GROWTH RATES AND NUTRIENT INTAKE OF HAND-REARED PINK-BACKED PELICANS (*PELECANUS RUFESCENS*) AT DISNEY'S ANIMAL KINGDOM

Shannon Livingston, MSc,[1]* and Eduardo V. Valdes, PhD[2]

[1]University of Florida, Department of Animal Sciences, Gainesville, Florida, 32611; [2]Disney's Animal Kingdom, PO Box 10,000 Lake Buena Vista, Florida, 32830

Abstract

Between December 18, 2006 and February 12, 2007, four pink-backed pelican (*Pelecanus rufescens*) chicks were hatched and hand reared at Disney's Animal Kingdom (DAK). A pelican hand rearing protocol was developed based on that of the San Diego Zoological Society. The diet was designed to consist of combinations of capelin, smelt, sardines and herring, along with a vitamin and mineral supplement and a thiamin/vitamin E paste. Fish species offered varied with age of chick starting with capelin and smelt, then adding sardines and then herring to the diet. As the chicks grew, it was decided to remove capelin from the diet and replace it with trout, which is a component of the adult pelican diet at DAK. Crude protein levels of the diet averaged 60% and fat levels averaged 20% (both DMB). The calcium level of the diet ranged from 1.3% to 1.8% and calcium to phosphorus ratios ranged from 1:1 to 1.4:1. The metabolizable energy (ME) of the diet was estimated at 4.3 kcal/g, based on published ME values of fish for other fish eating birds. All chicks exhibited similar growth rates and ME intakes. Adult body weight was achieved by seven weeks of age and three of four chicks were successfully raised and returned to the pelican colony.

Introduction

In the fall of 2006, the colony of pink-backed pelicans (*Pelecanus rufescens*) at Disney's Animal Kingdom (DAK) started nesting for the first time. Due to problems with river hippos (*Hippopotamus amphibious*) destroying pelican nests, four eggs were retrieved from the colony and set up in incubators at the Avian Research Center (ARC). Preparations were made to hand rear any chicks that hatched. Hand rearing protocols were obtained from local pelican rescue establishments as well as from the San Diego Zoological Society (SDZS). As the San Diego Zoo had recently successfully raised dalmatian pelicans (*Pelecanus crispus*), their protocol was used as the basis for the hand rearing protocol for the pelicans at DAK. On December 18, 2006, the first pink-backed pelican chick hatched at Disney's Animal Kingdom.

The objective of this study was to document the growth rates and the nutrient intake of hand raised pelican chicks at DAK in late 2006 and early 2007.

Methods

Four pelican eggs were retrieved from the pink-backed pelican colony and placed in incubators at the ARC for safety reasons. The hand rearing protocol used successfully by the San Diego Zoo was used as the basis for the protocol set up at DAK. The original DAK protocol is recorded in Table 1. Capelin, sardines and herring were obtained through the fish vendor used

by the animal nutrition center at DAK, as these items are not regularly stocked. The smelt and trout used for the hand rearing diet was the same as used for other fish based diets at DAK. Four chicks, two males and two females, hatched between December 18, 2006 and February 12, 2007. Birds were cared for by ARC staff and by Ituri keeping staff. Chick weights and food intakes were recorded daily. Adjustments were made to the hand rearing diet according to the needs of the individual chicks, as determined by the avian staff, veterinary staff and nutrition staff. Any dietary adjustments and medical procedures were recorded on each chick's record sheet. Using the weights and intakes recorded by the keepers, growth rates were determined and nutrient intake was calculated. Nutrient content of the diet was calculated using Zootrition software Version 2.5 (St Louis Zoo) and values obtained through independent lab analysis of all fish and supplements used. All nutrient levels were recorded on a dry matter basis (DMB).

