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Cover: Delacour's langur, male (*Trachypithecus delacouri*). Photo: T. Nadler.

EDITORIAL

The VIETNAMESE JOURNAL OF PRIMATOLOGY strives to perpetuate its yearly edition (although one missing *issue* in 2018) with the publication of all biological aspects and conservation challenges of Vietnamese primate species. The year 2018 brought some changes in the field of primate conservation and research in Vietnam.

After many years and several unsuccessful attempts to provide a clear program for the long-term conservation of Vietnamese primates, in May 2017 the Prime Minister signed the URGENT CONSERVATION ACTION PLAN FOR PRIMATES IN VIETNAM TO 2025, VISION TO 2030. The framework for conservation has been delimited now, but the actual implementation still largely remains to be done. The burden of work lasts predominantly on the shoulders of NGO's working in Vietnam. The last half of 2017 and the year 2018 has seen a number of planning rounds and concept discussions. But after two years – up to now - numerous resolutions are still waiting to be executed. It is to hope that this important document will soon get animated completely. It would be an incentive if the VJP can report continuously about the activities and actions to the realization of the ACTION PLAN.

As the founder of the Endangered Primate Rescue Center, there have been some changes at the end of the year 2018 with my personal involvement with the center. My position as director of the VIETNAMESE PRIMATE CONSERVATION PROGRAM, which I have held for 25 years, was transferred to the next generation of conservationists. After several challenges in the search for a capable leader for the Endangered Primate Rescue Center, Caroline Rowley took over this position. The center will continue its work as important facility for the conservation of Vietnamese primates, such as the rescue and rehabilitation of primates, the captive breeding of highly endangered species with the goal of strengthening extant populations and re-establishing populations in places where they have been eradicated, to serve as a training and research facility and finally to raise awareness to the general public about the urgent need to take concrete conservation actions.

My work for the conservation of Vietnamese primates will continue outside of the Endangered Primate Rescue Center - still a very broad field for urgent activities -- while the VIETNAMESE JOURNAL OF PRIMATOLOGY should also be continued as a support tool. With the changes in the management, the copyright of the VJP will be handed over from the Endangered Primate Rescue Center to the German Primate Centre, the generous donor since the beginning of the edition in 2007.

Tilo Nadler

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Preliminary results on the food intake and nutrient digestibility of southern white-cheeked gibbons (*Nomascus siki*) and red-shanked douc langurs (*Pygathrix nemaeus*) at the Endangered Primate Rescue Center, Vietnam

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Key words: food intake, diet, primate, protein to fibre intake, comparative nutrition

Summary

During a period of 6 days, we recorded the amount of food ingested, their nutrient content and the amounts of each nutrient in grams within the faeces (analysed in a laboratory) to determine the apparent digestibility for each nutrient for both the red-shanked douc (*Pygathrix nemaeus*) and the southern white-cheeked gibbon (*Nomascus siki*) housed at the Endangered Primate Rescue Center, Cuc Phuong National Park, Vietnam. Based on our results, both the gibbons and the douc langurs were able to ferment structural carbohydrates with the gibbons having a slightly higher apparent digestibility for both Neutral Detergent Fiber (NDF), Acid Detergent Fibre (ADF). The douc langurs digested a much larger amount when compared to the gibbons given the higher proportion of fibre they ingested by weight. The protein to NDF intake ratio is different between douc langurs and gibbons. Douc langurs were very specific and stringent in their selection of protein to fibre, choosing 2.7g of fibre to every gram of protein. Gibbons were less restrictive in their selection but ingested more fibre than was thought necessary for this apparent frugivorous species which suggest that fibre may be more important in their diets than previously thought.

Những kết quả ban đầu về việc lấy thức ăn và khả năng hấp thu dinh dưỡng của loài Vượn đen má trắng phía nam (*Nomascus sikí*) và loài Voọc chà vá chân nâu (*Pygathrix nemaeus*) tại trung tâm cứu hộ linh trưởng, Việt nam

