

Research article

Current practices in dietary management and disease incidence in red pandas *Ailurus fulgens* across European zoos

Lauren Samet¹, Janno Weerman² and Marcus Clauss³

¹Dogs Trust, London, United Kingdom.

²Royal Rotterdam Zoological & Botanical Gardens, P.O. Box 532, 3000 AM Rotterdam, The Netherlands

³Clinic for Zoo Animals, Exotic Pets and Wildlife, Vetsuisse Faculty, University of Zurich, Winterthurerstr. 260, 8057 Zurich, Switzerland

Correspondence: Marcus Clauss, email; mclauss@vetclinics.uzh.ch

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Abstract

The Endangered red panda *Ailurus fulgens* is commonly kept in European zoos. While it exists primarily on bamboo in its natural habitat, zoo diets historically have differed, which has been associated with health problems. A red panda diet survey was distributed across 106 European zoos in 19 countries in summer 2023. All collections feed fresh bamboo daily, as recommended in best practice feeding guidelines (BPG). However, three quarters of collections still feed commercial fruits, a practice advised against by European BPG for nearly a decade. Pelleted or extruded foods are commonly used to supplement red panda diets (79%), the majority of which contain considerably less fibre than bamboo. This mirrors published recommendations including the BPG, suggesting that in diet formulation past husbandry practices are more important than biological plausibility. A ‘panda cake’ product was fed by 48% of zoological collections but has been advised against by BPG and other sources due to links to poor dental health. A minority of collections (<7%) feed animal products including fish and dairy products. Eggs are fed in 38% of zoos. Skin and dental problems were the most commonly recorded health problems in zoo red panda, identified by 43% and 42% of zoos respectively. The findings show that while some BPG recommendations have been widely adopted, others have not, to possible detrimental effects on animal health and welfare. The comparison of nutrient concentrations in bamboo and the nutrient recommendations for red panda compound feeds in the BPG show that even BPG should be regularly assessed critically, ideally based on biological plausibility alongside husbandry tradition. More than thirty years after the published request in 1989 that a high-fibre product (i.e., crude fibre at 20-25% dry matter) should be produced for red pandas, such a diet has become available for the first time to our knowledge, indicating a certain inertia in zoo feeding practices. Future study of barriers to zoo uptake of dietary BPG would be useful for creating intervention points to promote change. Following BPG for species care is a quantifiable metric that could be added to welfare assessment or zoo standards.

Introduction

Traditionally, zoo animal diets were not necessarily formulated on the concept of mirroring natural diets but were designed based on human and agricultural feeding practices (Fens and Clauss 2024), alongside the sometimes misleading outward appearance of a species. This has led to a number of publications that state a discrepancy between the natural diets of species and those fed in zoos—such as in tapirs *Tapirus* spp. (Clauss et al. 2008; Rose and Roffe 2013; Wilson and Wilson 1973), ruminants (Taylor et al. 2013) and primates (Matsuda et al. 2018). Historical developments towards zoo rations that resemble natural diets more closely, both in ingredient and nutrient composition, are evident to persons that work in zoos (Fens and Clauss 2024). They can also be gleaned from comparing individual publications that document zoo diets

while some have been summarised in the literature, such as for giraffe *Giraffa camelopardalis* (Anon. 2005; Gussek et al. 2017) and tortoises *Testudo* spp. (Ritz et al. 2012).

Husbandry guidelines play an important role in this process even though their impact is difficult to assess, mainly because of a lack of published husbandry practice documentation at different historical time points. Indirect evidence for the effect of husbandry guidelines exists, for example in the finding that ruminant species with a WAZA studbook (which includes husbandry guidelines) achieve higher average longevity in zoos than species without a studbook (Müller et al. 2011). Also, historical improvements in neonate and adult survivorship in zoo animals have been linked to, amongst other factors, husbandry guidelines (Scherer et al. 2023, 2024; Tidière et al. 2023). To the authors’ knowledge, documentation about how well husbandry guidelines are followed is rare. The red panda

Ailurus fulgens is an exception: Eriksson et al. (2010) conducted a survey on how well current husbandry recommendations were followed in European zoos and Tanaka and Ogura (2018) compared the situation in Japan to that report.