Results and Discussion

Three of the four chicks were successfully raised to adult size and integrated into the pelican colony. One chick died of complications from metabolic bone disease (MBD) in the 6th week. The hand rearing protocol was adjusted from that of SDZS based on the needs of the chicks. Amounts offered to the chicks were increased from the original protocol, and were eventually put on an increase as requested basis rather than based on chick age. The chicks were offered small pieces of fish, species dependant on their age according to the protocol. The small pieces were offered to the chicks with tweezers, although they began self-feeding at a relatively young age. Other records of pelican hand rearing[6] indicated that chicks were fed a gruel diet using a syringe; however we found that these chicks were able to eat the cut-up pieces of fish with no problems. The number of feedings per day is listed on the protocol. Supplements were offered with the first or second feed of the day. Chelated iron and copper tablets were added to the diet based on blood values obtained from the first two chicks. Veterinary staff were concerned that chick blood values indicated possible anemia, so one tablet of chelated iron (Carlson Laboratories Inc, Arlington Heights, IL 60004; 27 mg iron as iron glycinate chelate) and one tablet of chelated copper (Carlson Laboratories Inc, Arlington Heights, IL 60004; five mg copper as copper glycinate chelate) were added to the diet at day 45 and day 15 for chicks 1 (060505) and 2 (070030) respectively. Chicks 3 (070064) and 4 (070066) were prescribed ¼ tablet each of iron and copper to be offered every other day, starting on day 7 and increasing in dose as the body weight increased. In addition, Thiamin E Vitamin Supplement for Piscivores (Stuart Products Inc, Bedford Texas 76021 – one g per kg fish) and Nekton S (Günter Enderle, D-75177 Pforzheim Germany - 0.5g per 250g fish) were included as supplements in the diet from day one for all chicks.

Due to availability issues (block frozen and not a regularly stocked item); it was decided to remove capelin from the hand rearing diet in late February. Capelin was gradually replaced with trout, which is a main component of the adult pelican diet. Chick one was weaned off capelin on day 88, chicks three and four by the end of week two. Figure 1 shows the growth rates for each chick. Growth curves show a similar trend for all chicks, increasing rapidly for close to eight weeks at which point they leveled off. Average weights for adults in the colony are five kg for males and 3.9 kg for females. The three surviving chicks had reached or exceeded the average body weight for their sex by seven weeks of age. All three chicks had body weights higher than the group average at the time of integration into the colony. Fish consumed as a percent of body

weight followed a curve similar to that representing the percent of body weight increase (Figure 2 and Figure 3). The highest increases in percent body weight took place in the first few weeks, where increases of 100% to 200% in body weight per week were observed. Nutrient intake levels reported are based on an assumed intake of different fish species as prescribed by the protocol. Total intake of fish was recorded each day for each bird; however intake levels of individual fish species were not. Based on the total intake and prescribed proportion of the different fish species from the protocol, nutrient amounts were calculated using Zootrition software. Regardless of adjustments made to the diet for each chick, the overall nutrient trends remained similar.

After day 15, the chicks were provided daily exposure to natural sunlight providing that the environmental temperature was greater than 15° C. One theory for the development of MBD in chick two was a deficiency in vitamin D3 due to a lack of sunlight exposure. Colder outdoor temperatures experienced during its developmental stages prevented this particular chick from spending much time out doors. Necropsy findings (available after all chicks were raised) indicated that kidney problems may have also contributed to the development of MBD through reduced renal absorption of vitamin D3. Calcium and phosphorus ratios started close to 1.0, increased in weeks two and three up to a maximum ratio of 1.4 and then leveled off close to 1.2 to 1.25. Absolute calcium levels of the diet ranged from 1.3% to 1.8% of the diet. The calcium level of the diet was above that recommended by the NRC for turkey poults[5] however, the phosphorus level of the diet was also higher, which resulted in a lower than recommended calcium to phosphorus ratio. As altricial chicks have a faster growth rate and lower calcification of the skeleton than precocial chicks,[4] supplementation to increase the calcium to phosphorus ratio may be warranted and is being considered for future protocols.