Tóm tắt

Trong 6 ngày, nhóm nghiên cứu đã ghi chép lượng thức ăn tiêu thụ, thành phần dinh dưỡng và hàm lượng mỗi chất dinh dưỡng ở đơn vị đo gam. Việc phân tích trong phòng thí nghiệm dựa trên mẫu phân thu tại trung tâm cứu hộ linh trưởng Cúc Phương của hai loài chà vá chân nâu và vượn đen má trắng phía nam. Mục tiêu nhằm xác định khả năng hấp thu chất dinh dưỡng của mỗi loài. Kết quả cho thấy, cả hai loài đều có khả năng hấp thu các chất carbonhydrates nhờ quá trình lên men. Vượn có khả năng hấp thụ chất xơ trung tính (NDF) và chất xơ không hòa tan axit (ADF) cao hơn loài Voọc một ít. Tuy nhiên, loài Voọc tiêu thụ một lượng lớn chất xơ trong khẩu phần ăn so với Vượn. Tỷ lệ protein chuyển hóa từ chất xơ trung tính (NDF) của hai loài cũng khác nhau. Voọc có sự lựa chọ rất đặc biệt và nghiêm ngặt đối với chất xơ ăn vào. Trung bình sự lựa chọn là 2.7 gam chất xơ cho mỗi gam protein hấp thụ. Loài Vượn không có sự hạn chế trong lựa chọn chất xơ ăn vào, tuy nhiên việc ăn chất xơ nhiều hơn đối với một loài chuyên ăn quả điển hình chứng tỏ chất xơ có vai trò quan trọng trong thành phần thức ăn của Vượn so với những nghiên cứu trước đây.

Introduction

Given the current status of southern white-cheeked gibbons (*Nomascus siki*) and red-shanked douc langurs (*Pygathrix nemaeus*) across their range, some urgent action is needed to improve their *in-situ* and *ex-situ* conservation management. Understanding the ecology of these species is one of the first steps in the development of conservation management plans and guidelines.

One aspect of the study of their ecology involves understanding the nutrition of both species and notably how they digest nutrients. This information allows us to determine how much of the nutrients they eat in the wild are physiologically used and therefore can help suggest nutritional needs of the species. This is an essential first step to improve *in-situ* conservation in terms of habitat requirements and *ex-situ* conservation with the improvement of captive management, breeding programs and rehabilitation and release, especially so for species that are highly threatened of extinction in the wild, such as the two focal species of this study.

Food intake and nutrient digestibility are best studied in captive settings. In the wild this would require full day follows of known individuals for focal sampling and detailed knowledge and quantification of food intake, which would be logistically unfeasible. The red-shanked douc is a member of the subfamily Colobinae, defined by their sacculated stomachs (Chivers 1994). Their stomach has favourable conditions to house microflora capable of digesting plant fibres (notable hemi-cellulose and cellulose) (Hale et al. 2017), allowing them to have heavily folivorous diets (Caton 1999; Wright et al. 2008). Their highly specialized diet and physiology is why they tend not to thrive under human care. Gibbons on the other hand, are described as frugivores (Conklin-Brittain et al. 2001) and are easier to maintain and reproduce when kept under human care. Fibre is expected to be an important nutrient for the health of langurs, but not for primates given the label of “frugivore” (National Research Council 2003).

In July 2015, we conducted a food intake study and collected data to assess the digestibility of both the southern white cheeked gibbon and the red-shanked douc langur at the Endangered Primate Rescue Center in Cuc Phuong National Park, Vietnam where both species have been maintained for over two decades. We present the preliminary results of this research and discuss implications and future needs for additional data collection.

Methods

Study species

Eight southern white-cheeked gibbons, housed in two enclosures (three and five individuals) and seven red-shanked douc langurs, housed in two enclosures (four and three individuals) were included in the study (Table 1).

Table 1. Southern white-cheeked gibbon (*Nomascus siki*) and red-shanked douc (*Pygathrix nemaeus*) individuals at the Endangered Primate Rescue Center included in the digestibility study.

ID No	Name	sex	Date of birth	Sire	Dam
Nomascus siki					
9-08	Simba	F	1998	WILD	WILD
9-12	Rafi	M	17/12/02	9-05	9-02
9-18	Zazu	M	4/08/13	9-12	9-08
9-02	Daisy	F	1993	WILD	WILD
9-05	Gorbi	M	1992	WILD	WILD
9-13	Gosy	F	21/11/06	9-05	9-02
9-15	Jonas	M	15/07/09	9-05	9-02
9-19	Matilda	F	4/10/14	9-05	9-02
Nomascus siki					
6-77	Fish	F	18/04/12	6-06	6-38
6-62	Basti	M	17/03/09	6-28	6-31
6-53	Chips	F	2003	WILD	WILD
6-38	Tine	F	? adult	WILD	WILD
6-09	Butz	M	1997	WILD	WILD
6-55	Laura	F	2/02/08	6-28	6-46
6-83	*no name*	M	25/02/14	6-09	6-55

Data collection

The data collection was carried out from the 10th July to 16th July 2015.