This paper uses zoo feeding practices for red pandas as an example of how zoo practices can be assessed against husbandry guidelines. The natural diet of the red panda is well-described, consisting nearly exclusively of bamboo (Johnson et al. 1988; Pradhan et al. 2001; Reid et al. 1991; Sharma et al. 2014; Thapa and Basnet 2015 reviewed in Wei et al. 2022; Zhang et al. 2009). Husbandry and nutrition guidelines have been produced for this species on a somewhat regular basis (AZA Small Carnivore TAG 2012; Bleijenberg and Nijboer 1989; Eriksson et al. 2010; Nijboer and Dierenfeld 2011, 2022; Warnell et al. 1989; Weerman 2015, 2021). Thus, the red panda can be used to ask how well zoo diets resemble natural diets, how feeding recommendations are followed and whether changes in feeding practices over time can be documented. These questions were addressed with a survey targeted at feeding practices sent to zoos participating in the red panda European Association of Zoos and Aquaria (EAZA) Ex-situ Programme (EEP). In addition, the survey asked about the occurrence of several putatively nutrition-related diseases.

Material and methods

From January to September 2023, a one-page survey on diet and feeding practices (Supplementary Information) was carried out across European zoos by dissemination from the species' EEP coordinator. The survey asked about the feeding of fresh bamboo and other dietary items and about the occurrence of dental problems, diarrhoea, constipation, bone fractures, skin problems, kidney disease, liver disease, tissue calcification and excessive skeletal calcification. The responses are presented using descriptive statistics.

In order to transform some of the responses regarding amounts of bamboo offered in lengths of culms into mass in grams, five culms with leaves each of *Phyllostachys aureosulcata*, *P. nigra* and *P. viridiglaucescens* were cut in Zurich, Switzerland in June 2023, at various lengths of 1–3 metres and the exact length and fresh leaf mass of these culms were measured. This resulted in an average 90 g of fresh leaves per metre of bamboo culm. If no length of culms was indicated, stems of 1.5 m length were assumed. These results are not representative for all bamboo varieties and growth stages across the zoos that participated in this study, but represent a reasonable basis for an estimation of the amount of leaves given the available information.

For responses providing an amount of a diet item in grams or where the answer could be transformed into a mass in grams, the average of all reported diets was calculated to compare this average across all diets with the feeding recommendations in the husbandry guidelines.

For commercial diets currently available and specifically labelled for red pandas, as well as such diets no longer available but indicated in the survey, nutrient information on crude protein, crude fibre, neutral detergent fibre, acid detergent fibre and starch as well as the top five listed ingredients were extracted from information available from the manufacturers' websites or (historical) catalogues.

Results

Surveys were completed by 106 of 219 contacted zoos from 19 countries across Europe; this corresponds to a response rate of 48%.

All facilities (100%, 106 of 106 zoos) fed fresh bamboo on a daily basis, an increase compared to 78% (54 of 69) in 2008

(Eriksson et al. 2010) and identical to the situation in Japan in 2015 (Tanaka and Ogura 2018). The most popular bamboo genus was *Phyllostachys* spp. (fed in 66% of institutions). A full list of the 44 bamboo species offered is presented in the Supplementary Information and shows a large increase in variety since the 2008 survey when only 17 species were offered (Eriksson et al. 2010). Most institutions (91.5%) reported that leaves were preferred over culms by their animals and 7.5% reported equal preference (two collections citing 'young shoots' specifically), one collection giving no response. Seven facilities (6.6%) reported that they fed bamboo for ad libitum consumption. The information provided by nine facilities (8.5%) could not be transformed into a quantitative amount. Across the other facilities, bamboo leaves were offered at an average of 477±498 g as fed, with a minimum of 73 g (11% of the as-fed diet) and a maximum of 4 kg (89% of the as-fed diet). The average amount thus was higher than the 300 g bamboo advised by the current Best Practice Guidelines (Weerman 2021). This threshold was reached or surpassed in 57 zoos (of 90 that provided quantifiable information, i.e. 63%). Other forms of forage fed included dried bamboo (fed at four institutions), fresh browse (at 25 institutions) and dried browse at a single institution; the majority of these latter responses did not allow quantification.