Protein and fat intake levels are shown in Figure 4. Protein started high in the first week, decreased slightly in weeks two and three, then returned to near starting levels of 60% to 65% (DMB). Fat content of the diet followed an opposite trend to that of protein levels. Fat content of the diet started at around 30% of the diet, increased to 40% in weeks two and three (when protein levels dropped) and then reduced to approximately 20% of the diet for the remainder of the recording period. Metabolizable energy (ME) values were estimated from gross energy (GE) values of the diet combined with an average of ME values of fish reported for other fish eating birds. Values of apparent metabolizable energy coefficients (AMEC) reported for a variety of fish species by members of Pelecaniformes (cormorants and pelicans) were summarized by Bennett and Hart (1993), the average of which was 0.762. AMEC for herring and trout were also determined for great blue heron chicks as 0.621 and 0.842 respectively.[1] Brugger[2] recorded the ME of capelin by double-crested cormorants as 0.841. These values were averaged, equaling 0.764, to provide an average ME of fish consumed by fish eating birds, which was used to estimate the ME of the diet consumed by the pelican chicks. This ME value was multiplied by the GE of the diet to estimate the ME intake of the pelican chicks. Figure 5 shows the estimated ME intake for each chick per gram of body weight. All chicks displayed peak ME/g BW between weeks three and four.

The anemia suspected in the chicks was satisfactorily resolved although it is unknown how the supplementation of chelated iron and chelated copper was involved. As comparable adult blood values were not available, banked blood samples from some adult birds in the colony were sent

to be retested for trace minerals. Iron levels were similar between the two groups, although the highest value was recorded by chick one prior to supplementation. Table 3 displays some mean trace mineral values for chicks and adult pelicans. Mean copper levels of the chicks were lower than those of the adults; however both mean iron and mean zinc levels were lower in the adults. Blood values obtained from wild rockhopper penguins (*Eudyptes chrysocomes*)[3] show mean values for copper, iron and zinc higher than those recorded for our pelicans. Future blood sampling will include trace mineral levels in order to better determine the normal levels of our pelicans.

As the original protocol called for headless fish for the first 3 weeks, whole fish samples were tested with and without heads for trace minerals. When offered fish without heads, the chick diets were deficient in copper and marginal for iron and zinc, according to requirements for poultry.[5] When the diets consist of whole fish with heads, the levels of copper, iron and zinc are within recommended guidelines. However, when the diets are supplemented with whole tablets of chelated copper and iron, amounts in the diet far exceed amounts recommended for poultry.[5] Without the chelated copper and iron supplementation, iron levels still exceed requirements of poultry. Copper values just meet poultry requirements. As it is unknown how pelican requirements actually relate to those of poultry, it may be wise to offer smaller amounts of copper supplementation to provide a margin of safety. For these reasons, future hand rearing protocols will, when possible, include whole fish with heads from day one. It is also recommended that chelated iron and copper be supplemented at a lower dose of ¼ tablet four times weekly for the first two weeks and then daily until six weeks of age, provided that further blood tests show that it is warranted. At six weeks of age, the iron supplementation will be discontinued. Copper supplementation will continue until the chicks are transitioned to the adult diet. Requirements for growing poultry show a decreased requirement for copper and iron at the age of four weeks (turkeys) or six weeks (chickens and quail),[5] hence the timing of supplementation changes.

The adult diet of pink-backed pelicans housed at DAK consists of equal amounts of whole lake smelt and trout, supplemented with Thiamin E paste. After the pelican chicks had reached adult size and been transferred from ARC to the Ituri pelican holding area, it was decided to begin the transition to the adult diet. The herring portion of the diet was gradually replaced with trout, and the sardine portion of the diet was gradually replaced with smelt. Over a two to three week period, the chicks were successfully transitioned to the adult diet.

