Toucan Hand Feeding and Nestling Growth

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KEYWORDS

- Toucan • Toucanet • Aracari • Hand feeding
- Growth curve

Toucans and toucanets are charismatic ambassadors for the rainforest. Their presence in captive collections typifies the "jungle." Because of this, they are popular additions to aviaries in zoos and private avian collections. They are kept as pet birds but much less commonly than psittacines. When they are part of a pet bird collection, they are often included in small breeding programs.

Investigations to improve breeding and rearing programs remain to be performed for most toucan species. Elements of importance in captive propagation include adult management, nutrition, nest management, and egg/chick management. Variations in chick management and nutrition often result in variable fledging success between facilities. Small numbers of chicks for each facility make conducting large scale investigations impossible. Additionally, species-based variations and external factors such as clutch size impact both chick rearing success and growth. Objective criteria to gauge hand-rearing protocols are often limited to the number of birds raised to fledging. While this is a reasonable measure of success, information on chick development is helpful in determining effective hand feeding and chick health.

Toucans, toucanets, and aracaris all belong to the phylogenetic family Rhamphastidae. It is common to refer to this family as toucans. This is a large family consisting of 6 genera with 42 species. These birds occur over a large geographic area from southeastern Mexico extending into South America. Toucan habitat varieties range from forest lowland to mountain regions with birds residing at altitudes of 150 to 3600 m above sea level. As the biomes vary, so do diet and life history characteristics. In short, not all toucans are alike.[1]

Approximately 30 toucan species are currently found in captivity. Of these, reproductive success has been reported in at least 20. Rhamphastids can do an

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The authors have nothing to disclose.

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excellent job rearing their young with minimal intervention. However, hand feeding allows for control of early chick development and can be used to increase productivity. Artificial incubation can improve hatchability by reducing issues of egg damage or neglect from parents. Incubation results in a need to hand rear babies. To facilitate hand feeding, a retrospective study was performed to review hand-rearing considerations and develop growth curves for toucans. This information should serve as a guide to those looking to advance toucan aviculture.

MATERIALS AND METHODS

Hand feeding records and chick weights were obtained from Riverbanks Zoo (RBZ), Dallas World Aquarium (DWA), and Emerald Forest Bird Gardens (EFBG). These facilities represent 2 members of the Association of Zoos and Aquariums (AZA) and 1 private facility with a broad base of experience in hand rearing of toucans and toucanets. Over the past 20 years, these facilities have been the major producers of hand-reared rhamphastids in North America.

General information related to hand feeding was recorded for each facility. Specifics for incubation, brooding, hand feeding, and weaning were collected from 2 of the 3 facilities (RBZ and EFBG). Data collected from these 2 facilities include general incubation parameters, brooder temperatures and chick containment, and specifics about hand-feeding formulas and techniques.

Weight data from individual birds at all 3 facilities were tabulated for the first 60 days of life. Only species with growth data from more than 5 birds and more than 2 clutches were included in the production of growth curves. Data were not partitioned by facility or sex of the chicks. In total, data from 152 birds were used for development of the 8 growth curves. The legend for each curve indicates the number of birds and number of facilities used for curve development. Hand rearing for each species did not occur in every facility; keel bill toucan, collared aracari, and emerald toucanet data were each derived from only 1 facility. Data for all other species were derived from combined data from 2 facilities. No species was hand reared in all 3 facilities at levels that permitted aggregation of data from all participants.

Incubation schemes varied from fully parent incubated to fully artificially incubated. Many eggs that hatched in incubators spent between 1 and 7 days incubating under the parents. Determination of when to pull eggs was often based on past performance of the parental pair as well as management considerations like weather conditions and ease of incubation. Both parent-incubated and incubator-raised birds were used in curve development.

Nest-hatched birds were generally pulled for hand rearing between days 1 and 9. Fifty-nine nest-hatched birds (8 saffron, 8 Guyana, 1 chestnut-eared, 7 green aracari, 4 collared, 12 emerald, 12 toco, and 7 keel-billed) were included in this study. Weights were not measured on these chicks while they were under the care of parents in the nest. For those birds, daily weights were only considered during the hand-feeding period.