We followed the exact same feeding schedule in place at EPRC. Douc langurs are fed three times a day (approximately at 6:30am; 10:30am; 3:30pm) and gibbons four times a day (approximately at 6:30am; 9:00am; 10:30am; 3:30pm). Enclosures are systematically cleaned before each feeding for douc langurs, while for gibbons enclosures are cleaned two to three times per day. To facilitate the study, douc langurs were fed only with the same five plant species during the study period, for which only leaves are consumed: *Averrhoa carambola*, Oxalidaceae (Vietnamese name Khế); *Dalbergia assamica* [*D. lanceolata*], Fabaceae (Vietnamese name: Co Khet); *Sterculia lanceolata*, Malvaceae (Vietnamese name: Sàng); *Alangium kurzii*, Cornaceae (Vietnames name: Chang Bang); *Clerodendrum paniculatum*, Lamiaceae (Vietnamese name: Bân Bân, Mò dỏ). Gibbons were fed their regular diet, which varies daily and depends on food seasonality and availability at the market.

All the food prepared for the animals was weighed for each cage separately before each feeding session. Rice porridge fed to gibbons in the morning and sweet potatoes given to doucs during the day as enrichment food were however weighed only once to use as standard value for analysis. All food items/plant species were weighed separately. Food for gibbons was weighed using a digital scale (Denver Instrument XP-300) and leaf bundles for douc langurs were weighed using a mechanic kitchen scale.

After each cage cleaning session, feces were collected and placed into Ziplock bags labeled with date and coded. One feces sample per cage per day was collected. All fecal samples were frozen immediately after collection.

The left-over food from each cage was sorted by food item/plant species and weighed separately.

A total of 57 samples were collected: 24 food samples, 28 feces samples and 5 leaf samples. The samples were tested at the Central Lab, Faculty of Animal Science and Aquaculture (FASA), Vietnam National University of Agriculture (VNUA) for their content in Neutral Detergent Fiber (NDF), Acid

Detergent Fibre (ADF), crude protein, crude fat, ash, moisture, energy, calcium, phosphorus, and lignin. Only the parts actually consumed by the animals were tested for nutritional content.

Preliminary Results and Discussion

Over the course of the study period (six days), the gibbons were fed with a diet of rice porridge, 13 types of vegetables, 10 types of fruits, boiled eggs and peanuts. The douc langurs were fed five browse species in similar quantities and sweet potatoes. Different proportions by weight of each food item were fed and eaten (Table 2).

Table 2. Proportion of fresh weight of food items fed and eaten by southern white-cheeked gibbon (*Nomascus siki*) and red-shanked douc (*Pygathrix nemaeus*) over a 6-day study at the Endangered Primate Rescue Center.

Food Item (%)	*P. nemaeus*		*N. siki*	
	given	eaten	given	eaten
Browse	98.60	95.73	-	-
Vegetables	1.40	4.27	57.86	61.58
Fruits			33.07	29.37
Egg			0.54	0.52
Grains			6.76	7.07
Peanuts			1.76	1.47

Note: the browse that gibbons were fed is negligible and was not recorded.

Interestingly, the gibbons chose to eat more vegetables and less fruits than the proportions provided overall. Historically these species are fed high fruit diets in captivity. Using the amounts of food ingested, we were able to calculate the nutrients ingested on a dry matter basis (Table 3).

Table 3. Concentration of nutrients ingested by southern white-cheeked gibbon (*Nomascus siki*) and red-shanked douc (*Pygathrix nemaeus*), on a dry matter basis, from the diet fed over a 6-day study period at the Endangered Primate Rescue Center.

