

Zoo Animal Nutrition III

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Diet selection by the White-naped Pheasant Pigeon *Otidiphaps nobilis aruensis* at the Barcelona Zoo

Presented at the Joint Nutrition Symposium at Antwerp, Belgium, 2002

Abstract

Otidiphaps nobilis aruensis is a Columbiforme endemic to Aru Isle (south-west of New Guinea). There is very little information about the biology and wild status of this subspecies, and it is poorly represented in captivity. This study was performed with 11 pheasant pigeons born at the Barcelona Zoo. The aim of this study was to determine (1) the main components of the diet consumed by the captive population of white-naped pheasant pigeons at the Barcelona Zoo and (2) some of the factors that could have an influence on their diet selection. An intake study was performed for 14 days and samples of the diet offered and refused by the birds were collected for proximate and crude energy analyses. Due to the small sample size, there was a great variability among individuals. However, only the age and the origin of the birds had significant effects on some of the dependent variables (diet items, nutrient and water intake). It was also found that the white-naped pheasant pigeons selected a diet with a great percentage of grains, with an average nutrient composition of 18.9% crude protein, 8 % fat, 4.6 % crude fiber and 5.4 % ash. The protein intake per animal was 4.16 g per day, showing that the animals were ingesting a diet that covered the estimated requirement found in the literature. Similarly, according to the estimation formulas and the suggested energy requirements for maintenance from several authors it was found that the pheasant pigeons consumed 133 kcal of metabolic energy (ME) per kg of body weight (BW)^{0.75} daily, which equalled 1.7 times the estimated basal metabolic rate (BMR), and thus were meeting their estimated energy needs.

Key words

pheasant pigeon, diet selection, protein intake, energy intake

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Digesta kinetics in feral pigeons (*Columba livia*)

Presented at the Joint Nutrition Symposium at Antwerp, Belgium, 2002

Abstract

The experiment was conducted to determine the digesta kinetics of liquid phase and particles in feral pigeons (Columba livia). All animals were individually caged. Mean retention times (MRT) were estimated in seven adult pigeons (bodyweight 275–320 g) fed a pulse dose of Co-EDTA (Co 8 mg/animal), Cr-mordanted fibre (Cr 1 mg/animal, particle size <2 mm) and the n-alkane hexatriacontane (C₃₆ 3 mg/animal, as labelled food pellets). Individual samples were collected every 1 ½ h for 12 hours and one more sample was collected 24 h after marker application. Average MRT for the liquid phase marker Co was 5.3 h (± 3.18). For the particle phase markers Cr and C₃₆, MRT was 6.8 h (± 2.87) and 8.4 h (± 3.25), respectively. Transit time (TT) was < 1 h in all birds. The retention times of all three markers differed significantly. This is surprising since it is expected that the particle markers would not differ in their kinetic behaviour. Possible explanations are discussed in relation to the biology of pigeons

Key Words

Birds; Digestion; Marker; Mean retention time

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G.P.J. Janssens, B. Geeroms, M. Bürkle,
M. Reinschmidt, G. Werquin

Body condition and breeding success of nectarivorous parrots at Loro Parque Fundación as affected by dilution degree of nectar food and pollen supplementation

Presented at the Fourth European Zoo Nutrition Conference, Leipzig, 2005

Abstract

Nectarivorous parrots in captivity are commonly fed commercial nectar foods. Their dilution level can affect voluntary energy intake which can alter body condition in the long run. Besides nectar, pollen are also considered as a main ingredient in the diet of nectarivorous parrots, but specific information is scarce. The present study aimed to investigate the effect of nectar food dilution and pollen addition on body condition, body weight and reproductive performance in the practical feeding of a nectarivorous parrot collection. Nectarivorous parrots in the collection at Loro Parque Fundación were randomly allotted to four dietary treatments: two groups were fed ad libitum a commercial nectar food at a dilution in water of either 1/3 (v/w) or 1/4 (v/w). Half of each group also received pollen in their diet at an inclusion rate of 1/5 (w:w on undiluted nectar food basis). Measurements of body weight and body condition score were taken at day 0 and day 100. The difference in weight change was not significant between groups. Yet, body condition score increased with the 1:3 dilution whereas it decreased with the 1:4 dilution. Differences between sexes and the feeding of pollen did not reach the level of significance. Some breeding results were numerically better in the pollen-fed birds, but failed to reach the level of statistical significance. In conclusion, an appropriate dilution degree of nectar food might be a useful tool to prevent aberrant body condition like obesity in nectarivorous parrots.

