VOLUNTARY INTAKE BY HYACINTH MACAWS (*ANODORHYNCHUS HYACINTHINUS*)

María Julieta Olocco Diz, Ing P.A., Nutritionist
Nutrition Department, Temaikèn Foundation, Escobar, Buenos Aires, ARGENTINA

Abstract

In August 2004 two juvenile Hyacinth Macaws (*Anodorhynchus hyacinthus*) arrived at Temaikèn Wild Animal Park. Their feathers were in very bad condition and they weighed 1,230 g on average. At the very beginning, a diet with a great variety of ingredients was given. Two months later, during a first 5-day period leftovers were measured. At that moment the animals weighed 1,305 g on average. Once it was identified which ingredients were preferred, during a second 14-day period the animals were offered a new high calorie diet in order to improve their weight. After that, a maintenance diet was given twice a day and leftovers were measured again. The diet consumed during this third 5-day period, was 50% water; 16.86% crude protein on Dry Matter Basis (DMB) and 15.39% crude fat (DMB). At this time animals averaged 1333.55 g. At the end of the trial these birds had increased their feed intake from 9% to 13% of their body weight on an as-fed basis. Their feather colour also progressively improved.

Introduction

The Hyacinth Macaw (*Anodorhynchus hyacinthinus)* is the biggest parrot in the world. Historically, its distribution included central Brazil, Argentina, Paraguay and Bolivia. In Brazil, the former wide distribution has shrunk to the Pantanal area and small dispersed points. The natural habitat is the Pantanal Biome, which is completely flooded for nearly 5 months. On those soils, groves of *Acrocomia sp.* and *Schelea sp* are found. The nuts of those palms make up the largest percentage of the Hyacinths' diet. [(4)]

Hyacinth Macaws have the biggest bills of all parrots. They are not only remarkable in size but also in strength. These birds use their lower mandible like a chisel to split extremely hard palm nuts.[(4)]

Because of its beautiful coloration, the Hyacinth Macaw is a common victim of animal trafficking[(7)]. It appears likely that many more are now in captivity than remain living in the wild. This species is in danger of extinction and is classified as threatened (Vulnerable/Rare).[(1)]

On October 18th 2004, we started to formulate a definitive diet for two juvenile Hyacinth Macaws that arrived at Temaikèn on August 13th 2004. The condition of their plumage was very bad and the feed intake was not good. They were accustomed to eating mainly palm nuts in their previous home, which proved to be very difficult to find near Temaikèn. Different foods were tried until the best consumed ingredients were defined.

Methods

On their arrival, the birds were placed in a 2.10 m x 1.55 m x 3.20 m cage in the internal area of the clinical ward at Temaikèn Veterinary Hospital. The temperature at the hospital was controlled between 26° and 27° C. The female weighed 1130 g and the male weighed 1330 g.

This study consisted of three parts (Table 1). Initially, during 5 days a great variety of ingredients were weighed and offered. The following day the leftovers were collected and weighed. During this period, three 15-minute observations were made every day (10:00 am, 12:00 am and 5:30 pm) and attitude, competence and preferences were recorded.

During this part of the trial, apples, seed mixes for hens, water melons, cooked carrots, complete feed for layers (hens), and bird feed (CéDé® Universal & CéDé® Eggfood color) were offered all together in one feeder on the floor. The other feeder, that was also on the floor, had pears, oranges, complete feed for broilers, corns, and parrot seed mixes. The last feeder was hung at a height of 1.5 m and it offered almonds, peanuts, coconuts, raw carrots and complete dog food.

Feeding logs were set up to record date, animal weight (precision scale used: Moretti® OM 6000, max. weight 6 kg, accuracy 1g), ingredients offered, amount offered, amount consumed, and overall behaviour of the animal at feeding. Animals were weighed before each feeding and data recorded. (Fig 1- Photo 1)

After this first period, knowing which ingredients and which part of the ingredients were well consumed, a diet was formulated in order to improve the Hyacinth macaws feed intake. During the second 16-day period, this special diet was offered and animal weights were recorded.