Conclusions

The hand rearing protocol used to raise pink-backed pelicans was successful in raising chicks to healthy adult-sized birds. Table 2 shows proposed revisions to the protocol including substituting trout for capelin, offering whole fish with heads (when size permits) and reducing the amount of chelated iron and copper offered. Over the period of the hand rearing process, chicks showed tendencies to periodically prefer one fish species to another. For this reason, it is advised to offer more than one species of fish, possibly preventing an unnecessary decrease in food intake. A combination of fish species that results in a diet (DMB) containing 60% crude protein, 20% crude fat and an ME value of 4.3 kcal/g appears to provide adequate nutrition for the growth of pink-backed pelicans. Care should be taken to provide a proper balance of

minerals. This study found that 1.3% to 1.8% calcium in a 1:1 to 1.4:1 ratio with phosphorus allowed for proper bone formation when combined with adequate exposure to sunlight. Levels of other macro minerals as well as trace minerals should be monitored to prevent anemia and other signs of mineral deficiency. Sunlight is required to allow for the proper functioning of vitamin D and calcium metabolism. In the event that natural sunlight is not available, it may be wise to substitute periodic exposure to UV lights and provide a supplemental source of vitamin D3.

Acknowledgments

The authors wish to recognize the dedication of the aviary and Ituri teams in the hand rearing process. Excellent records were kept throughout the hand rearing process by all the keepers involved, without which, this study would not have been possible. In particular, we would like to thank Paul Schutz, one of the avian zoo managers responsible for the pelican rearing as well as keepers Kevin Graham and James Grant, for not only keeping good records, but for making sure we received copies of them weekly. We would also like to thank the aviary and nutrition departments of the San Diego Zoological Society for sharing their pelican rearing protocol with us.

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Table 1. Original hand rearing protocol for Pelicans chicks at Disney's Animal Kingdom*

Day	Items	Feeds per day	% BW[1] fed	Comments
1	50% capelin 50% smelt 1g thiamin/E paste[2] per kg fish 2g Nekton S[3] per kg fish	5	30%	Fish with no heads or tails Offer vitamins in 1st or 2nd feed of the day Mix fish in pedialyte as needed for hydration
3			35%	
5			40%	
7			50%	
8	1/3 capelin 1/3 smelt 1/3 sardines Supplements as before			No heads or tails
10			40%	
11		4		
15	25% capelin 25% smelt 25% sardines 25% herring			Whole fish with heads and tails
16		3		
23			30%	
25			25%	
26			20%	
41			15%	
44			13%	
53		2		
?	Transition to adult diet	2		
				Adult diet consists of 50% smelt and 50% trout. Thiamin/E paste is supplemented at 1g per kg fish

*Based on the protocol provided by the San Diego Zoo
[1]BW=body weight
[2]Stuart Products Inc, Bedford Texas 76021
[3]Günter Enderle, D-75177 Pforzheim Germany

Table 2. Revised hand rearing protocol for Pelicans reared at Disney's Animal Kingdom

Day	Items	Feeds per day	% body weight fed	Comments
1	50% sardine; 50% smelt 1g thiamin/E paste[1] per kg fish 2g Nekton S[2] per kg fish ¼ tablet each chelated iron[3] and copper[4]	5	35%	Use smallest whole fish available, leave heads on, tails can be removed Offer vitamins in 1st or 2nd feed of the day. Mix fish in pedialyte as needed for hydration. Iron and copper offered 4 times weekly Average hatch wt – 76g
3			40%	Average chick wt – 99g
5			50%	Average chick wt – 144g
7			45%	Average chick wt – 225g
8	1/3 sardine; 1/3 smelt; 1/3 trout; Supplements			Leave heads on, tails removed
10			35%	Average chick wt – 350g
11		4		
15	25% sardine; 25% smelt 25% trout; 25% herring			Leave heads and tails on Increase copper and iron to ¼ tablet of each daily
16		3		
23			30%	Average chick wt – 1570g
25			25%	
26			20%	
41			15%	Average chick wt – 4255g
43				Copper supplementation stays at ¼ tablet daily – iron is removed.
44			13%	
53		2	10%	Average chick wt – 5100g
10 weeks	30% smelt; 30% trout 20% sardine; 20% herring	2	Same amounts as adults	Start transition to adult diet
11 weeks	40% smelt; 40% trout 10% sardines; 10% herring	2		
12 weeks	50% smelt 50% trout	2		Adult diet. Remove Nekton S and copper supplementation

