Links

**EAZA**

*http://www.eaza.net*

EAZA has its own website since May 1999. Although this site is still under construction, it already provides overviews on members per country, EEPs, ESBs and TAGs. Links to websites of EAZA members will be included.

—

**AZA**

*http://www.aza.org*

The website of The American Zoo and Aquarium Association with information on their departments, their members, publications, schools, conferences and meetings among others.

—

**VetBase**

*http://www.vetinfo.demon.nl/links.htm*

Links to veterinary and animal sites.

—

**AVMA**

*http://www.avma.org*

The American Veterinary Medical Association (AVMA) welcomes you to NetVet & Electronic Zoo...
Your link to thousands of veterinary medical and animal-related online resources

—

**DierentuinNet**

*http://www.dierentuin.net*

On this Dutch homepage you can find links to the homepages of zoos all over the world. A good substitute for ZooNet (*http://www.mindspring.com/~zoonet*), the English variant which was recently removed from the Internet.

## Nutritional Related Links

**Zootrition**

*http://www.islandbusinessgroup.com/zootrition.htm*

Zootrition dietary management software was recently completed by the Wildlife Conservation Society. On this website you will find technical information, support and update information for Zootrition users. The order form of Zootrition can also be found at this website.

—

**NAG**

*http://www.arizonahealth.com/nag*

Homepage of the Nutrition Advisory Group of AZA with information about the Third NAG Conference to be held in October this year in Columbus, Ohio.

—

**CNS**

*http://www.cnsweb.org*

Website of the Comparative Nutrition Society with, among others, information about their biannual symposia, CNS News and how to join CNS.

—

**USDA / ARS**

*http://www.nal.usda.gov/fnic/foodcomp*

ARS is the primary in-house research wing for the US Department of Agriculture (USDA). Here you can locate information on a variety of national programmes including animal production, food safety, aquaculture, animal health and diseases, and animal well-being.

—

**Food Safety**

*http://www.extension.iastate.edu/foodsafety*

Website of the Iowa State University about the Food Safety Project. Information can be find on for instance HACCP (see page 24-25 of this EAZA Zoo Nutrition News).
For a better understanding of the steps you make to a safe kitchen, look at Ten Steps to a Safe Kitchen (*http://www.extension.iastate.edu/foodsafety/steps/steps.html*).

## Food manufacturers

| | |
|---|---|
| **Kaytee Animonda** | *http://www.kaytee.com* |
| **Mazuri** | *http://www.mazuri.com* |
| **PetAg** | *http://www.petag.com* |
| **Provimi** | *http://www.eridania-beghin-say.com/html/activ/provimi/provimi1.htm* |
| **Versele Laga** | *http://www.kingstown.demon.co.uk/versele.htm* |
| **Waltham** | *http://www.waltham.com* |

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# Central Kitchen

## Central animal nutrition kitchen in Emmen Zoo

by Cora Berndt,
Emmen Zoo, The Netherlands

*In Emmen Zoo, for years now, the employees work with a central animal-nutrition kitchen. It started as a simple system, but over the years it has grown to become a more professional, efficient, modern and centralized form of nutrition-management.*

The central kitchen is located at the back part of the zoo where all kinds of suppliers can easily access the park with their trucks. In this kitchen there is a team of four people working, consisting of a part time nutritionist, a section-head and two assistants. Two of them concentrate on the preparation of approximately 300 recipes for virtually all animals in the zoo. One team member is responsible for the washing-up. Cleaning dirty trays and buckets is done with a large automatic dishwasher. Another team member is occupied with orders, taking the food around the zoo by electro-car, supplementation of adequate and usable supplies for the next day and preparation of troughs with pellets.

Analysis of nutrition is done by the nutritionist using (among other things) the computer software 'Animal Nutritionist', with the intention of upgrading to 'Zootrition' soon. Specific health problems that are nutrition-related can only be dealt with sound administration. This means that when reviewing the nutrition, in order to identify where the problem lies, you need to know exactly what has been fed to the animals every day. If the recipes are stored in the computer and the food is prepared according to the recipes, this information is easy to obtain. Recipes that are not monitored will soon have lifes of their own and it will be almost impossible to trace what an animal has eaten every day for years, in instances of kidney or liver problems, diarrhoea or allergic reactions.

All data about the diets and recipes for the different species are stored in the computer. The recipes appear on computer screens in the kitchen, and with a press on a button the kitchen personnel can get the recipe of their choice on screen. On the screen appears: what species the recipe is for; the number of animals; what items they get to eat that day, the quantity for that day, whether it requires to be peeled or cut, how the food must be served, how much is fed per animal per day and other information as required. Once the food has been prepared it is saved in a cooler. At 7 a.m., the prepared food is taken out of the cooler and driven to the different departments by electro-car. At the departments, the keepers of each section serve the food to the animals and the dirty dishes from the previous day are taken back to the kitchen immediately.

A diet can be altered at any time if requested by the keeper or the veterinarian, but only in consultation with the nutritionist. When a change is requested as a once-only treat, a special 'playfood-commission' is the approach used. This commission consists of three animal caretakers and the zoo nutritionist.