Finally, for the third period, a new maintenance diet was formulated (using Zootrition Version 2.0- Wildlife Conservation Society) and given to the birds. Also, the voluntary intake was measured during 5 days (Table 2).

During the first and the third periods, leftover collections were carried out only from Monday to Friday due to the personnel availability.

The diet was offered twice daily in order to improve acceptance of some of the ingredients. During the morning the complete dog food and complete monkey food were given. Amino acid supplement was added to the water. After midday the rest of the diet was given. Also during this week, three 15-minute observations were made every day (10:00 am- 12:00 am and 5:30 pm) and recorded. Water was always available.

***Table 1**: Offered diets in grams.*

Ingredient	Presentation	First Diet (g)	Fatting diet (g)	Maintenance Diet (g)
Period		**1st: 5 days**	**2nd: 16 days**	**3rd: 5 days**
Almonds	Whole with shell	15	50	25
Amino acids	Powder		5	5
Apples	Fresh- Pieces	145		
Bananas	Pieces with peel		100	

Bird food (CéDé® Eggfood color)	Paste	3		
Bird food (CéDé® Universal)	Paste	3		
Broccolis	Raw- Pieces			50
Calcium carbonate	Milled	1,25	2	2
Carrots	Raw- Pieces	19	150	50
Carrots	Whole- cooked	25		
Coconuts	Pieces with shell	53	40	20
Complete feed for broilers (Cargill®)	Pellet	38		
Complete feed for hens (Cargill®),	Pellet	38		
Complete feed for monkeys (21 % CP)	Extruder			90
Complete food for dogs (Eukanuba®, Adult Maintenance)	Pellet	19	110	110
Corn with stalks	Whole- cooked	25	150	150
MCP (Kynofos® 21)	Granulated	2,5	5	5
Mix for parrots	Whole seeds	50		30
Oranges	Fresh- Pieces	38		
Peanuts	Whole with shell	15	40	20
Pears	Fresh- Pieces	38		
Pineapples	Fresh- Pieces		100	70
Seed mix with beans for hens	Whole seeds	45		
Sunflower seeds	Whole		30	
Sweet potatoes	Raw- Pieces			70
Vitamins and Minerals (Mixtural®)	Powder		2	2
Water melons	Noisette	10		
TOTAL		**582,75**	**584**	**629**

Results

The male weighed 1,441 g and the female 1,197 g at the beginning of the trial. During the first period they weighed 1,429.5 g and 1,180.5 g on average respectively and consumed 9% of their body weight on an as-fed basis. During the following period they went up to 1,492.55 g and 1,220.6 g on average. During the third period the average weights were 1,457.8 and 1,209.3 g and the feed intake had increased to 13% of their body weight on an as-fed basis (6.5% DMB). (Fig. 1)