Key Words

Psittacidae, nectar, body weight

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D. McDonald

Iron storage disease and commercially formulated bird foods: is excess vitamin A implicated?

Presented at the Joint Nutrition Symposium at Antwerp, Belgium, 2002

Abstract

Iron storage disease is prevalent in many frugivorous and insectivorous birds maintained on commercially formulated foods. Various factors have been implicated in the development of this disease including genetic predisposition, immunological stress, viruses and nutrition. In this contribution, various nutritional factors of commercial birds foods are reviewed, including the generally high vitamin A content of many products.

Keywords

iron storage, commercial bird foods, vitamin A

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Hepatic haemosiderosis in birds: nutritional composition and stress mechanisms may contribute to the development of the disease: a review

Presented at the Fourth European Zoo Nutrition Conference, Leipzig, 2005

Abstract

Although the exact pathogenesis of haemosiderosis in frugivorous birds has not been elucidated, there is a common concensus that dietary iron load should be restricted. However, current recommendations for total dietary iron are mostly empirical and disregard differences in bio-availability. This paper describes the different chemical forms of iron and their biological availability. Other dietary components (tannins, phytic acid, fibers, ascorbic acid, organic acids, minerals) significantly influence the bio-availiability of the iron in the food and are at least as important. Also stress and immunological reactions may induce iron accumulation in the liver: in contrast to mammals, stress stimulates iron absorption from the intestine and may initiate haemosiderosis in birds.

Key words

Iron storage disease, Iron availability, tannin, phytic acid, Immune mechanisms, transferring

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Diet of captive short-tailed leaf-nosed bats (*Carollia perspicillata*): the need for caution with feed supplements

Presented at the Joint Nutrition Symposium at Antwerp, Belgium, 2002

Abstract

*This paper presents the results of a limited case-study into diet related causes of iron accumulation in the liver of captive short-tailed leaf-nosed bats (*Carollia perspicillata*) in Artis Zoo. Results based on diet analysis and calculation with nutritional software show that dietary iron content was higher than recommended for various frugivorous species. It is also shown that over 90 % of the iron in the diet is contributed by multivitamin and multimineral supplements. The results of an additional diet survey indicate that this is the case in other zoos as well.*

Keywords

*Fruit bats, *Carollia perspicillata*, diet, iron, dietary supplements*

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M. Clauss, T. Hänichen, J. Hummel, U. Ricker, K. Block,
P. Grest, J.-M. Hatt

Excessive iron storage in captive omnivores? The case of the coati (*Nasua* spp.)

Presented at the Fourth European Zoo Nutrition Conference, Leipzig, 2005

Abstract

*We collated necropsy reports for 13 coatis (*Nasua* spp.), revealing four cases of moderate and six cases of massive iron deposition in liver tissue. This survey corroborates an earlier report that noted a high frequency of iron deposits in coatis at necropsy. A comparison of the reported natural diet of coatis and the usually fed captive diets revealed that whereas vertebrate products (dog/cat food, prey items) represent the staple diet items for captive individuals, free-ranging coatis only rarely consume vertebrate prey; their natural diet is dominated by wild fruits and invertebrates. This discrepancy should be reflected in high levels of readily available heme iron in captive diets, with little or no heme iron in the natural diets. Therefore, it could be hypothesized that the use of vertebrate products in animals not adapted to such high levels of readily available heme iron could be a cause for dietary iron overload. Further studies on the relevance of excessive iron storage in omnivores/insectivores, and their etiopathology, are indicated.*

Key Words

iron storage disease, hemosiderosis, hemochromatosis, coati, insectivore, omnivore, heme iron, meat, shrew, tenrec

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Energy and nutrient intake, feeding behaviour and activity budget of captive Douc langurs (*Pygathrix n. nemaeus*)