RESULTS

Incubation and Brooding

Incubation was reviewed for RBZ and EFBG. Incubation lengths vary but, in general, smaller birds such as toucanets and aracaris have a 16-day incubation period. Larger toucans such as the keel bills and tocos have a 16- to 18-day incubation. Regardless of whether chicks are reared by hand or by adults, juveniles are self-sufficient at or before 60 days of age. Many species demonstrate fledging at approximately 42 days. Artificial incubation techniques varied by facility and by

Fig. 1. Three brooder set-ups. Thermometers at the side measure temperature. Humidity is maximized with the ring at the bottom of the unit. Each cup contains 1 or 2 young chicks. (*Photograph courtesy of* Jerry Jennings, Fallbrook, CA.)

species. Incubation parameters include a high-quality incubator maintained at 98.5° to 99°F (36.9°–37.2°C) with a relative humidity maintained at 65%. Regular egg weights during incubation from EFBG were not available for review. RBZ maintains incubators such that eggs lose between 12% and 16% of its freshly laid weight during incubation. The relative humidity needed to achieve this may range from 65% to 95%, depending on factors such as eggshell quality. EFBG uses Turn-X incubators (Lyon Technologies, Chula Vista, CA, USA); eggs are automatically rotated using pans with a turning ring. RBZ uses Grumbach "Compact S84" incubators (Asslar, Germany); rollers turn the eggs hourly.

Brooder facilities at EFBG consist of temperature- and humidity-controlled containers (**Fig. 1**). Chicks are generally segregated by clutch. As the chicks grow, they are kept in larger containers or separated into individual containers. Brooder temperatures start at 97°F with relative humidity maintained at 93% to 95%. As chicks develop feathers and increase in size, brooder temperatures are decreased to ensure the comfort of the chicks. By day 7, brooders are maintained at 93° to 95° F for all infants. Chicks are held in bowls or cups with paper towels or towelling that is free of loose strings to ensure good footing and safety from tangles. Paper towels with 2-inch × 2-inch Rubbermaid (Atlanta, GA, USA) shelf liner on top are considered superior bedding at EFBG due to the ability for staff to easily assess the droppings.

Once feathered, baby toucans become much more active. Birds are moved from bowls to plastic tubs on absorbent wood pulp bedding (Carefresh by Absorption Corp., Ferndale, WA, USA). Development is rapid and impressive (**Fig. 2**). At approximately 6 weeks of age, most toucan species begin to fledge. Due to increased mobility at this phase of development, they are placed in weaning cages. These cages are equipped with 2 perches placed close to the bottom, to permit access to food bowls without the birds leaving the perch. Access to perches of the appropriate diameter is important. It can help prevent significant foot problems that may result from spending too long in a bowl or a cup. In nature young toucans exercise their feet for several days as they climb up and down the interior of the cavity to look out of the nest hole and prepare for fledging.

Fig. 2. Collared aracari (*Pteroglossus torquatus*) at 25 days in an individual bowl; at 30 days on wood pulp bedding in a tub; and at 45 days in a tub for feeding (birds at this age are transferred to a weaning cage to facilitate perching and self-feeding). (*Photograph courtesy of* Jerry Jennings, Fallbrook, CA.)

Hand feeding continues at 5 feedings per day. Four of the 5 feedings consist of formula; 1 consists of pieces of fruit and soaked pellets (Mazuri [A division of Purina Mills, Gray Summit, MO, USA] Low Iron Softbill pellets) offered by hand or with forceps. Over the next 2 to 3 weeks, babies begin to eat fruit and soaked pellets. The extent of self-feeding is gauged by monitoring their feces, which increasingly contain fruit and are the color of pellets. As the birds learn to feed themselves, they increasingly resist hand feeding. The number of hand feeding events is reduced to 3 times daily and then twice daily. Once they are weaned, the soaked pellets are gradually switched over to dry pellets. If the birds initially refuse dry pellets, they are offered soaked pellets until they accept the dry.

Hand Feeding

Ramphastids are eager eaters; they will gape at the slightest change in ambient light, nearby movement, and/or gentle tapping on the beak. They do not possess a crop, and thus hand feeding time is prolonged compared to hand feeding psittacines of comparable size. A 2- to 3-week bird can take as long as 30 minutes to feed as opposed to less than 5 minutes for a psittacine. The bird is full when the soliciting ends and the bird's head goes back as if satiated. Some birds will solicit even when fully fed. Both RBZ and EFBG feed formula that is prepared fresh for each feed. EFBG feeds formula that is at room temperature (80°–85°F); RBZ feeds formula at a temperature that is very warm to the touch (104°–106°F). EFBG uses disposable syringes and cups for the first 2 to 3 weeks of a bird's life. Both facilities clean syringes and supplies between each feeding and soak them in Nolvasan (Fort Dodge Animal Health, Fort Dodge, IA, USA) solution and rinse equipment before use.