The hazard of contamination can be a great risk. When hygiene is not observed and contamination occurs, there is a great risk that this contamination will spread throughout the zoo. Therefore hygiene is a top priority. It is maintained by strict separation of vegetarian and non-vegetarian products in preparing the diets, by strict instructions in handling, storage and routines and of course by thorough cleaning methods. Also, the kitchen is only accessible to kitchen personnel.

There are many benefits of a central kitchen. For example, the long-term saving on costs, by ordering adequate quantities of food. Kitchen work (chopping, peeling, weighing and thorough cleaning) is done by professional employees qualified in 'cooking', hygiene etc. Keepers can then use their qualifications and skills for more suitable tasks like research, enrichment, guided tours for visitors etc. It must be emphasized however, that keepers in Emmen Zoo still play an active part in making decisions on what their animals should eat.

Photo: Emmen Zoo

## Food safety and food quality assurance in the zoo

by Peer Bijker, Utrecht University, The Netherlands, Joeke Nijboer and Willem Schaftenaar, Rotterdam Zoo, The Netherlands

*Quality assurance in general, and in particular veterinary and zoo technical care, are nowadays an integral part of the policy of zoos. Modernisation and renovation of zoos is taking place rapidly. Nevertheless, and quite unfortunately, the importance of the production and preparation of safe food (as part of the quality) with regard to the health of the animals, as well as with regard to establishing good hygiene (image) through food quality assurance is sometimes underestimated. Large investments have been made towards keeping animals in ecologically acceptable settings. Not all zoos have invested in a good food quality system at the same level. In literature not much has been published on the safety of zoo food and on quality assurance systems.*

***What does safe food mean?***

Safe food is essential for keeping animals alive and to maintaining them in good condition.

In general the following types of food for zoo animals can be distinguished:

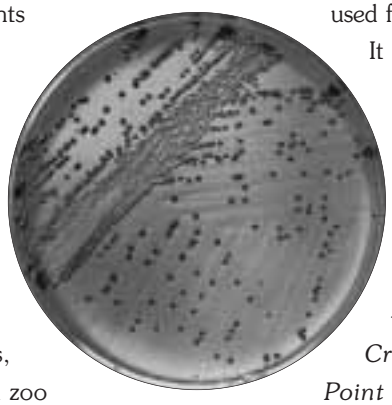
- Food of animal origin; such as carcasses of slaughtered animals, bones, meat, meat products, fish, eggs and live food
- Food of plant origin: such as fruits, vegetables, hay and leaves
- Drinking water

In all stages of food production and food preparation, contamination of the food can take place. This implies that all stages of the production line (from primary production on the farm to the final preparation of the food for zoo animals) must be controlled by means of a quality assurance system. This is what can be referred to as an Integrated Quality Assurance.

The following are potential hazards and causes of unsafe food:

- Classical agents such as *Bacillus anthracis*, Mycobacteria and Aujeszki virus
- Bacteria related to the intensive animal husbandry and the environment such as *Salmonella* sp., *Campylobacter*, *E. coli*, *Yersinia pseudotuberculosis*, *Clostridium botulinum*
- Human related bacteria such as *Shigella* and *Staphylococcus aureus*
- Parasites, such as *Taeniidae* and *Trichinella*
- Protozoa, such as *Toxoplasma*
- Other hazards, such as residues of therapeutics, vaccines and chemical contaminants

Intake of unsafe food can cause sickness of animals. Nowadays salmonellosis is one of the topics being discussed in health care of zoo animals. Already in the eighties, research in Rotterdam zoo performed by Utrecht University showed intensive Salmonella cycles: *Salmonella thyphimurium* phage type var. Copenh. ORS was isolated from zoo animals (lories), food (meat) and from the environment. Another concern is the risk of a zoonosis spreading form animals to keepers and the public. Outbreak of a severe zoonosis, caused by contact with zoo animals or their faeces should be prevented. In this respect an infection with verotoxinogenic *E. coli 0157* (haemorragic enteritis) can be mentioned. Cows can be carriers of these bacteria in their intestines without showing any clinical symptoms.



*Salmonella thyphimurium*

Modern zoo policy should include quality assurance systems concerning all aspects of zoo management. In our opinion zoos need to invest in food quality assurance systems for the following reasons:

- Animal health and welfare
- Modernisation and renovation of many zoos is taking place rapidly
- In most countries directives for the protection of the health of the personnel and the protection of the environment have been developed

***How to achieve safe food?***

Two quality and safety assurance systems are applicable:

- *ISO 9000*

  This system describes the processing of food. In the industry it has been used for certification purposes. It contains logistics, flow charts of the processing, and the organisation structure. Responsibilities and qualifications are also well documented.

- *The Hazard Analyses Critical Control Point (HACCP) concept*

  This system is mainly focussed on prevention of infection and/or contamination. It describes the safeguarding during production/ processing and/or preparation of a foodstuff. It contains hazard and risk identification procedures, evaluation standards, and determination of Critical Control Points (CCP's) and monitoring of it. Protocols for Good Hygienic Practices (GHP) have to be set up and implemented as a prerequisite of the HACCP system.