[1]Stuart Products Inc, Bedford Texas 76021

[2]Günter Enderle, D-75177 Pforzheim Germany

[3]Tablet = 27 mg iron as iron glycinate chelate; Carlson Laboratories Inc, Arlington Heights, IL 60004

[4]Tablet = five mg copper as copper glycinate chelate; Carlson Laboratories Inc, Arlington Heights, IL 60004

Table 3. Mean trace mineral blood values (± standard deviation) of juvenile and adult pink-backed pelicans at Disney's Animal Kingdom and free-ranging rockhopper penguins[3]

Trace mineral	Juvenile Pink backed pelicans	Adult pink-backed pelicans	Free-ranging rockhopper penguins[3]
Copper, ppm	0.15 +/- 0.06 n=6	0.31 +/-0.17 n=9	0.29 +/- 0.06 n=36
Iron, ppm	1.0 +/- 0.83 n=6	0.41 +/- 0.24 n=9	2.28 +/- 1.40 n=38
Zn, ppm	2.18 +/- 0.35 n=6	1.74 +/- 0.47 n=9	2.80 +/- 0.46 n=38

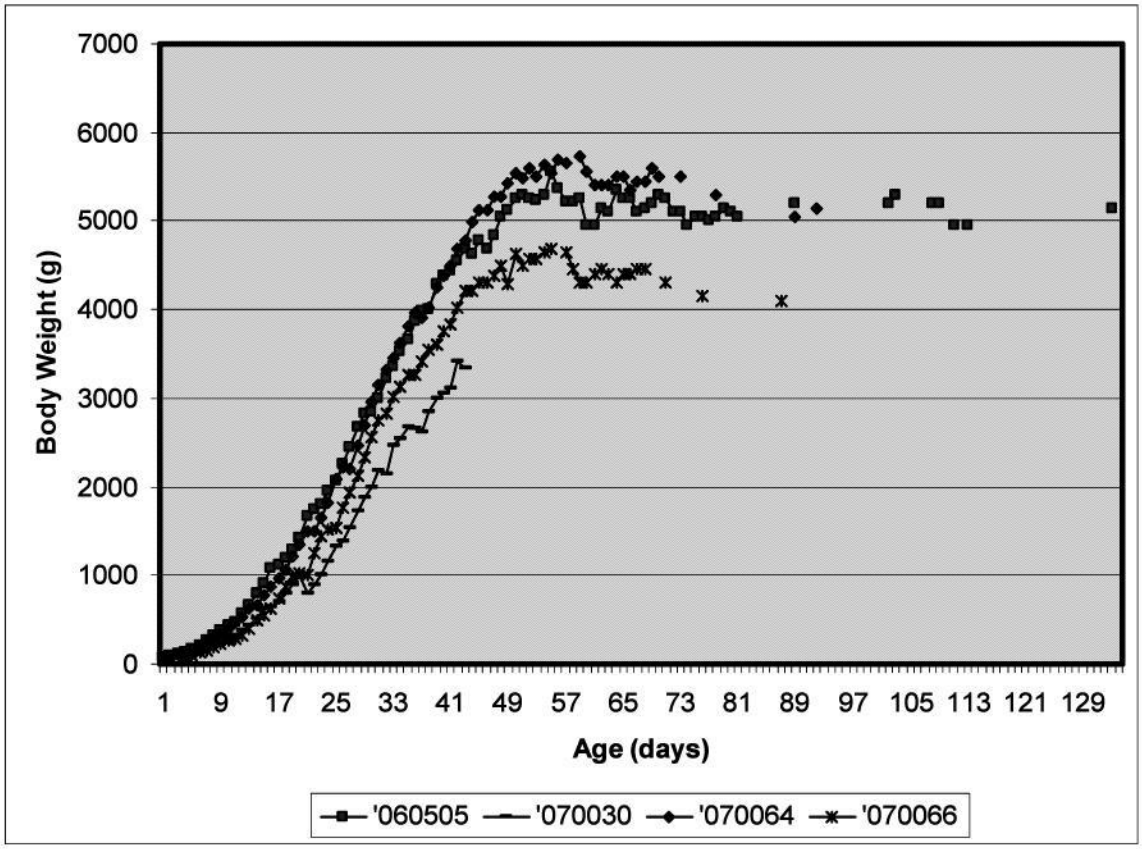

Figure1. Growth rates of pink-backed Pelican (*Pelecanus rufescens*) chicks raised at Disney's Animal Kingdom.

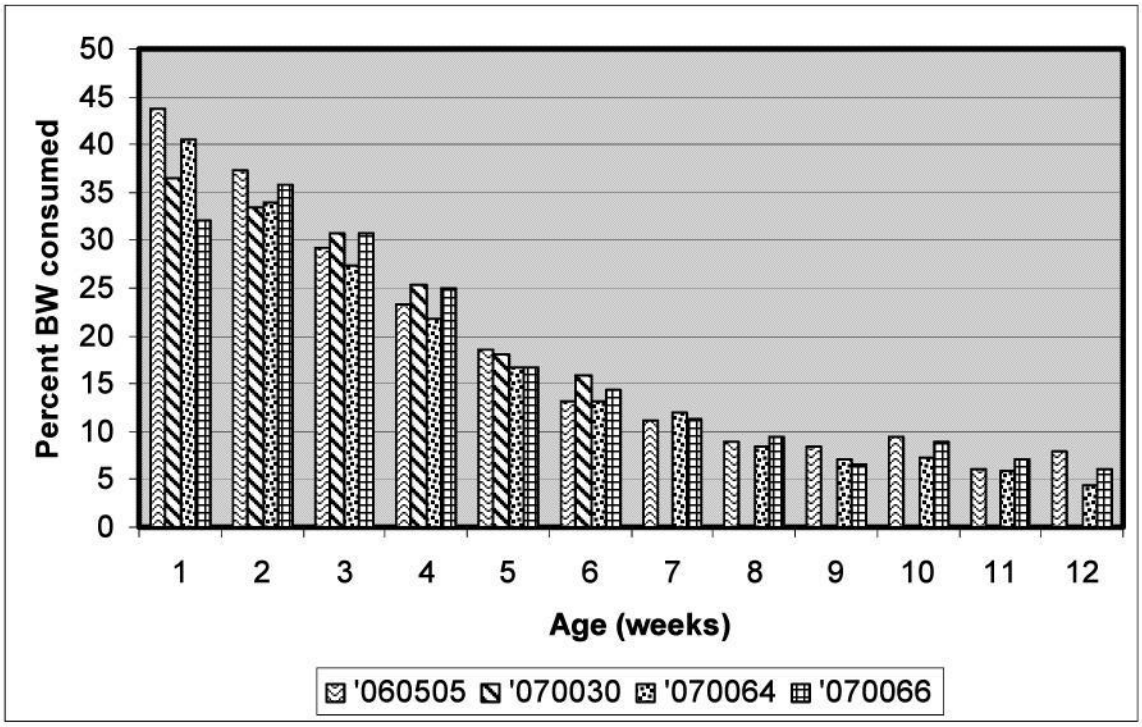

Figure 2. Percent body weight (BW) consumed weekly by pink-backed pelican chicks at Disney's Animal Kingdom.