EFBG uses Mazuri commercial hand feeding formula (Mazuri Hand Feeding Formula 5TMX) mixed with distilled water to a consistency of pea soup. To this, pureed commercial canned baby fruit is added at a ratio of 5% to 10% fruit to formula. The formula is fed by syringe based on the bird's body weight. Initial feeding are no more than 5% of the bird's body weight (total daily amount) for the first few days. The amount fed is increased over the hand rearing period based on the bird's increasing body weight and an increasing food amount such that by 6 weeks of age, birds are receiving 9% to 10% of body weight for total daily feeding.

At 6 hours post hatch, hand feeding begins with distilled water. Birds are given water at 25% of their body weight. At 12 hours they receive 25% of their body weight in half-strength formula such that an 8- to 10-g bird receives 0.2 mL of food in increments of 0.1 mL. Babies pulled from their parents are first fed 4 hours after their removal from the nest. For the first 3 weeks of life, babies are fed 9 times per day at 2-hour intervals from 6:00 AM through 6:00 PM, then at 8:30 PM and 11:30 PM. This schedule allows for maximum daily weight gain with a 6½-hour interval between the last and first feedings. Adding a 10th feeding does not improve weight gains.

Hand-feeding protocols for facility RBZ are similar with a few significant changes. Chicks are kept on a towel surface in a small dish at 99.0°F (37.2°C). Small feedings are given every 1.5 to 2 hours from about 7:00 AM 11:00 PM. As the chick grows, the time between feeds is increased along with the amount per feed; the chick is not fed through the night. A 1-mL syringe is used to feed young toucan chicks. Kaytee (Chilton, WI, USA) Exact Original Formula is used as the basic hand feeding product for this facility. The first feed is distilled water or an oral electrolyte such as Pedialyte (Abbott Laboratories, Columbus, OH, USA) with only a very light sprinkle of Kaytee. For all of the other feeds, the hand feeding formula is prepared, (and progressively thickened) according to the manufacturer's instructions. As is done at EFBG, pureed commercial canned baby food is added at a ratio of 5% to 10% fruit to formula.

The chick is weighed daily prior to feeding at the same time each day. After each feed, food residue is cleaned from chick's mouth with a small piece of moistened cloth or a cotton-tipped applicator. Once the chick is 7 or 8 days old, a transition from the liquid diet to the adult diet is made. Very small pieces of pinkie mice, soaked Hills Science Diet Canine kibble (Topeka, KS, USA), fruit and soaked pellets are fed. The pellets are Marion Zoological (Plymouth, MN, USA), Red Apple Jungle; they are moistened by soaking for 45 seconds in distilled water. The same brand of pellet is fed to the adults.

Medications

Both facilities administer oral Nystatin for the first 1 to 4 weeks of the chicks' life. EFBG has a regular administration frequency of 3 times daily for 1 to 4 weeks depending on the chick's general condition and growth. RBZ has a decreasing frequency for 3 weeks. Dosing starts at 3 times a day for the first week; twice a day for the second week; and finally once a day for the third week. RZP uses no medications when hand feeding chicks that are removed from the parents at 10 days of age or greater.

Weight Curves

All 3 facilities contributed to the development of growth curves for the 8 toucan species. The growth curves for each species are presented in **Figs. 3–6**. All curves detail weight changes from day 1 to day 60. In all species examined, early growth was completed by this age. Growth curves generally level off between days 34 and 40. Smaller species are generally self-sufficient by 45 days of age. Larger species such as toco and keel-billed toucans are self-sufficient at or before 60 days of age.

Fig. 3 illustrates the growth data for the keel bill and toco toucans. The keel bill curve was derived from data from 24 birds held in one facility and raised over a 5-year period. The toco toucan curve represents 20 birds from 2 facilities raised over a 4-year period. **Fig. 4** illustrates data from collared and green aracaris. The collared aracari curve is derived from data from 24 birds raised in 1 facility over 4 years. The green aracari data are based on data from 2 facilities raising 12 birds over the course of 3 years. **Fig. 5** depicts the data from chestnut-eared aracaris and saffron toucanets. Five birds from 2 facilities were available to produce the chestnut-eared curve. Two facilities and a total of 24 birds were examined for the production of the saffron toucanet growth curve. **Fig. 6** contains the growth curves for Guyana and emerald toucanets. Eight birds from 2 facilities and 35 birds from 1 facility were used to produce the respective graphs.