In the nineties, Rotterdam Zoo and Utrecht University started a student project to develop a food quality assurance system in the Zoo. The project was performed in collaboration with the Rotterdam Erasmus University in 1993 and the Agricultural University Wageningen in 1995.
Two manuals for food quality assurance were made. The set up of the project was as follows:

- Analysis of relevant reports concerning quality and safety assurance of food for zoo animals
- Formulation and description of food and hygiene related problems in zoos
- Extensive description of food processing in the zoo and production of flow charts
- Identification of the critical control points of food processing
- Set up of protocols for quality control, monitoring and hygienic practices
- Interviews with staff and personnel about the protocols
- Adjustment of the protocols
- Implementation of the protocols
- Evaluation and review of procedures and protocols

***What were the main problems related to the development and implemantation of the food quality assurance system in Rotterdam Zoo?***
It is very difficult to understand the risks of unsafe food for zoo animals. Few quantitative figures about risk identification and risk characterisation (estimation of the adverse effects likely to occur in a population) are available. Food quality assurance systems do not normally have the first priority of the staff and it is difficult to visualise the benefits. Another point of concern is that sometimes personnel is not highly motivated to implement systems including administration and self control aspects.

***What can be achieved by implementation of a food quality assurance system in a zoo?***
The implementation of a food quality assurance system will be able to:

- Change the attitude of zoo personnel towards better hygiene standards
- Lower the risk of infection of animals, personnel and public
- Improve the efficiency of food distribution by improving the logistic system
- Improve the quality of food

By adjusting and implementing simple procedures and by using the right equipment hygiene can be improved considerably at low costs.

## What can the nutritionist do with the results of the pathologist?

by Gerry M. Dorrestein,
Utrecht University, The Netherlands

*There is abundant evidence that diet and health are intimately connected. A disease may be the primary consequence of nutritional deficiencies or excesses, or a deficiency may be complicated by opportunistic microbial invaders that take advantage of the host's decreased resistance. Diseases in many cases will lead to mortality, but even without a specific disease, all animals will die one day.*

It is an essential part of zoo management to have a necropsy done on every animal that dies. The main reason is obvious. Zoo personnel, including the veterinarian, need to know why the animal died. Questions normally asked are: why did the animal die, is there an infectious problem, is there a zoonosis, why was the therapy not effective, how can we prevent the problem the next time?

However, much more information can be collected from a dead animal. Every dead animal is a sample from a collection and will provide information about the quality of preventive medicine (e.g. parasites), about the presence of carrier status of certain infectious diseases (e.g. mycobacteriose, salmonellosis, campylobacteriosis, chlamydiosis), but also about possible nutritional problems (e.g. hypovitaminosis A, $D_3$, C, E; hypervitaminosis A, $D_3$ or Se, Ca deficiency, iron/copper storage, arteriosclerosis, fatty liver).

Many of these nutritional problems lead to pathological changes of tissues recognisable by the pathologist. Results from these findings might lead the nutritionist to re-asses the diet, or further analysis of the organs may be required to confirm a diagnosis. However, nutritional problems are not always directly reflected in pathological changes. Certain postmortem findings (e.g. chronic aspergillosis, candidiasis) are often correlated to a chronic deficient diet resulting in an impaired immune system.

It is even more difficult when non-specific disease patterns, all including wasting, are initiated by an inadequate diet, or related to insufficient energy or inadequate protein intake. It is more easy when an animal keeps eating till it dies than when an animal stops eating and dies subsequently. You can believe it or not, but we have seen animals dying of starvation, because it was not clear which shift of keepers was supposed to feed the animals.

With all the available knowledge about nutrition, there are still many different species that are difficult to maintain in an optimal condition within captivity. This may be due in part, to the lack of detailed knowledge about nutritional requirements, or may depend more on the 'structure' of the food. Comparative pathology permits abnormal findings to be extrapolated from other, better-known species. In this way, an indication of the cause of the problem can be suggested on many occasions and the nutritionist can adjust the diet composition to provide a positive or negative confirmation of the pathologists' findings.

## Some diet related problems seen in birds

by Nico J. Schoemaker, Utrecht University, The Netherlands

Birds are traditionally classified into granivores, carnivores, piscivores and fructivores. Most typical granivores however, should be classified as omnivores. In addition to seeds, psittacines for example have been reported to eat the following products in the wild: insects and their larvae, flowers, fruits, leaves, tree bark, and clay.

Because seeds are relatively cheap, and both easy to transport and store, they have often become the sole food source for many bird species. Many retailers have falsely sold these diets as being complete. Seeds are limiting in the following nutrients: Vitamin A, $B_{12}$, $D_3$, K, riboflavin, panthothenic acid, niacin, biotin, iodine, iron, copper, manganese, selenium, sodium, calcium, zinc, lysine and methionine.

No exact nutrition recommendations are available for non-poultry avian species, although the recent work of the nutrition and management committee of the Association of Avian Veterinarians has led to a list of recommendations for psittacines and passerines. This list is currently under review by the Association of American Feed Control Officials (AAFCO).

In the last decade a tendency to shift from seed-based diets to more complete diets has taken place. First cod-liver oil was applied to seed hulls with resultantly less severe cases of hypovitaminosis A. Food dyes were applied to such seeds to distinguish them from non-supplemented seeds. Then veterinarians started to advise owners to add table scraps to bird diets. This also resulted in fewer deficiencies, although a balanced diet was still not achieved. European breeders in particular started to use eggfood as a supplement. This eggfood contained both vitamins and minerals, as well as animal derived amino acids and if the birds ate sufficient amounts, deficiencies would be minimal. Unfortunately many birds still preferred seeds and therefore deficiencies persisted. Only commercial, extruded diets rule out the possibility of bird self-selection. Many owners claim that their birds will not eat these diets. Yet, with a motivated owner and adequate support from their avian veterinarian, every bird can be switched to feeding on an extruded diet.