Presented at the Joint Nutrition Symposium at Antwerp, Belgium, 2002

Abstract

Douc langurs are very difficult to keep in captivity, which is mainly due to nutrition-related problems. This study aims at providing first quantitative data on the nutrition and feeding behaviour of captive douc langurs, thus supporting the development of suitable diets for colobines in captivity. Individual food intake was recorded quantitatively over a period of three months in nine captive individuals. Nutrient and energy concentrations of the consumed diets were calculated and compared to results from relevant studies of other colobine species. Determinants which might influence food intake in the study groups were assessed, and an activity budget was established. The animals spent 54 % of daily observation time with resting and sleeping, and 23 % with feeding. The diet consumed by the langurs consisted of 33 % vegetables, 21 % leaves, 21 % fruit, 12 % salad and 14 % other food items. A low crude fibre content of the captive diet was obvious when compared to the diets of wild colobines, whereas the protein content was similar in captive and wild diets. The amount of energy consumed by any of the studied douc langurs was lower than the calculated energy requirement. The different foodstuffs differed in their acceptance by the animals. Leaves always had the highest amounts of leftovers. A greater diversity of leaves offered, however, correlated with a higher leaf intake. The results are discussed with regard to the presumably sub-optimal energy intake of the studied douc langurs. The fact that a considerable proportion of the offered leaves was not consumed might be indicative of leaf quality (palatability, taste etc.) not matching with the requirements of the langurs.

Key words

*Folivory, body weight, energy requirement, leaf quality,
leaf species diversity*

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Nutrient composition of leaves consumed by captive and semi-free-ranging Douc langurs (*Pygathrix nemaeus*)

Presented at the Fourth European Zoo Nutrition Conference, Leipzig, 2005

Abstract

*This paper presents results of a study on food and nutrient intake in captive and semi-free Douc langurs *Pygathrix nemaeus* spp., which was carried out at Cologne Zoo and at the Endangered Primate Rescue Center, Vietnam. Leaf diets of captive and semi-free Douc langurs were investigated. Information is given on food plant species, as well as on the nutrient composition of a large spectrum of food plant species' leaves (crude protein, crude ash, selected minerals – calcium, potassium, magnesium, sodium, phosphorus, copper, iron, manganese, zinc –, and fibre – neutral detergent fibre, acid detergent fibre, acid detergent lignin. In general, leaves offered to Douc langurs at Cologne Zoo had numerically a higher crude protein and phosphorus and a lower fibre, calcium, and copper content than leaves used in the Vietnamese rescue center.*

Key words

food plant, protein/fibre ratio, Leguminosae

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Effect of dietary fibre on the faeces score in colobine monkeys at Dutch ZOOS

Presented at the Fourth European Zoo Nutrition Conference, Leipzig, 2005

Abstract

In captivity colobine monkeys often display a soft to watery faecal consistency, in contrast to their wild conspecifics, which usually display well-formed faeces. It has been suggested that dietary fibre, and possibly also dietary water content is related to faecal consistency. To further test this assumption we pooled data on 15 individual feeding periods from six feeding trials with colobine monkeys from different species, during which dietary and faecal chemical composition had been determined and faeces consistency had been scored with one consistent scoring scheme. Our pooled data suggest that dietary neutral detergent fibre (NDF) and dietary dry matter content were significantly, positively correlated to a better faeces consistency, whereas dietary protein content was negatively correlated to faeces consistency. Influences on the faeces consistency like easy digestible carbohydrates and the mineral content of the diet were not considered. Firmer faeces did not contain less water, but more NDF and less protein. It is suggested that diets fed to colobine monkeys in Dutch zoos should be reduced in protein and dietary water, and increased in fibre content. A recognized problem for attaining this goal is the lack of a readily accepted primate pellet that is not only called "high fibre" but that actually mimics the fibre content of the diet of free-ranging colobine monkeys.

Key words

colobinae, langurs, fibre, digestion, faeces consistency

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K.A. Dörnath Aguirre Alvarez, A.A. Aguirre,
K. Eulenberger, E.S. Dierenfeld

Feeding the gentle giant: aspects of gorilla dietary and feeding regimes in EEP holdings