Feeds used across institutions are summarised in Figure 1. Only a single institution did not feed any other items except fresh bamboo. Eighty-four institutions (79.3%) fed a pelleted/extruded food (Figure 1A). Ten pelleted or extruded products were identified in use across Europe for feeding red panda; eleven institutions fed more than one type of product. Nine of these products were 'leafeater' style pellets or extrudates, while one was specifically named for red panda and one for 'omnivores'. Feeding any form of a commercial, semi-moist 'panda cake' was carried out in 51 (48.1%) of institutions. Four panda cake products were used across 51 institutions, three of which fed two types of products. Thirty-four (32.1%) institutions used both a pelleted/extruded product and a cake product. Seven (6.6%) of institutions fed neither a pelleted/extruded nor a cake product. Feeding any form of supplement was recorded by 25.5% (27) of zoos. Nutritional supplementation ranged from multivitamin and mineral products designed for exotic captive carnivores or companion animals (mostly dogs) to calcium-based mineral supplements for multispecies use. Only two of the zoos that used a supplement did not use a pelleted/extruded or a cake product; 25 institutions used the supplement in addition to a pelleted/extruded or cake product.

Seventy-nine institutions (74.5%) fed out cultivated fruits to their animals, 49 (46.2%) fed coloured (non-green) vegetables and 18 (17.0%) green leafy vegetables (Figure 1B). Eggs were the most common animal-based product fed in 40 zoos (37.7%), followed by insects (8.5%), mice (6.6%) and day-old chicks (5.7%). Dog food (3.8%), cooked chicken (2.8%) and mincemeat (1.9%) were other forms of animal-based product used in diets, as was fish (3.8%; including fresh fish and salmon oil) and dairy (2.8%; e.g. cottage cheese and yoghurt). Cooked potatoes, rice, raisins (dried fruit) and nuts were listed when asked to describe 'other' dietary items; however, it was not clear how often these items were used.

When compared to the recommended diet composition (Figure 2A), the average diet fed at the responding zoos was 17% lower in bamboo and 12% lower in pellet/extrudate than recommended by current Best Practice Guidelines (Weerman 2021). They also included a wider range of dietary items (Figure 2B). Of the 90 zoos for which quantitative data for the whole diet was available, only 17 (19%) offered bamboo as ≥70% of the whole diet as fed and only three of these fed a pelleted or extruded food at about 25% or more.

Six commercial products were specifically designated as 'red panda' diets (four red panda cake products and two extruded products). For five of these, a crude nutrient composition was

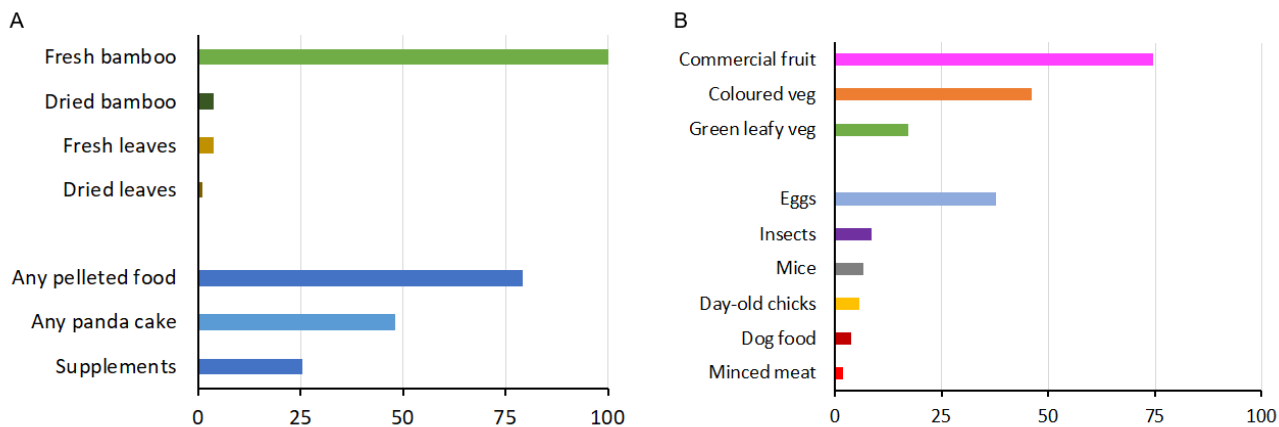


Figure 1. Percentage of 106 zoological institutions using various ingredients as part of their red panda *Ailurus fulgens* diet: (A) forages and commercial herbivore or panda products; (B) produce and other individual diet items. No differentiation was made between dry and moist dog food.

available. When comparing their nutrient composition (as provided on the labels) to data for bamboo (Table 1), it is evident that these products vary greatly in nutrient and ingredient composition; for example, crude fibre levels in these products ranged from 10.8 to 23.3% dry matter.