### Common problems

**Vitamin A** – Hypovitaminosis A is the most common deficiency seen in parrots. Vitamin A is necessary for the differentiation of the epithelium and a deficiency will lead to a metaplasia (thickening) of the mucus membranes. Vitamin A, but especially its precursor ß-carotene, has an immune stimulating effect. The combination of metaplasia and immune deficiency can easily lead to chronic rhinitis and respiratory fungal infections. ß-Carotene is only converted to vitamin A when required, therefore giving birds a ß-carotene source like spirulina, a blue/green algae, can prevent *hypo*vitaminosis A without the risk of causing *hyper*-vitaminosis A, which can occur when supplementing with a vitamin A source. Hypervitaminosis A has recently become a greater problem in the USA since the introduction of pelleted diets. Owners continue to supplement these already balanced diets resulting in vitamin overdoses. Symptoms of hypervitaminosis A are fairly similar to those of hypovitaminosis A.

**Calcium, Phosphorus and Vitamin D** – Seed-based diets are very low in calcium and high in phosphorus. The phosphorus is mostly tied up in a chemical complex with phytate, making this element relatively unavailable. Phytate also binds calcium causing the same problem of bioavailability and a calcium source like grit is necessary to prevent problems. Calcium is required not only for the formation of bones and eggshell, but is also necessary for blood clotting, nerve conduction, secretion of glands and muscle contractions. Vitamin D plays an important role in the uptake of calcium, which mostly takes place in the first part of the duodenum. Vitamin $D_3$, of animal origin, is 20 times more potent than vitamin $D_2$, which is of plant origin. Vitamin $D_3$ can be synthesized in the skin under the influence of UV-light.

Diseases caused by deficiencies of calcium and/or vitamin $D_3$ are secondary nutritional hyperparathyroidism, rickets, osteomalacia, and a hypocalcaemia syndrome seen in African grey parrots. Secondary nutritional hyperparathyroidism is a common problem seen in birds. A calcium and vitamin $D_3$ deficiency will lead to stimulation of the parathyroid gland. During growth this will lead to poorly calcified bones that result in bent bones and greenstick fractures. Many of these birds will be presented to their veterinarians when the worst stage is over and the bones are already calcified once more (see X-ray photo). Many breeders have found that using commercially available hand feeding diets have diminished the frequency of this condition among their birds dramatically.

Osteomalacia is seen in egg-laying hens. The need for calcium is so high they cannot compensate for this loss from their own stores. These birds will start laying thin shelled eggs, develop egg binding and pathological fractures

due to the thin bone cortex can been seen on radiographs.
In African grey and timneh parrots a specific syndrome is known to cause tetanic convulsions due to a severe hypocalcaemia. No abnormalities of the skeleton are seen on radiographs. Measuring calcium plasma levels confirms the diagnosis. These can be as low as 0.75 mmol/l (reference 2.1 - 2.6 mmol/l). The best treatment is to supplement with both calcium and vitamin $D_3$.

Over-supplementation of the diet with vitamin $D_3$ can cause an intoxication of which the initial symptoms are polyuria and polydipsia. Cockatiels and macaws are noted as being particularly sensitive to hypervitaminosis $D_3$.

**Iron** – Iron storage disease is a common disease among mynah birds and toucans, but many other fruit eating birds are susceptible. The precise etiology of iron storage disease in mynah birds and toucans is not fully understood. An increased uptake of dietary iron is considered a probable cause. Vitamin C is known to reduce $Fe^{3+}$ into $Fe^{2+}$ and efficiency of $Fe^{2+}$ uptake in the gut is known to vary, resulting in a higher iron-load in some species. Toucans usually do not show any symptoms prior to death, while mynah birds show respiratory distress due to an ascites (fluid filled abdomen), and possible cardiac failure. Diagnosis can only be confirmed by demonstration of iron in liver tissue with a Persian Blue stain. A low iron (maximum of 65 mg iron/kg diet) and low vitamin C diet are recommended for treatment. The use of the chelating agent deferoximine and the addition of tannin to the drinking water has also been suggested.

**Iodine** – A iodine deficiency leading to goiter is most commonly seen in budgerigars that are fed an all-seed diet containing mainly millet seeds. Common symptoms are regurgitation and respiratory distress caused by the enlarged thyroid gland. This gland cannot be palpated since it is totally covered by the sternum. Millet seed, the seed most commonly fed to budgerigars, is both low in iron and protein. A low protein diet is considered goitrogenic. Treatment consists of adding iodine to the drinking water and switching the bird onto a complete diet.

**Obesity** – Although many people do not consider obesity a disease, it must be considered a problem. Galahs, amazon parrots and budgerigars are particularly prone to obesity, which can lead to hepatolipidosis and lipoma. Restriction of the amount of food provided for these species is recommended. If already overweight, it is advised these birds must lose weight, but since anorexia can aggravate the hepatolipidosis, it is advised that the weight loss be gradual.