Fig 1*- Hyacinth Macaws weights and as fed intake*

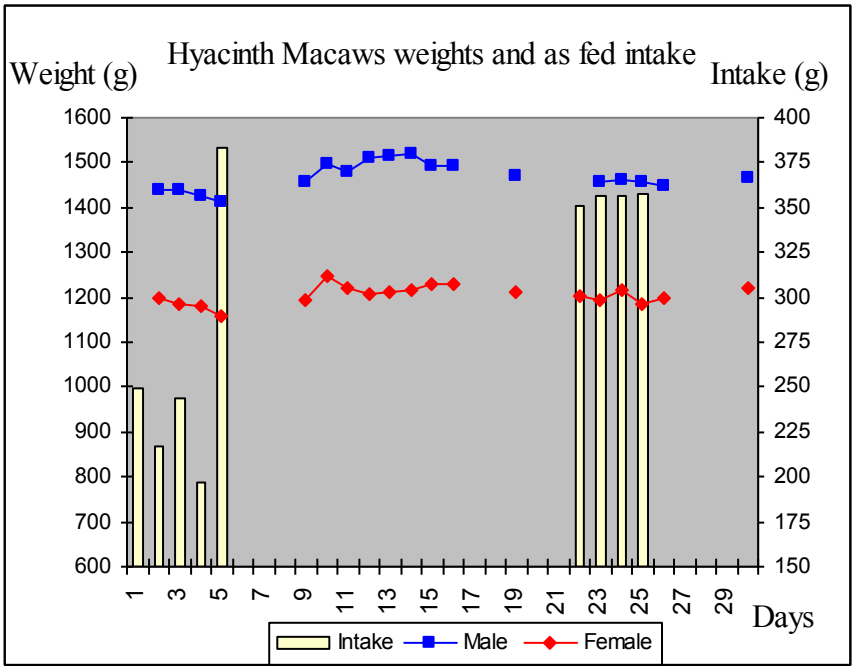

Table 2: Diet Intake

Ingredient	Consumed part	First Diet (g)	Maintenance Diet (g)
Period		**1st: 5 days**	**3rd: 4 days**
Almonds	Whole with shell	13.5	19.25
Amino acids	-		
Apples	Without peel	53.8	
Bird food (CéDé® Eggfood color)	-	2.0	
Bird food (CéDé® Universal)	-	2.0	
Broccolis	Whole		8.75
Calcium carbonate	-	0.8	
Carrot	Whole	4.8	
Carrot	Whole	19.0	37.25
Coconut	Whole with shell	13.5	20.00
Complete feed for broilers (Cargill®)	Whole	0.6	
Complete feed for hens (Cargill®),	Whole	0.6	
Complete feed for monkeys (21 % CP)	Whole		64.50
Complete food for dogs (Eukanuba®, Adult Maint.)	Whole	18.0	70.75
Corn with stalks	Whole	22.5	84.50
MCP (Kynofos® 21)	-	1.7	
Mix for parrots	Without husk	23.8	
Oranges	Without peel	15.8	
Others		29.7	2.55
Peanuts	Whole with shell	12.5	17.50
Pears	Whole	15.8	

Pineapples	Whole		17.75
Seed mix with beans for hens	Whole	1.0	
Sunflower seeds	Without husk		5
Sweet potatoes	Whole		7.75
Vitamins and Minerals (Mixtural®)	-		
Water melon	Whole	5.3	
TOTAL on average		**237.7**	**355.55**

The maintenance diet consumed in the third part of the trial was 50% Water, 16.86% CP (DMB), 15.39% CF (DMB), 5.45% Ash (DMB), 0.82% Ca (DMB), 0.82% P (DMB). (Source Zootrition). (Table 3)

Table 3*: Selected nutrient analysis (DM basis) of average diet consumed by Temaikèn Hyacinths.*

Dry Matter %	Crude Protein %	Crude Fat %	Crude Fibre %	Ash %
50	16.86	15.35	3.81	5.45

At the very beginning observations were difficult since animals were curious of personnel behaviour and stared at them. At the end of the trial they were familiar with their presence and ignored them, keeping to themselves. In general the male always spent more time feeding than the female, but the female got the diet first selecting the favourite ingredients.

Regarding the observation records, the hyacinths' favourite ingredients were peanuts and almonds with shell. Almond shells were also well accepted. The corn on the stalks, the coconut with shell, the complete feed for dogs and the raw carrots were chosen in second place. Fruits and small pellets had very low consumption. The animals chose bigger pieces of fruits or vegetables, perhaps because they could use their feet to grab them.

Discussion

Across granivorous avian species, the protein requirements (expressed as percentage of the diet) increases with increased body size. Therefore, higher levels of protein may be required by macaws[3]. Dierenfeld and Graffam (1996) gave some examples that suggested the protein requirements for some macaws are around 16%- 22% protein (DMB), and not more than 10% fat (DMB)[2]. Also there are some diets for hyacinths from Disney zoo (Valdez 2003)[6] that were formulated with 21.77% crude protein (DMB) and 8.98% crude fat (DMB). On the other hand, data from Koutsos (2001) suggests that palm nuts that are consumed in the wild by Hyacinths have 50% lipid content[3]. Considering the diet in this study, it was concluded that with 16.86% protein content (DMB) and 15% fat content (DMB), which is likely to be correct, the feathers recovered their colour progressively and the animals also maintained their weight.