Two collections provided no responses in the pathology section of the survey; across the other 104 zoos, responses were not always provided for every disease state. Skin and dental problems were the most reported, in 45% and 44% of collections

respectively (Figure 3). Skin problems were frequently seen in 10% of collections that responded to this question; dental problems were frequently seen in 7%. Diarrhoea had been seen in 42% of collections (1% described it as frequent and 41% described it as rarely occurring). Constipation was observed by 15% of collections but only 'rarely'. Kidney disease had been observed in 17% of the collections (3% describing prevalence as frequent, 14% as rare). Most zoos ($\geq 92\%$) had never observed tissue calcification, skeletal calcification and bone fractures.

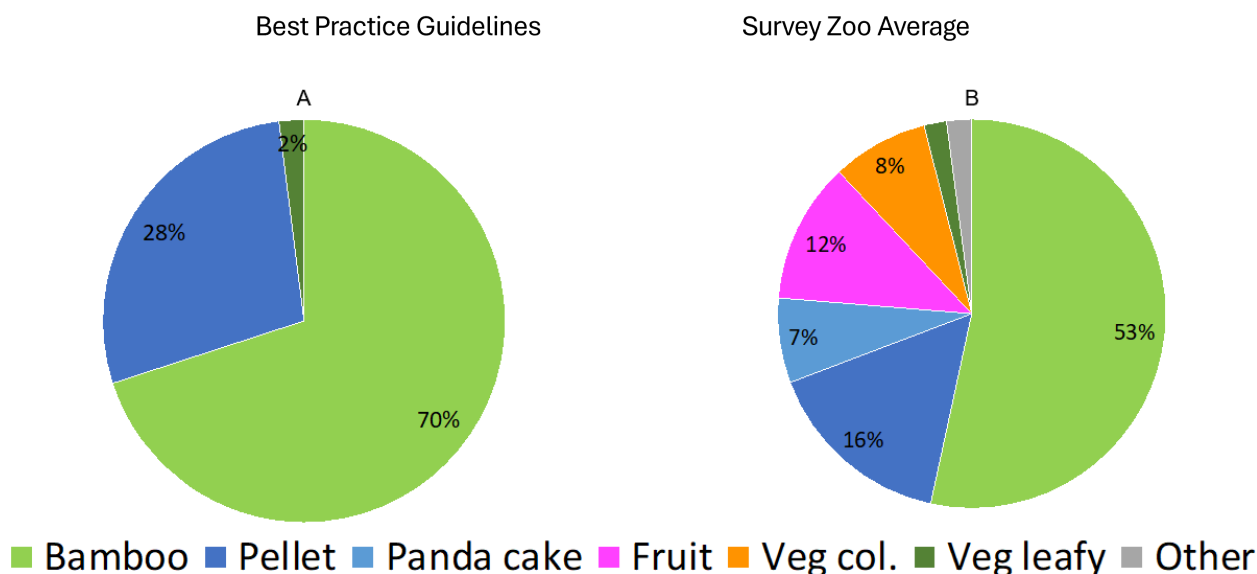


Figure 2. (A) As-fed diet composition as recommended by current Best Practice Guidelines (Weerman 2021); (B) average diet (on an as-fed basis) fed by the responding zoos. Note that this diet is the average of all quantitative information and not representative for any single zoo. Veg col. = coloured vegetables; Veg leafy = green leafy vegetables. For a more detailed description of 'other' diet items, see Figure 1B.

Discussion

This recent zoo diet survey for red pandas documents positive changes in feeding within European zoos compared to previous surveys, while also indicating that some practices appearing to violate biological logic are still being continued in some institutions. It confirms knowledge about the susceptibility of red pandas to certain health problems and may serve as a basis for future evaluations.