**Multi-deficiencies** – Birds often do not have a deficiency of just one nutrient. However multi-deficiency does not have specific symptoms. Reproductive disorders, poor feather quality and decreased immunity leading to secondary infections can be considered to be at least partially due to multi-deficiencies in the diet. It is therefore important to recognise that these patients should receive nutritional support alongside any treatment of their specific problem.

*Many of the problems seen in birds are at least partially due to either deficiencies or excesses of nutrients in the diet. Knowledge of the nutrient requirements for birds, both increasing awareness of existing information and the scientific pursuit of more detailed requirements, is mandatory to reduce their incidence. Formulated diets have had some success and advising the use of commercial, extruded diets for feeding birds may be the way to prevent their occurrence in the future.*

*Radiograph of a young amazon with severe bending of the tarsi and pelvis. Old fractures of the humerus, radius and ulna due to nutritional hyperparathyroidism are also visible.*

Photo: N. Schoemaker

**Suggested further reading**

Chapters on *Nutrition* (R.N. Brue) and *Malnutrition* (P. Macwirther)
In: Avian Medicine: principles and application (eds. B.W. Ritchie, G. J. Harrison and L.R. Harrison)
Lake Worth: Wingers Publishing, 1994

Chapters on *Nutrition* (T.E. Roudybush) and *Nutritional Disorders* (J.M. Smith and T. E. Roudybush)
In: Avian Medicin and Surgery (eds. R.B. Altman, S.L. Clubb, G.M. Dorrestein and K. Quesenberry)
Philadelphia: WB Saunders, 1997

*Clinical nutrition of companion birds*
S. Donoghue and S. Stahl (1997)
Journal of Avian Medicine and Surgery 11(4): 228-246

*Formulated diets versus seed mixtures for psittacines*
D.E. Ullrey, M.E. Allen and D.J. Baer (1991)
Journal of Nutrition (121): s193-205

# Pellet Bird Feeding

## Transferring birds to pellet feeding

by P. Ghysels, Versele Laga, Deinze, Belgium

*In the last ten years various companies have produced bird foods in the form of extruded pellets. Many prominent bird breeders and zoos have already made the transition to pellet feeding, and have obtained good results. In order to prevent frequently recurring nutritional conditions such as hypocalcemia, hypovitaminosis, obesity, gout, etc. specialists recommend transferring birds to an extruded diet. However, conversion difficulties are a major barrier to using pellets by the bird keepers. Indeed there are a few requirements to make the conversion successful: professional advice, motivation, perseverance of the keeper, a good conversion method and the use of some practical tips.*

### Professional advice

A qualified professional will emphasise the nutritional advantages of pellets and the favourable results obtained when such diets are given to farm animals, zoo animals and pets. In all these species doubt and uncertainty marked the initial phase. Results of zoo professionals and experienced breeders will be very important in convincing the bird keepers to commence conversion. The manufacturer can be of assistance, using his experience to answer questions and to give individual tips.

### Motivation

A bird keeper who is not entirely convinced of the advantages of a complete bird food will automatically have more problems in conversion. Conservative bird keepers who have been achieving 'good' results prove to be more difficult to motivate. Bird keepers who, over the years, have had their share of problems with poor breeding results or frequent deaths will be converted more easily.

### Perseverance

The perseverance of the bird keepers will determine the success of conversion. In most cases the birds will not readily accept the new diet and will have to be coaxed a little. In this case food rationing may be employed. During the conversion period, the bird keeper will have to be punctual in his ways. Because food is being rationed, it is important to measure the rations accurately and serve the meals at regular intervals. Even though some birds appear to become accustomed to the new food after just 2 to 3 weeks, the conversion can only be considered complete after a 6 to 8 week period.

### Conversion methods

The **portion method** is fast and safe for the conversion of all healthy birds, especially in the case of larger species. The pellets are mixed with the current diet. The total quantity of food is limited to the normal daily ration. Pellets and seeds are carefully mixed. The percentage of pellets will be gradually increased. Tests showed that there were great differences, between individual birds and between different species, in the conversion time.

The **combination method** is particularly suitable for safely converting smaller bird species in a period of 5 to 6 weeks. Because smaller species eat only a few grams per day, it is practically impossible to weigh out an exact portion for 1 day. Mix in a reclosable box 75% of the current diet with 25% pellets. Make up enough food for about 1 month. After each feeding, the box is refilled only with pellets. In this way the percentage pellets in the mix will gradually increase. The mixture is served every 3 days in portions containing a 3-day ration. The food is only refreshed when the eating tray is practically empty. Tests demonstrate that conversion of small species with this method is possible in a short period of time, but considering the loss of condition, it is not recommended. The birds must of course be healthy before conversion is undertaken.