Presented at the Fourth European Zoo Nutrition Conference, Leipzig, 2005

Abstract

This study represents a first review of various aspects of current dietary and feeding regimes for gorillas within the EEP. It also gives an initial overview on health risks posed to gorillas linked to diets. It was carried out by means of an extensive literature review and a survey using a questionnaire. The response rate to this survey was 79 %. Most zoos (77.8 %) base their gorilla diets on empirical knowledge – either exclusively or in combination with other information sources. The majority of the holdings feed their gorillas between three and five times daily and offer at least ten different food items. Over 200 distinct food items are being offered throughout the year. Categories fed are browse, vegetables/greens, fruits, animal products, commercial diets and other. One hundred percent of the zoos participating in the study offer browse as well as vegetables/greens; 93.3 % offer fruits; 91.9 % offer animal products; and 64.4 % offer at least one commercial diet. Sixty percent of the zoos supplement their gorilla diet; this supplementation varies significantly amongst these zoos. Ninety percent of all participating holdings offer a source of potable water at all times. Eighty percent of the zoos show seasonality in their diets, over one-quarter (26.7 %) never separate the gorillas for feeding, and only 9 % of zoos never hand feed. As for health issues, 17.8 % zoos state their gorillas to be either generally obese or overweight, and 20 % of the participating holdings have observed or suspected dietary related health problems. R/R is present in 71.1 % of EEP holdings. As a result of this study, a bibliography containing over 240 publications was compiled and browse, vegetable and fruit lists were collated; these are available upon request. This study shows that gorilla diets and feeding regimes vary considerably amongst zoos. It is imperative that gorilla diets are based on latest nutritional recommendations; this applies to nutrient ranges rather than ingredients per se.

Key Words

gorilla, diet, nutrition, survey

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Poisoning of zoo animals by the gardener, or: an unsuspecting method of population control in zoo collections

Presented at the Fourth European Zoo Nutrition Conference, Leipzig, 2005

Abstract

The Wilhelma Zoological and Botanical Garden in Stuttgart seems to be predestined as a model for various methods of influencing the health of zoo animals by the feeding of toxic plants. But without doubt, other zoological gardens could contribute to this interesting subject, too. This can be done either by planting an appropriate botanical decoration in animal enclosures or in selecting special flowers, shrubs and trees for the visitors area. This paper will focus on seven cases of proven or suspected plant poisoning in zoo animals observed in Stuttgart and one case observed in the Munich Tierpark Hellabrunn. Poisonous plants were given by keepers, visitors or grew within reach of the animals.

Key words

plant poisoning, plant intoxication, Przewalski horse, Asian elephant, barbyriusa, milu, okapi, kea, kaka, yew, Aracea spp., false acacia, ivy, willows, boxwood, glycinia

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Nutrient content of Carolina willow (*Salix caroliniana*) browse components fed to exotic herbivores

Presented at the Fourth European Zoo Nutrition Conference, Leipzig, 2005

Abstract

*The objective of this study was to evaluate the nutritive content and in vitro dry matter digestibility (IVDMD) of leaves, green stems, bark, and wood of Carolina willow (*Salix caroliniana*) used as browse for exotic herbivores. One bundle of willow was harvested in April, August, September, and October 2003 (average = 6.82 kg fresh weight, n = 4) and stored at 4.4 °C until sampled. Each bundle was separated into leaves, green stems, and woody stems. The woody stems were divided into four diameter categories (< 0.5 cm, 0.5–1.0 cm, > 1.0–2.0 cm, and > 2.0 cm) and further separated into bark and wood. Each component was weighed and frozen for analysis of dry matter (DM), crude protein (CP), acid detergent fibre (ADF), lignin, gross energy (GE), starch, minerals (Ca, P, Mg, K, Na, Cu, Fe, Mn, Mo, and Zn), and IVDMD. Bundles averaged 5 % green stems, 20 % leaves, 21 % bark, and 54 % wood on a dry matter basis. Leaves had the greatest and wood had the least CP content. Acid detergent fibre was lowest in bark from stems less than 2 cm in diameter and greatest in wood. Bark from stems, greater than 0.5 cm in diameter, had the greatest Ca content with wood having the least. Phosphorus content was greater in green stems than bark and wood from stems greater than 0.5 cm in diameter. Leaves had nearly fivefold greater Zn concentration than wood. Bark, from stems less than 1 cm in diameter, had greater IVDMD than wood. As ADF content of the browse components increased, their IVDMD decreased. Based on the extent to which each species consumes willow browse components, the nutritive content varied, but could be a part of a balanced diet.*

Key words

leaves, stems, bark, wood, in vitro dry matter digestibility, feeding program

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The influence of roughage intake on the occurrence of oral disturbances in captive giraffids