Before discussing these findings in more detail, some limitations of the study need to be acknowledged. Even though surveys such as this one are common practice within the zoo community, their results need to be considered with caution. Designed for brevity, so that filling out would not require much time, and hence aiming for a high response rate, they evidently lack detail that could be acquired by visiting each zoo and specifically weighing the dietary items offered. In particular, with dietary items that are not easily quantified such as the bamboo offered to red panda, estimating the actual amounts fed remains speculative. In addition, asking about health problems is possibly less reliable than evaluating necropsy reports and veterinary notes. Also, it was unknown who filled in the answers.

This dietary zoo survey documents positive changes in feeding red pandas within European zoos, namely that 100% of zoos surveyed fed bamboo daily compared to only 68% in 2008 (Eriksson et al. 2010) and also a distinct increase in the variety of bamboo species used. This finding mirrors those seen in Japanese zoos (Tanaka and Ogura 2018), famed for their species' longevity and reproductive success, indicating bamboo has been understood as an essential dietary item. As the main dietary component (~95%) of wild red panda diets (Wei et al. 2022), experts have suggested daily ad libitum bamboo provision for over a decade (AZA Small Carnivore TAG 2012; Nijboer and Dierenfeld 2011, 2022; Thapa and Basnet 2015; Weerman 2015, 2021). These findings are encouraging, in particular as they even indicate a surpassing of the minimum amounts of bamboo in the current Best Practice Guidelines (Weerman 2021) by more than half of the responding zoos. The logistical challenge of providing bamboo all year round, stated in the older literature as a reason for resorting to alternative diet items (Warnell et al. 1989), is no longer accepted in the Best Practice Guidelines (Weerman 2021), particularly since temperate bamboo species are available that are productive year-round.

However, the fact that many institutions are following recommendations based on the natural diet of the species makes several other findings of this survey even more surprising. This relates to aspects of both ingredient and nutrient choice: the use of dietary items that do not occur in the natural diet of red pandas in relevant amounts or at all, as well as items that differ distinctively in their nutrient composition from the natural diet.

It has been repeatedly stated that the diet red pandas receive in zoos often deviates from their natural diet (e.g. Kock et al. 1989; Thapa and Basnet 2015). Nijboer and Dierenfeld (2022) gave a historical overview of red panda zoo diet developments. Early red panda diets included milk and boiled rice (Bartlett 1870). Later, combinations of low-fibre cereal gruels or omnivore diets and fruits or vegetables were added (Bircher 1989; Bleijenberg and Nijboer 1989; Brambell 1977; Conway 1981; Holst 1989; Kock et al. 1989; Müller 1989; Roberts 1975; Stevenson et al. 1989; Warnell et al. 1989). Diets sometimes included substantial portions of meat (Doherty and MacNamara 1977; Plumb 2004) and some even incorporated a 'fasting day' typical for large carnivore nutritional management (Nijboer et al. 1989). These historical practices are not in line with either old (Roberts and Gittleman 1984) or current (Weerman 2021) recommendations.

For some zoos, lower than recommended total dietary bamboo levels may be partly due to the variety and amounts of other

dietary components included in red panda diets. Eighty different dietary components were reported in the survey of Nijboer et al. (1989) and this variety of dietary items from a broad range of food groups was still represented in the survey results of current day practice—even items that are clearly advised against by current Best Practice Guidelines (Weerman 2021) such as meat, fish, dairy products, fruit or gruels. Aside from bamboo (~70% of the as-fed diet), the rest of the diet should be based around a high fibre leafeater pellet or extrudate (28%) (Figure 2A). However,