# Pellet Bird Feeding

| Alternate Day Method | | | | | | | |
|---|---|---|---|---|---|---|---|
| D1 | pellets | D10 | **seeds** | D19 | pellets | D28 | **seeds** |
| D2 | **seeds** | D11 | pellets | D20 | pellets | D29 | pellets |
| D3 | pellets | D12 | pellets | D21 | pellets | D30 | pellets |
| D4 | **seeds** | D13 | pellets | D22 | pellets | D31 | pellets |
| D5 | pellets | D14 | **seeds** | D23 | **seeds** | D32 | pellets |
| D6 | pellets | D15 | pellets | D24 | pellets | D33 | pellets |
| D7 | **seeds** | D16 | pellets | D25 | pellets | D34 | **seeds** |
| D8 | pellets | D17 | pellets | D26 | pellets | D35 | pellets |
| D9 | pellets | D18 | **seeds** | D27 | pellets | D... | pellets |

The **free choice method** is the simplest. Contrary to other methods, the total amount of food is not limited. In this method, birds are given the opportunity to select their familiar food. So conversion of seed eating birds takes a much longer time. However an exception can be made for fruit eating birds, where the free choice method is probably the most satisfying.

With the **alternate day method** the birds are offered either pellets or seeds during the whole day. The number of days during which pellets are fed, is increased gradually, always followed by one day seed feeding. This day of seed feeding allows the bird to regain some energy in case they have not eaten enough during the pellet days.

This method has been used very successful in the conversion of all 1500 parrots in the NOP Bird Rescue Centre in Eindhoven (The Netherlands). Due to the enormous number of birds that had to be converted, an individual approach of the birds was not possible and would cause too much stress. The efficiency of this method was first checked during a preliminary test with three groups of 26 birds (African greys, amazones, small cockatoos), comparing different conversion methods.

The evaluation parameter was weight loss. Birds that lost more than 15% weight were taken out of the test. Weight loss of the birds was monitored, as was the number of days it took to for bird weight to stabilise once more. A bird was considered stabilised if he regained his initial weight and kept this weight for at least three days. The Alternate Day method was chosen ultimately because none of the birds were eliminated from the trial, making the method safe for converting large groups of birds where individual monitoring of the birds is not possible.

**Some practical tips**

- Convert only healthy birds. If possible weigh the birds regularly and make a record of their nutritional situation.
- Convert the birds individually or per couple. In a group, there is a chance that the strongest birds eat all the familiar food. The Alternate Day method is an exception to this rule.
- Young birds will adapt more easily to a new diet than older birds. Birds fed with a more varied diet will also more readily accept a new kind of food.
- Freshly bought birds must first get used to their new surroundings, habitat and feeding trays before starting the conversion.
- To make the pellets more attractive, a sweetening agent, for example fruit juice, honey or syrup, can be added. But make sure the birds are already accustomed to this taste by adding it to their current food.
- By installing a tray filled with pellets close to their favourite sitting place, the birds can inspect the pellets at leisure.
- By using a new tray for the current diet which is less accessible and using the old shallow tray for the pellets, the birds will be converted more rapidly.
- Offering the pellets throughout the day, and the current seed mixture only for a few hours will hasten the conversion process. Seeds should then be presented in the evening, so that the bird is hungry enough during the day to try out the pellets.
- In the period between hatching and weaning of the young, the parent birds will especially look for 'soft' food. Pellets become soft in the crop of the parent birds and can be easily fed to the young. So conversion can be swifter if applied in the breeding period.
- At weaning time, the young only learn to peel seeds gradually. When these young birds are presented with pellets at weaning age, they will eat them to quickly satisfy their hunger.
- 'It is good to set an example' is also true for birds. If you already have birds that eat the pellets, you can place these in the neighbourhood of those who still have to be converted.
- Birds that are eating the pellets should receive the pellets and the seeds in separate eating trays. In this way you can limit wastage brought about by searching for familiar food.

# Feeding Enrichment

## A way of stimulating natural behaviour of captive bears?

by Petra A. Grandia, International Bear Foundation, Rhenen, The Netherlands

*Zoo nutrition has many aspects e.g. researching the nutritional requirements of exotics, refining diet formulations, maintaining hygiene and improving the quality of food items offered, all topics covered by other authors in this special edition of EAZA News. There is however, at least one other very important consideration – how the food is packaged or presented to the animals. This is a topic particularly relevant in zoos, given that many techniques to enrich the lives and environments of captive animals are based on providing an unpredictable food source designed to stimulate the mind and senses, thereby producing more naturalistic foraging behaviour. Yet these techniques must be balanced with providing adequate nutrition. In the following article Petra Grandia describes how the International Bear Foundation attempts to achieve this balance.*

The International Bear Foundation (IBF) was founded in 1993 on the initiative of Ouwehands Zoo. The Bear Forest was built to give mistreated bears a shelter and improve their quality of life. It is a forested enclosure of 2 hectares, in which 12 brown bears (*Ursus arctos*) and six wolves (*Canis lupus*) are housed. The bears are former 'dancing' bears, circus bears, bears from war regions and surplus bears from other zoos. The enclosure is developed as a semi-natural, stimulating environment, in which the bears can behave as naturally as is possible in captivity. The bears live on a natural substrate, vegetation is available, there is a pond with flowing water and there are artificial dens. The Bear Forest also has an important educational value and contributes to scientific research on brown bears and wolves.

### Reasons for enrichment

Although the Bear Forest was designed as a stimulating environment, some of the bears show abnormal behaviour, for instance stereotypic behaviour or lack of activity. These behaviours might indicate decreased well-being of these bears, possibly caused by a lack of relevant stimuli. It is known that the welfare of bears improves when they are housed in a complex (unpredictable) environment, in which they are challenged on a cognitive level (Forthman *et al.* 1992, Hediger 1950, Mettke 1995). The Bear Forest is already adapted to satisfy many of these needs (see introduction), however in order to improve the well-being of the bears and to encourage them to display more natural behaviours, we are using another enrichment strategy which is entirely focused on their foraging behaviour (i.e. feeding enrichment).