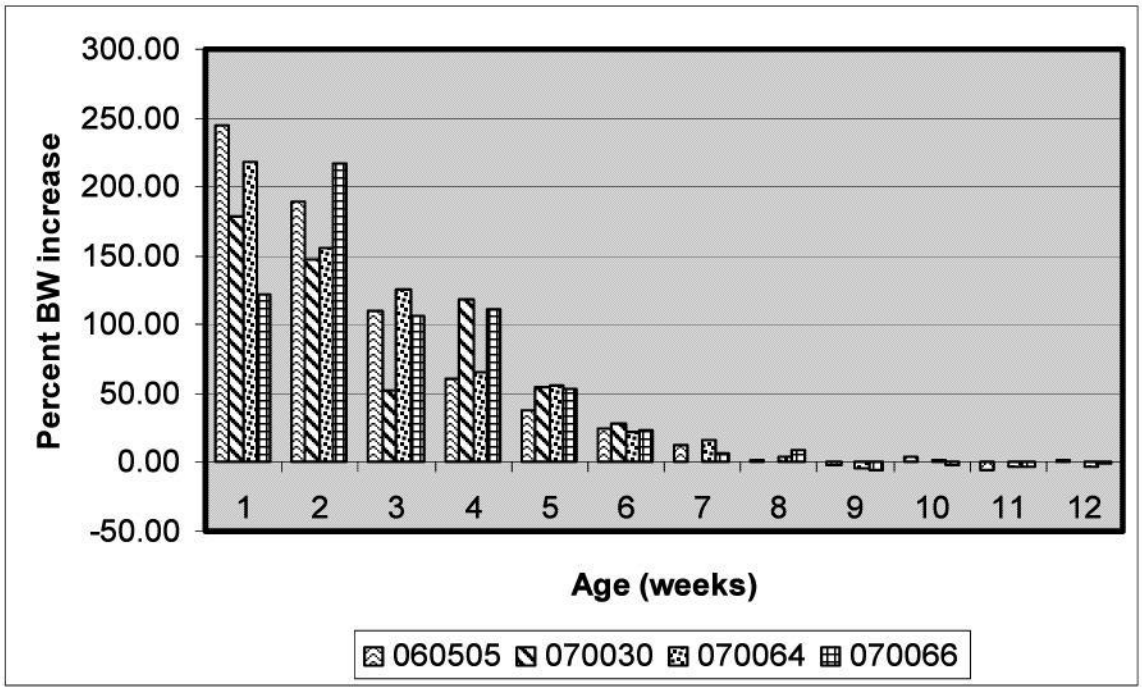

Figure 3. Percentage of body weight (BW) increase weekly by pink-backed pelican chicks at Disney's Animal Kingdom.