Blue is a structural colour in feathers. In most cases, its occurrence depends on a scattering of light caused by the structure of the keratin in the spongy layer of the feather rami, rather than on

the presence of pigment. Essential amino acids that occur in keratin include methionine, histidine, lysine, triptophan, threonine, isoleucine and valine. It is possible that amino acid deficiencies could alter the structure of keratin and consequently alter feather colour. Feather colour may change from blue to black in birds that are sick or malnourished. When this occurs, melanin granules in the middle of the feather, if present, would absorb all wave lengths of light, giving the visual effect of black.[5] At the beginning of the trial the birds presented gray zones in the feathers of the nape of the neck and mantle as well as on their abdomen and black feathers in their wings, which might be the result of the structure of the keratin (Photo 2). Some tail feathers were also damaged and so they had to be replaced. Therefore, supplementing amino acids was essential to improve the condition of the feathers. In this case an in-house formula of amino acids that included methionine, lysine, tryphtophan, arginine, cystine and histidine was used in the water. Consequently, intense blue was recovered after shedding (Photo 3 - 4).

Considering the animals preferred hard ingredients, powder supplementation became difficult, since it did not contain these ingredients. Supplementing in water was a good solution although it is known to be problematic for two reasons: instability and oxidation"[3]. As part of the diet amino acid supplement was added once a day in clean water.

Many animals are able to balance energy, amino acids and calcium levels in their diets by selecting among dietary items, but there is little evidence that animals can select adequate levels of many other nutrients[3]. Therefore different times of feeding must be taken into consideration to improve the acceptance of some balanced ingredients as pellets.

Conclusion

The principal goal of this trial was to determine the appropriate diet amounts of the offered items to the Hyacinth Macaws. On the other hand, it also revealed which ingredients the animals preferred, what the method of consumption was and which part of the ingredients they consumed. Special care must be taken when formulating their diet since hard nuts must be given both to keep their bills healthy and for enrichment purposes.

The development of this diet will be taken into consideration for other Hyacinth Macaws that arrive at Temaikèn in the future.

Acknowledgments
Special thanks to Viviana Quse (Senior Veterinarian) and Ana Duggan (Junior Veterinarian) for helping me with corrections to this paper. Also my gratitude to the Veterinary Hospital Staff (Julieta Esmaiman, María Gabriela Loriente Reyes, and Paola Quiroz), who helped me with the weights of the animals and the collections of the leftovers.

LITERATURE CITED

1- Collar, N. J., Gonzaga, L. P., Krabbe, N., Madroño Nieto, A., Naranjo, L. G.; Parker, T. A. & Wege, D. C.; (1992); Threatened birds of the Americas: the ICBP/IUCN Red Data Book. Cambridge, UK: International Council for Bird Preservation.

2- Dierenfeld, E.; Graffam W.S. (1996) Manual de Nutrición y Dietas para animales Silvestres en Cautiverio (Ejemplos para animales de América latina); Wildlife Conservation Society; Bronx, NY; Pp 64 and 71-72.
3- Koutsos E.A.; Matson K.D.; Klasing K.C.; (2001) Nutrition of Birds in the Order Psittaciformes: A review; Journal of Avian Medicine and Surgery; USA. 15 (4) 257- 275
4- Lücker, H.; (1995); Biology, Breeding, and Keeping of the Hyacinth Macaw (*Anodorhynchus hyacinthinus);* Zoo Pädagogik Unterricht (Year 3, Volume III); Kassel, Germany.
5- Macwhirter P.; (1999) Malnutrition; Ritchie, B.W.; Harrison G. J. and Harrison L. R.; Avian Medicine: Principles and Application; USA; C31 pp 842- 860.
6- Valdez E.V.; (2003); Recetas y Análisis Nutritivos de las Dietas de "Disney Animal Kingdom (DAK)" USA.
7- Zalmir, S.C. (2002) Natural History Aspects of South American Psittacines; Exotic; DVM; Vol 4.3. p 20-22.

Photo 1: Operant conditioning for weighing.

Photo 2: Feather condition at arrival.

Photo 3: Feather condition after new diet.

Photo 4: Feather condition after new diet.