	Ash	Protein	Fat	ADF	NDF	TNC	Ca	P	Energy	Ca:P
P. nemaeus	8.1	18.5	3.9	20.4	44.8	24.5	2.7	0.2	6.3	13.5
N. siki	4.7	11.1	3.6	9.0	30.1	50.3	0.5	0.2	2.8	2.1

All nutrients are in % dry matter; Energy is in kcal/g.
ADF=Acid Detergent Fibre; NDF=Neutral Detergent Fibre; TNC= Total Non-structural.
Carbohydrate; Ca=Calcium P=Phosphorus

The almost entire leaf diet of the douc langurs was high in protein, fibre and calcium while being low in soluble carbohydrates. These values are expected for a forgut fermenting primate although the high calcium content was a surprise (Nijboer et al. 2006). The gibbons chose to ingest a higher than expected fibre content (Neutral Detergent Fibre [NDF] = 30.1%) for a "frugivore" (National Research Council 2003). Ingesting and processing this amount of fibre takes significant morphological and physiological adaptations. Fruits given to primates in captivity are not equivalent to the fruits eaten in the wild (Schwitzer et al. 2009). Cultivated fruits are typically much higher in sugars and lower in fibre (Hon et al. 2018). Our misconception of frugivores having low fibre and high sugar requirements may therefore be erroneous (with some possible exceptions, e.g. spider monkeys) (Cabana et al. 2018).

The nutrients ingested multiplied by total dry mass ingested equals the number of each measured nutrient ingested in grams. These values were divided by the amounts of each nutrient in grams within the faeces to determine the apparent digestibility for each nutrient for both species (Table 4).

Table 4. Percentage (mean and standard deviation SD) of the apparent digestibility of macronutrients for southern white-cheeked gibbon (*Nomascus siki*) and red-shanked douc (*Pygathrix nemaeus*) fed at the Endangered Primate Rescue Center.

	Energy	Protein	Fat	ADF	NDF	Ca	P
P. nemaeus - Mean	86.61	80.17	54.4	83.92	89.15	86.59	51.34
P. nemaeus - SD	8.41	12.12	29.20	10.14	6.71	8.26	26.39
N. siki - Mean	91.26	87.99	81.01	86.63	92.58	88.74	84.44
N. siki - SD	4.52	9.27	19.74	6.52	3.34	5.69	8.53

ADF=Acid Detergent Fibre; NDF=Neutral Detergent Fibre; P=Phosphorus; Ca=Calcium

Based on our results, both the gibbons and the douc langurs were able to ferment structural carbohydrates with the gibbons having a slightly higher apparent digestibility for both ADF and NDF. Keeping in mind that the douc langurs ingested more fibre by weight, they therefore digested a much larger amount when compared to the gibbons. Colobine primates are expected to have an apparent digestibility of NDF of at least 60% (Edwards & Ullrey 1999; Nijboer et al. 2006). Our results indicate a mean apparent digestibility of 89.15% for the douc langurs which is consistent with their fibre degrading bacteria housed in their digestive system (Clayton et al. 2016). A mean apparent digestive efficiency of 92.58% for gibbons is much higher than anticipated and may highlight how adapted gibbons may be to fibre in their diet.

Lastly, the protein to NDF intake ratio is different between douc langurs (Fig. 1) and and gibbons (Fig. 2). Douc langurs were very specific and stringent in their selection of protein to fibre, choosing 2.7g of fibre to every gram of protein. Gibbons were less restrictive in their selection and the line of best fit generated had a low R value (0.68), which means the values are correlated but only barely. What was surprising, however, is that the gibbons definitely ingested more fibre than was thought necessary for this apparent frugivorous species (National Research Council 2003). Perhaps captive care for them should focus more on fibrous browse and vegetables and less on highly succulent fruits since this appears to be what they are intently selecting. Higher fibre diets also come with a host of health benefits for primates under human care (Clayton et al. 2016). With the surprisingly high apparent digestibility of fibre and the selection of fibrous foods, fibre may be more important in their diets than previously thought.

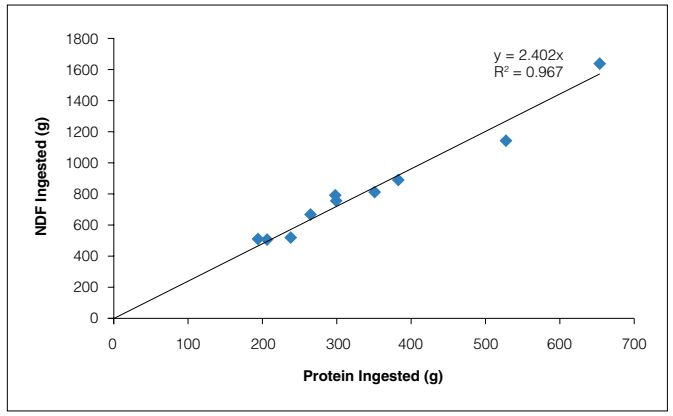

Fig.1. Protein to NDF intake ratio for douc langurs.