Presented at the Joint Nutrition Symposium at Antwerp, Belgium, 2002

Abstract

Feeding behaviour of giraffe and okapi in captivity can differ significantly from the state in the wild. Duration and complexity of feeding and ruminating behaviour, and total amount of food ingested, are often reduced, while the energy content of the diet is increased compared to the wild. As known from domestic cattle in intensive keeping systems, oral disturbances like tongue-playing or licking of objects are reported to occur in captive giraffe and okapi. Oral disturbances are considered to be related to an intensive feeding system, e. g. characterised by a low intake of (physically) structured feeds like hay or fresh forage. We review evidence for this relation in domestic cattle and in giraffids in zoos, and add some own data on 6 giraffes and 3 okapis, which suggest an increasing influence of a high unstructured/structured feed ratio on oral disturbances. The causal and functional factors responsible for oral disturbances are understood only partly to date. It is unclear whether deprivation of feeding or of ruminating behaviour is more important, whether deprivation of behaviour itself or deviations of the normal physiology of the digestive process are responsible for a relation of oral disturbances with low roughage intake, and whether they can be interpreted as adaptive behaviour. Independent of a detailed explanation for the occurrence of oral disturbances, a higher roughage intake seems to reduce the occurrence of this behaviour. Suggestions are made as to which measures may be taken to achieve an adequate roughage intake in selective ruminants, and which kinds of roughage can be regarded as adequate for them. Further research is needed to be able to judge the suitability of different kinds of roughage for giraffe and okapi.

Key words

oral disturbance, Giraffa camelopardalis, Okapia johnstoni, physical structure of feeds

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The allocation of a ruminant feeding type to the okapi (*Okapia johnstoni*) on the basis of morphological parameters

Presented at the Joint Nutrition Symposium at Antwerp, Belgium, 2002

Abstract

*As the anatomy of the digestive tract of the okapi (*Okapia johnstoni*) has not been described in relation to the ruminant feeding type classification to date, we here report anatomical measurements on a complete digestive tract of an okapi euthanised in captivity and measurements of its ingesta particle size and forestomach protozoa species, supplemented with other information on two okapi forestomachs and anatomical literature data. The digestive tract of the okapi is characterised by a comparatively small reticulorumen (wet contents 9.8 % of body weight) with weak rumen pillars (thickness 7–10 mm), a shallow reticular honeycomb structure (reticular crest height 1–2 mm) and a small omasum (curvature 28–33 cm); particularly long papillae unguiculiformes have been reported and were found in one forestomach investigated, but are not a consistent finding. The ratio of the length of the small vs. large intestine was low (1.3–1.8). The liver investigated was comparatively large (1.56 % of body weight). Faecal particle size investigated was large compared to other ruminant data. Forestomach protozoa were almost exclusively *Entodinium* species. All these parameters are in accord with a classification as a typical browser according to Hofmann (1989). However, the parotid glands investigated represented only 0.071 % of body weight, which is within the range typically reported for grazers. Potential causes and consequences of this finding are briefly discussed.*

Key Words

*okapi, *Okapia johnstoni*, anatomy, digestion, nutrition, browser, rumen, reticulum, omasum, intestine, salivary gland*

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A. Liesegang, M. Wehrle

Feeding practice of roe deer (*Capreolus capreolus*) in Zoo Goldau – a case report

Presented at the Fourth European Zoo Nutrition Conference, Leipzig, 2005

Abstract

Feeding roe deer in captivity is a challenge. Since the animals in Goldau Zoo (3 adult animals with 2 juveniles) did not consume hay at all, alternative fibre sources had to be found. Browse silage was introduced to have the possibility to offer browse also during wintertime, and the high proportion of protein and NFE-rich pellets was reduced. The animals accepted the new diet much better and consumed more. The diet contained more fiber than the diet offered before. This case report demonstrates a quick change of appetite in a roe deer group after the changing to a fibre-rich diet.