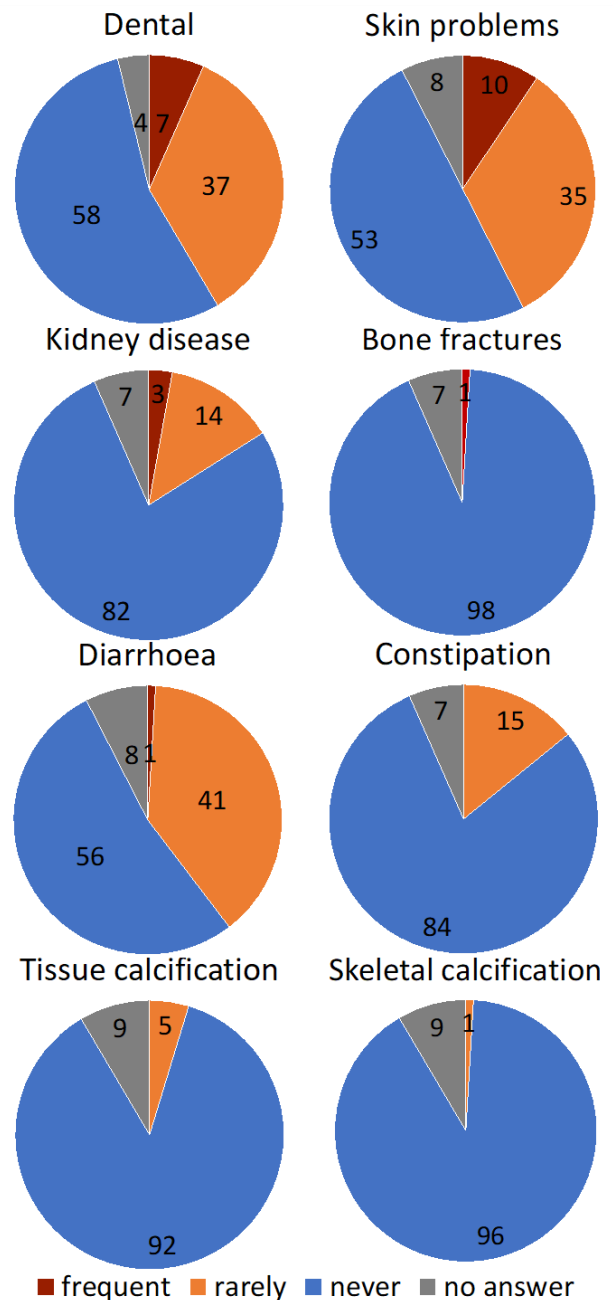


Figure 3. Percentage of responses regarding whether different health problems occurred at 104 zoos keeping red panda *Ailurus fulgens*

Table 1. Selected nutrient composition (%) of bamboo from the compilation of Nijboer and Dierenfeld (2011) compared to information on five commercially available products designated for 'red pandas'. Data given on a dry matter basis.

	Crude protein	Crude fibre	NDF	ADF	Starch	Source/Top three ingredients
Bamboo	13-27	ng	64-89	24-41	ng	Nijboer and Dierenfeld (2011)
Bamboo leaves	17.7	22.6	64.6	36.5	ng	Xi et al. (2007)
Extrudate	17.1	12.6	23.0	13.7	37.8	corn, alfalfa, egg powder
Extrudate	22.8	23.3	41.1	27.8	8.9	grass meal, alfalfa meal, potato protein
'Cake'	20.7	18.8	ng	ng	ng	alfalfa, maize, beet pulp
'Cake'	21.1	11.7	ng	ng	26.1	porridge oats, soy hulls, oat hulls
'Cake'	21.4	10.8	ng	ng	ng	oats, grass, breadcrumbs

NDF neutral detergent fibre, ADF acid detergent fibre, ng not given

on average zoos reported feeding only 16% of the as-fed diet as pellets or extrudates (Figure 2B). Feeding a complementary pellet or extrudate in adequate amounts should mainly provide safety in terms of provision with macro- (protein) and micronutrients (minerals and vitamins) that may not always be guaranteed in the bamboo selection available as the bulk diet item. Animals not ingesting adequate amounts of such a product are therefore at risk of nutrient deficiency. Fear of such a deficiency may have led to the common use of additional vitamin and mineral supplementation within red panda diets (26% of zoos). However, as the point in providing a pelleted/extruded diet component is the delivery of micronutrients, using both such a component and an additional vitamin/mineral supplement is unwarranted.