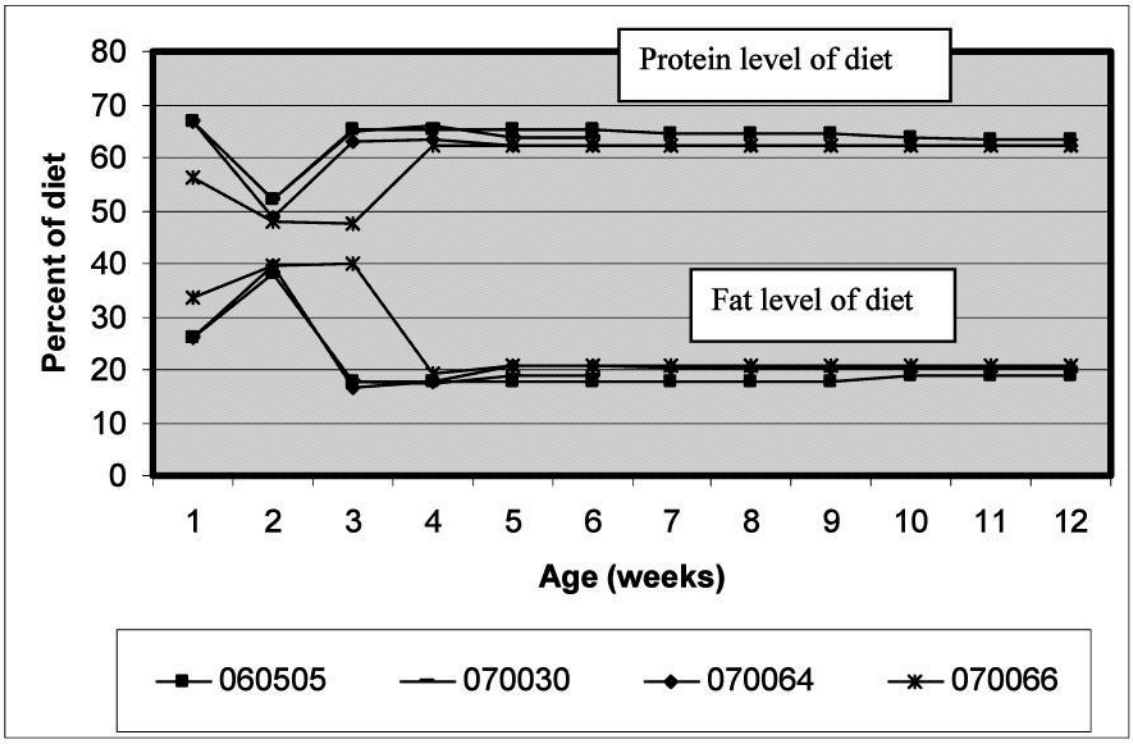

Figure 4. Protein and fat content (dry matter basis) of the diet consumed by pink-backed pelican chicks at Disney's Animal Kingdom.

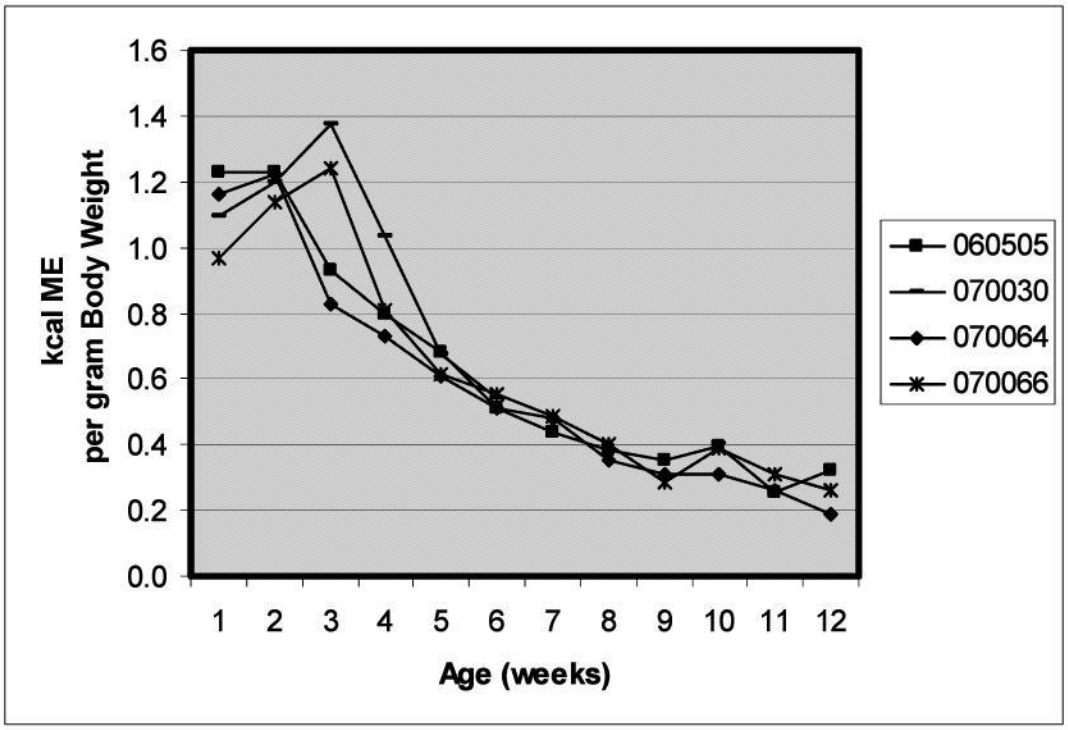

Figure 5. Metabolizable Energy (ME) intake of pink-backed pelican chicks at Disney's Animal Kingdom.