Feeding enrichment is likely to be successful in stimulating natural behaviour, because of the strong internal motivation of animals to collect food. Different experiments demonstrate that captive animals like to 'work' to collect their food (Mench 1998, Kreger *et al.* 1998). This applies especially to animals with an opportunistic food range like bears, because these animals already explore their environment regularly (Kreger *et al.* 1998). By developing a feeding enrichment programme, the bears will be challenged on a cognitive level, their senses will be stimulated, their explorative and manipulative behaviour will be stimulated and the amount of abnormal behaviour (stereotypic behaviour) will hopefully be reduced (Carlstead *et al.* 1991, Forthman *et al.* 1992). The definition of feeding enrichment we use is: "Offering food to the bears in an interesting, challenging and natural way". The feeding enrichment programme in the Bear Forest was designed on the basis of the bears' natural ecology.

### Nature

Brown bears have adapted to different habitats: they live in seacoast areas as well as in the high mountains. Bears are omnivorous animals. However, the diet of the brown bear consists of 80% vegetation and 20% meat, insects, and fruits (Almack 1986, Atwell 1977, Clevenger *et al.* 1992, Elgmork and Kaasa 1992). Brown bears are opportunistic feeders, they eat seasonal foods which contain the largest amount of energy (fat or proteins) and a relatively small amount of raw fibre (young leaves, flowers, berries) (Clevenger *et al.* 1992, Elgmork and Kaasa 1992). The bears actively select these food items, and these are often found at different locations within their habitat. This is the reason why the bears spend approximately 50% of their active time foraging. In winter, there is not much food available for the bears, and they adapt to this situation by means of dormancy (from half October until half April). A global survey of the food items which bears eat in nature throughout the year (Almack 1986, Atwell *et al.* 1977, Clevenger *et al.* 1992, Elgmork and Kaasa 1992):

# Feeding Enrichment

| | |
|---|---|
| Early spring: | Meat (often carrion, sometimes deer calves) |
| Late spring: | Young grass and herbaceous plants, roots and tubers |
| Summer: | Berries, tubers, roots and insects |
| Autumn: | Berries, nuts and other fruits |
| Winter: | During dormancy the bears seldom eat anything |

**Enrichment**

The feeding enrichment programme in the Bear Forest started by changing to a seasonal diet. Until February of this year, the bears were always fed the same food items (dog pellets, vegetables, fruit, bread and occasionally fish and nuts) throughout the year, and only the quantities differed between seasons. In February we converted to a more natural diet, changing the food items and quantities offered. At that point the bears received only meat and hay. In April the diet was changed to meat and carrots, beetroots, and different kinds of cabbage. We plan to feed the bears green vegetation (grasses, herbs) as soon as those items are available in sufficient quantities.

The second part of the feeding enrichment programme consists of some experiments. We want to analyse the impact that different feeding times and feeding places have on the behaviour of the bears, but also what happens when food items require more effort and manipulation before they can eaten. Until now the feeding times were very regular (and thus predictable). The food was always deposited on the same spots in the Bear Forest (in front of the bears), and the bears gathered at certain spots during feeding time. A few of the bears showed unnatural feeding behaviour, like begging. By changing feeding times, feeding places and manipulation required of the food items to a more natural situation, we hope to observe more natural behaviour patterns in the brown bears.

**Observations**

In April we started the first experiment, in which the place of feeding was varied. We carried out observations for 10 consecutive days, in which the feeding took place on the same spots in front of the dens for five days (A), and was spread through the forest on the other 5 days (B). The different A- and B-days were randomly distributed over the experimental period. The behaviour of the 13 bears was observed every 10 minutes from 8:00 a.m. until 17:30 p.m., with a short break every two hours. This resulted in 80 hours of observations, and 480 data points. These data are currently being processed.

At present we are designing a second experiment, in which we will vary the feeding times. We will change the feeding times towards a more natural situation: different times each day and a higher frequency of feeding periods. This experiment will most probably take place in May 1999.


**References**

*Grizzly bear habitat use, food habits and movements in the Selkirk mountains, northern Idaho*
J.A. Almack (1986)
In: Proceedings Grizzly Bear Habitat Symposium (eds. G.P. Contreras and K. Evans)
Intermountain Research Station

*Brown bear summer use of alpine habitat on the Kodiak National Wildlife Refuge*
G.C. Atwell, D.L. Boone, J. Gustafson and V.D. Berns (1977)
In: Bears, their biology and management (eds. C.J. Martinka and K.L. McArthur)
Fourth International Conference on Bear Research and Management, Kalispell

*Environmental enrichment for zoo bears*
K. Carlstead, J. Seidensticker and R. Baldwin (1991)
Zoo Biology 10: 3-16

*Food habits of brown bears (Ursus arctos) in the Cantabrian Mountains, Spain*
A.P. Clevenger, F.J. Purroy and M.R. Pelton (1992)
Journal of Mammology 73 (2): 415-421