Cultivated fruits are higher in sugar and lower in fibre than wild fruits (Oftedal and Allen 1996a; Schmidt et al. 2005; Schwitzer et al. 2009); nonetheless wild fruit are not even a major item in free-ranging red panda diets (Wei et al. 2022). Best Practice Guidelines have long actively requested to no longer feed fruit to red pandas because it can be harmful to their health (Weerman 2015, 2021) with the animal's preference for sugars leading to consumption of fruit over higher fibre dietary items thus reducing/diluting the total nutrient value of the diet (Nijboer and Dierenfeld 2022; Weerman 2015, 2021). Nevertheless, in the present survey, 75% of zoos still reported the use of fruits. Feeding fruit to red pandas has possibly declined over the last two decades (in 2004 94% of UK and Irish zoos fed fruit to their red pandas; Plumb 2004). Removing fruits completely from European red panda diets and allowing for increased bamboo and high-fibre pellet/extrudate consumption is the most obvious dietary strategy to improve diets and health. Given the logistical simplicity of this step, the reluctance to cease fruit feeding is considered cultural, indicating whether biological facts or human preferences and past practices are given priority at a specific zoo (Fens and Clauss 2024). The fact that current Best Practice Guidelines (Weerman 2021) still state that small amounts of fruits can be used sparingly for training or medication probably supports the persistence of the practice of using fruits.

Fruit, gruels and panda cake in red panda diets have been cited as responsible for poor periodontal health in the species, one of the top three health problems still reported in European zoos (44%; Figure 3). Due to their high sugar or starch content and soft unabrasive textures, ingested material may collect between teeth and lead to tartar, gingivitis and eventually tooth loss

(Bleijenberg 1984; Nijboer and Dierenfeld 2011, 2022; Warnell et al. 1989; Weerman 2015, 2021). Whilst a cereal-based 'gruel' is no longer a dietary staple (to the authors' knowledge last recorded in the 1980s, see references cited above), panda cake appears to have become a popular alternative (fed in 48% of zoos, Figure 1). This line of products is renowned for its palatability and general acceptance by both animals and caretakers, most surely linked to its typically low fibre levels (Table 1) and possibly due to species-specific nomenclature in the product name. Panda cakes may thus provide an example of how a product that is not based on the biology of the species—neither in terms of consistency nor nutrient composition—nevertheless gains the status of a species-specific food in the zoo community. Whilst nearly half of zoos surveyed still fed panda cake, Best Practice Guidelines no longer support its use (Weerman 2021). Ironically, 32% of zoos fed panda cake alongside a leafeater-type pellet/extrudate, suggesting no nutritional advantages for its inclusion within the diet, only additional risks of lowering total dietary fibre content (Table 1) and increasing risk of compromised periodontal health. Possibly, the branding of such products as 'panda-specific' make the decision to exclude such products from diets psychologically more difficult. It is important to note that one should not subject pelleted or extruded feeds to a generic judgement but base this judgement instead on the ingredients and nutrient levels of these products. It has been suggested that for herbivores (i.e. also for the red panda), non-starchy ingredients and fibre levels are the most suitable evaluation criteria for compound feeds (Rothacher et al. 2023). Current Best Practice Guidelines (Weerman 2021) state that cake can be used in old animals that have problems ingesting pellets or extrudates; possibly, this is best achieved by making a gruel from high-fibre pellets or extrudate rather than using a low-fibre cake product.

The responses to the list of health issues confirm reports that dental problems, skin problems and soft faeces are of concern in red pandas (Duouay and Ramsay 2022; Thomasson and Vitali 2022). Of these, the mentioned relationship between fruit and starchy, low-fibre cakes appears the most evident and easily avoidable by ceasing the use of such diet items. With the use of bamboo as a staple diet item, the additional use of an extruded (and possibly high-fibre) product would likely enhance dental health (e.g. Buckley et al. 2011). The use of higher fibre pellets or extrudates may well contribute to faeces consistency, as observed

in other species (Nijboer et al. 2006); Nijboer and Dierenfeld (2022) provide suggestions for judging red pandas' faecal quality. The reasons for skin problems (mostly related to hair loss) are still under debate (Duouay and Ramsay 2022). If the diet recommendation of using about 30% of a mineralised pelleted/extruded feed is followed, mineral deficiencies—not generally considered a main possible cause of skin issues in red pandas—can be ruled out. If the dietary recommendation of having fresh bamboo as the major diet item is followed, fatty acid or amino acid imbalances—not generally considered a cause of skin issues in red pandas—can also be ruled out. The suspicion that low-fibre, energy-dense diets might be related to the problems (Glatston, cited in Duouay and Ramsay 2022) would automatically be addressed if the diet consisted solely of bamboo and a nutritionally balanced high-fibre pellet/extrudate. Finally, the lack of reports of hyperostotic bone problems in the current survey suggests that this issue is unlikely a generic problem of red pandas in zoos (Duouay and Ramsay 2022).