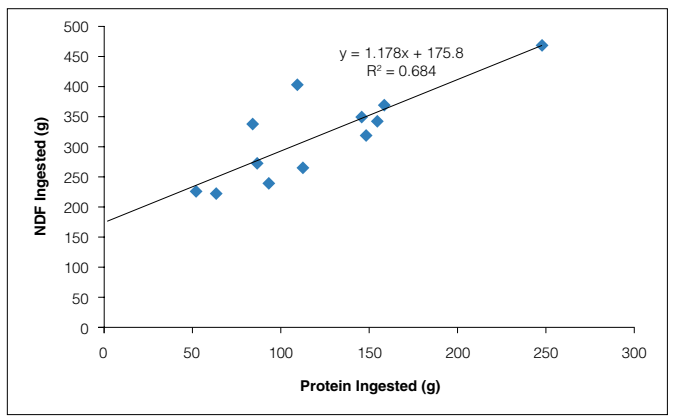

Fig.2. Protein to NDF intake ratio for gibbons.

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Preliminary study of an albino individual in a Francois langur group (*Trachypithecus francoisi*) with reference to *Trachypithecus* genus color variation

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Key words: albino, Francois langur, *Trachypithecus francoisi*, pelage color, behaviour

Summary

An albino female Francois langur was identified in a Francois langur group consisting of 12 individuals in Encheng National Nature Reserve, Daxin, China. Preliminary observation indicated that the albino was pure white from head to tail and clear contrast with other members. She exhibited foraging and cliff-climbing behaviors like other individuals. There were no cases of discrimination against her during our observation periods. Further study on both genetic differences amongst her parents and siblings and behaviors would be necessary to reveal the genetic mechanisms of albinism in langurs, which may provide more evidence to study the albinism mechanism among the *Trachypithecus* genus.

Kết quả nghiên cứu ban đầu về cá thể bạch tạng trong bầy Voọc đen má trắng (*Trachypithecus francoisi*) và liên hệ với sự đa dạng màu sắc của giống *Trachypithecus*

Tóm tắt

Một cá thể cái loài Voọc đen má trắng mắc bệnh bạch tạng được nhận diện trong bầy gồm 12 cá thể tại khu bảo tồn Encheng, Daxin, Trung Quốc. Những quan sát trực tiếp cho thấy cá thể này có màu sắc thân trắng toàn bộ từ đầu đến đuôi, và tương phản hoàn toàn với các cá thể khác trong bầy. Về tập tính từ kiếm ăn đến leo treo trên núi đá, cá thể này hoàn toàn giống các cá thể khác. Suốt thời gian nghiên cứu, chúng tôi không ghi nhận bất kỳ hành động kỳ thị nào từ các con khác trong bầy đối với cá thể cái này. Cần có thêm những nghiên cứu về di truyền đối với bố mẹ và các thành viên trong gia đình của cá thể này để có những kết luận về cơ chế di truyền đối với bệnh bạch tạng ở các loài Voọc. Những nghiên cứu này cũng có thể đưa ra những bằng chứng rõ ràng hơn về cơ chế gây bệnh bạch tạng trong giống *Trachypithecus*.

Introduction

Body color is important for camouflaging (Sun 2006) and most primates display black, black and white, or a dark coat (Fleagle 2013; Groves 2001; Mittermeier et al. 2013). The colobine genus *Trachypithecus*, includes 20 species. Of these, seven species are classified in the *francoisi* langur species group including the Francois langur (*T. francoisi*), the white-headed langur (*T. leucocephalus*) and the Cat Ba langur *(T. poliocephalus*) in the northern area of the distribution, the Delacour's langur (*T. delacouri*) in the central area and the Hatinh langur (*T. hatinhesis*), the black morph of the Hatinh langur (*T. hatinhensis* morph *ebenus*) and the Lao langur (*T. laotum*) in the South. Populations of all three clades are able to survive in karst habitats, landscapes underlain by limestone. Therefore they

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