*Food habits and foraging of the brown bear Ursus arctos in central south Norway*
K. Elgmork and J. Kaasa (1992)
Ecography 15 (1): 101-110

*Effects of feeding enrichment on behavior of three species of captive bears*
D.L. Forthman, S.D. Elder, R. Bakeman, T.W. Kurkowski, C.C. Noble and S.W. Winslow (1992)
Zoo Biology 11: 187-195

*Wild Animals in Captivity – An Outline of the Biology of Zoological Gardens*
H. Hediger (1950)
Dover Publications, New York

*Beren in Zagreb*
D. Huber (1995)
In: Large bear enclosures – An international workshop on captive bear management (ed. P. Koene - 1996)
International Bear Foundation, Rhenen

*Context, ethics and environmental enrichment in zoos and aquariums*
M.D. Kreger, M. Hutchins and N. Fascione (1998)
In: Second Nature; Environmental enrichment for captive animals (eds. D.J. Sheperdson, J.D. Mellen and M. Hutchins)
Smithsonian Institution Press, Washington/London

*Environmental enrichment and the importance of exploratory behavior*
J.A. Mench (1998)
In: Second Nature; Environmental enrichment for captive animals (eds. D.J. Sheperdson, J.D. Mellen and M. Hutchins)
Smithsonian Institution Press, Washington/London

*Ecology and environmental enrichment – The example of parrots*
C. Mettke (1995)
In: Research and captive propagation (eds. U. Ganslosser, J.K. Hodges and W. Kaumanns)
Filander Verlag, Fürth

# Closing Remarks

At the close of the First European Zoo Nutrition Meeting a roundtable discussion was held to discuss the future of zoo animal nutrition within Europe. What follows is a summary of the most relevant remarks:

Some years ago within the EAZA Research Group, a sub-group on nutrition was initiated but later abandoned. The EAZA Research Group committee now develops and instigates research based on needs and so, while not a direct interface between zoos and science, it supports initiatives that will lead to the coordination of zoo animal nutrition within Europe.

Relevant European nutrition groups which are more or less involved in zoo animal nutrition are the Nutrition Society (UK), The European Society of Veterinary and Comparative Nutrition and the Institute fur Zoo Biology and Wildlife Research (Berlin). The Fachgruppe Zootierernahrung im Zoo (Germany), the French Zoo Nutrition Group (Nutri-Zoo) and the Pet Bird Nutrition Group (Germany) also have regularly meetings.

It was suggested by some that we should not form a completely new European Zoo Animal Nutrition Group but that individuals can, if they fulfil the criteria, join the NAG (of AZA) or CNS (Comparative Nutrition Society) and receive for example NAGNOTES (an e-mail newsgroup of NAG). The NAG zoo nutrition group tends to deal with practical day-to-day issues while CNS takes a more theoretical and scientific approach to comparative animal nutrition. Presently both groups have biannual conferences that alternate with each other and CNS has plans to organise a conference in Europe in 2004.

Joeke Nijboer agreed to gather information relating to aspects of zoo nutrition from all the different European countries. Joeke will be acting as a facilitator, collating and distributing information, helping to prevent duplication of work and making more efficient use of relevant material. His function will not be to act as an advisor for every zoo nutrition query.

In return for this commitment, I would ask that everyone involved in zoo animal nutrition sends me a copy of any zoo animal nutrition projects that are being or have been undertaken – a brief paragraph is sufficient. Once everybody has replied, it will be possible to review the status of zoo animal nutrition research in Europe, providing information that will be placed on a special Internet site. EAZA News and the EAZA Research Newsletter will also be used in the future to distribute information about zoo animal nutrition.

Notes from the roundtable discussion were sent to all the conference participants. If any other readers want to obtain a copy of these notes, write, fax or e-mail Joeke Nijboer, Rotterdam Zoo. E-mail: j.nijboer@rotterdamzoo.nl

Questionnaires were sent out to all 180 participants in order to get some feedback from the conference. A third (36%) of the questionnaires were returned before our editing deadline of May 1st. Of those, 61% felt that the balance between applied/practical talks and scientific/research presentations was about right, and of the remainder (31%) were more than happy with the balance, while 8% were unhappy preferring more applied talks. Only four respondents were not content with the length of the conference (three days). Three of them would have liked the conference to be longer! Some participants remarked that with so many talks and posters presented, not enough time was available for the talks.

Everyone agreed that there should be a Second European Zoo Nutrition Meeting in the future. Almost two thirds (60%) preferred a biannual meeting, 21% preferred an annual meeting and 12% were undecided between the two, while 7% of the participants had other suggestions. 37% (24 participants) would conditionally join the nutrition organising committee. And 25% (16 participants) showed interest in helping to organise the next conference. Many remarks were noted but one merits special attention – that during future nutrition meetings more attention should be given to aspects of feeding behaviour and behavioural enrichment through feed.

The enthusiasm of the participants and the results from the questionnaires has encouraged the organising committee to proceed with promoting zoo animal nutrition in Europe. Agenda points on the next meeting will certainly include extending the organising committee, setting zoo nutrition targets, customising/developing zoo nutrition software, improving communication and planning the Second European Zoo Nutrition Meeting.

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Member of Organising Committee of the First European Zoo Nutrition Conference

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