One of the more surprising findings when reviewing the literature on red panda nutrition is that the nutrient composition of bamboo is well-known and texts on red panda feeding have included tabulated data on this from very early on (Bleijenberg 1984; Kock et al. 1989; Nijboer and Dierenfeld 2011, 2022). Nevertheless, the zoo community and zoo food manufacturers evidently accept and produce diets of a distinctively different nutrient composition. As Kock et al. (1989) stated: "There appears to be a consensus of opinion in the literature that the red panda needs a high level of fibre in its diet. However, this is not being implemented generally." For example, in a recent recommendation for red panda diets, Nijboer and Dierenfeld (2022) recommend a fibre nutrient target of 10% in dry matter, even though it dramatically undershoots the fibre levels of bamboo given in the same table, without giving any explanation for this deviation. This practice is mirrored in commercially available products designated for red pandas that have distinctively lower fibre levels than the natural diet, without explaining the reasons for this deviation (e.g. most products in Table 1). Actually, even the minimum nutrient levels recommended in Best Practice Guidelines (e.g. Weerman 2021) follow this practice of deviating drastically from the nutrient composition of natural diets, without giving any explanation. This may reflect an approach that prioritises past husbandry practices as well as instantaneous palatability over biological plausibility. Because past husbandry practices have been published and can therefore be cited, authors composing Best Practice Guidelines that intend to follow an evidence-based approach by relying on published literature may tend towards perpetuating historical practices. In the authors' view, if distinct differences in the nutrient composition of natural and zoo diets are to be accepted, this should be justified by explanations that can be scrutinised for their viability.

More than 30 years ago, Kock et al. (1989) recommended that a compound feed for red pandas should be produced that contains crude fibre at levels of 20–25% in dry matter to resemble bamboo and be provided basically for ad libitum consumption. As of today to the authors' knowledge, only a single commercial red panda diet corresponds to this recommendation (Table 1) and first became available in 2023. Although this is a positive development, such historical reflections might recommend that the zoo community speed up such developments.

It is highly likely that a high-fibre product will have a lower instantaneous acceptance by animals than more palatable, lower-fibre products. However, it is well-known in the zoo literature that instantaneous animal preference should not be considered an indication for a suitable diet (Ofstedal and Allen 1996b; Remis 2002; Ullrey 1989). This applies especially to items that do not correspond to the natural diet. In red pandas, this is exemplified by observations that they prefer cultivated fruit to bamboo

when offered a choice (Basumata et al. 2015). By contrast, it is reasonable to follow animal preference when offering a choice of diet items corresponding to their natural diet, such as browse species to browsers (e.g. Tovar et al. 2005), eucalyptus varieties to koalas *Phascolarctos cinereus* (e.g. Cook et al. 2005) or bamboo varieties to pandas (Tovar-Luna et al. 2007). Whereas commercial food producers might include considerations of palatability in the design and marketing strategies for their products, it is the task of zoo managers to not let their choices for commercial products be dominated by palatability or preference.

Conclusion

Several lessons from this survey can be applied to all zoo animals. The diet traditionally offered to zoo-kept species deviates from the natural diet, without rational explanation in modern day husbandry practice. Even commercially available diets named as if appropriate for a species often (but not always) deviate from the natural diet in ingredients and perhaps more importantly nutrient composition. Typically, this is in the form of less fibre and more easily digested carbohydrates, leading most likely to a ready acceptance by the animals but not to more suitable nutritional content. Yet the question about the biological or didactic reason why a designated red panda food contains much less fibre than the species' natural diet remains unanswered. The present study thus leads to two requests: first, to follow published dietary guidelines in the case of the red panda, especially with respect to abandoning the use of fruit, gruels and cakes and basing diets on bamboo and a nutritionally balanced high-fibre pellet/extrudate; second, to critically assess quantitative dietary content such as the proportion of bamboo and fibre content in the natural diet of red pandas against the recommended diet. The only diet that should not require a biological and didactic justification is the natural diet.

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