Key words

ration, browse, wild ruminant, captivity

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Different supplementation of minerals in bats and the consequences on bone mineral density

Presented at the Fourth European Zoo Nutrition Conference, Leipzig, 2005

Abstract

*We investigated the consequences of mineral supplementation of mealworms at a facility where mustached bats (*Pteronotus parnellii rubiginosus*) from Trinidad were kept for experimental purposes. For 11 months after capture from the wild, the animals were constantly housed indoors and fed a diet of mealworms without mineral supplementation. After several animals died with skulls soft at palpation, this diet was suspected to be mineral deficient. From then on, mealworms were placed on a mineral mix one day prior to feeding, thus increasing their calcium content. For an assessment of the efficacy of the mineral supplementation, bone mineral density (BMD) was measured in the left radius with peripheral quantitative computer tomography. The animals were divided into 3 groups: six animals that died on capture were representing the free-ranging controls (Group A), eight animals died on the preliminary feeding regime without supplementation (Group B), and six animals fed the final, mineral-supplemented mealworms (Group C). BMD was highest in group A. Group B had significantly lower bone mineral density than Group A. Interestingly, Group C, receiving supplementation, showed no significant difference compared to Group A. This supports the assumption that it is important to feed a mineral supplementation to captive bats to conserve their normal bone structure.*

Key words

insectivore, mineral supplementation, calcium, bone, mealworms

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Analysis of different fish handling, storage and thawing techniques in eight zoos in the Netherlands

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Abstract

Many fish-eating animals living in zoos are fed thawed fish. For a constant daily supply it is necessary to purchase commercially prepared, large blocks of whole frozen sea fish. These fish blocks remain frozen and stored until time of use. The storing, handling, and especially the thawing of fish all have decisive influence on its hygiene status. In this study, we surveyed the handling, storing and thawing procedures for fish in eight different Dutch zoological collections, using a questionnaire that contained 75 questions about the subject. During visits to the zoos, persons working with fish (ordering, thawing, and/or feeding the fish) were questioned about their routines. After questioning, tours through the parks were made and the different areas were visited. The methods used for working with the fish in each unit of the participating zoos were noted and pictures of each specific situation were taken. The methods of fish handling differ amongst zoos. Even within the same zoo different methods were used. Each zoo had several points that could be improved. This could be any step in the whole fish handling process: ordering, receiving, storing, handling, thawing, feeding, hygiene and sanitation.

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The effect of feeding enrichment on the behaviour of captive Dendrobatid frogs

Presented at the Fourth European Zoo Nutrition Conference, Leipzig, 2005

Abstract

*The majority of environmental enrichment studies have involved captive mammals, but global declines in amphibians have prompted increased attention towards their captive breeding and reintroduction programs. Food-related behaviours are highly affected by captivity, as in the wild foraging constitutes a major activity. Feeding time can offer a diversion in the relatively static captive environment; however, the predictable manner in which food is often provided demands few appetitive or consumatory behaviours. This study determined that feed presentation affected the behaviour of a population of strawberry poison-dart frogs (*Dendrobates pumilio*) kept on public display at Edinburgh Zoo. Using focal and scan sampling, feeding behaviour and daily group activity was compared when frogs were presented with either a point source or an enriched "leaf" feed technique where the food dish was covered by a leaf, which allowed prey items to disperse. Overall feed treatment had little effect on the proportional frequencies of behaviours displayed by the group as a whole. There was no difference in mean number of foraging individuals with feed treatment but duration of daily time spent in feed area was significantly increased when leaf feed was presented and individual foraging observations determined frogs exhibited more prey-tracking behaviours. The enriched feed presentation tended to increase time intervals between prey capture events, therefore making foraging more challenging, reducing rapid feeding rates, and prolonging foraging activity. Though the use of live insects is an important enrichment technique, routine point source feeding can still become predictable and unchallenging, as evident from the casual observation that many frogs tended to gather in close proximity to the feed area prior to food addition. Zoo visitors often express concern for mammals kept in barren environments and describe them as being "bored" but amphibian species kept in equivalent conditions are often described by zoo visitors as "boring" and do not benefit from the same level of concern for their welfare. The provision of naturalistic enclosures and appropriate husbandry practices designed to target species-specific requirements could be used to increase behavioural repertoire, improve animal welfare and also raise the profile of a taxon which is often described as "poor exhibit animals".*

Key words

foraging, welfare, amphibian, live prey

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1 refers to the [Zoo Nutrition News Issue 1](#) (1999)

2 refers to the [Zoo Nutrition News Issue 2](#) (2001)

3 refers to the [Zoo Nutrition News Issue 3](#) (2003)

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