The curves all follow the path expected lag, log, and plateau growth phases. The components of growth can be characterized as a lag phase occurring from days 0 to approximately 10, a log phase of remarkable growth generally occurring from days 10 to 38, and a plateau phase extending from the late 30s to early 40s until day 60.

DISCUSSION

The goal of this investigation was to briefly review results of 3 strong toucan rearing programs as a foundation for other toucan rearing programs. The growth curves provide a template for aviculturalists and veterinarians in gauging individual development of hand-fed toucans. While individual birds may vary along the curve, these data are critical for determining whether growth rates are within a normal range for birds. Over time, it is expected that individual facilities will be able to generate their own growth curves based on their specific management programs.

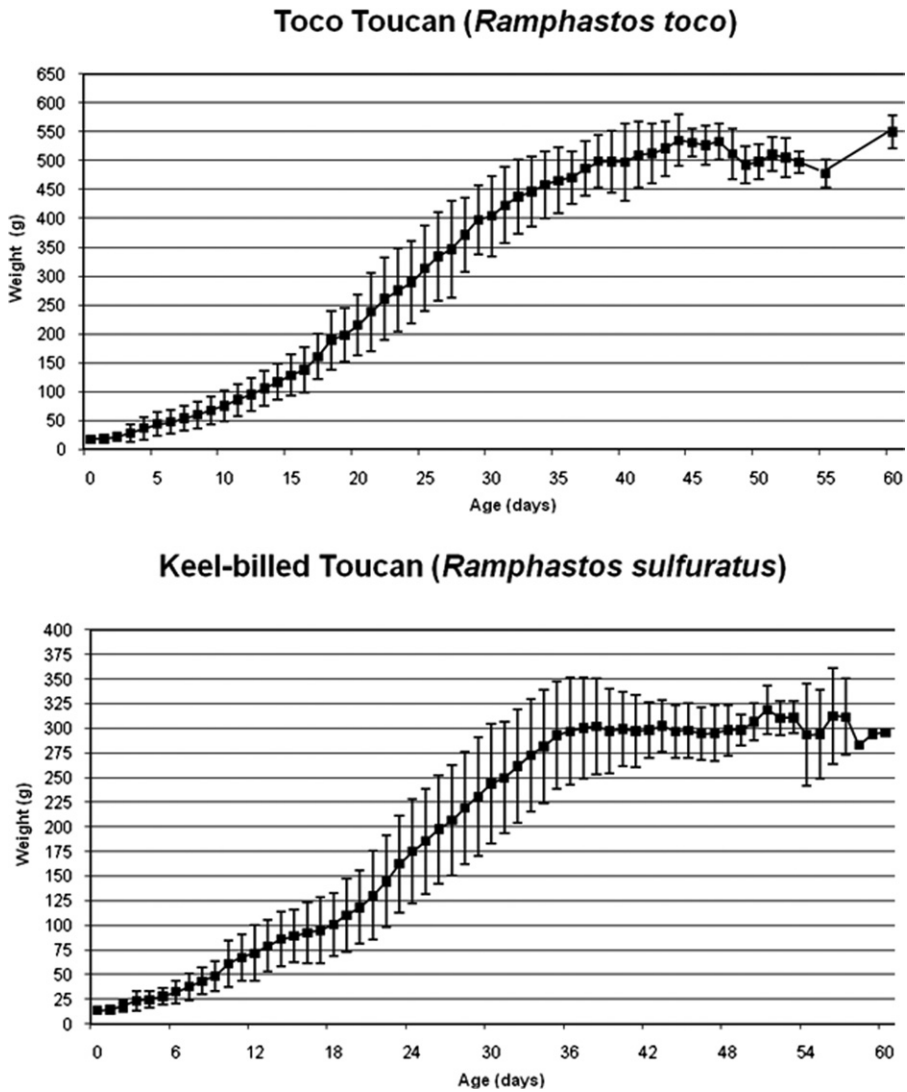

Fig. 3. Mean growth data for hand-fed toco (mean ± SEM; n = 20, facilities = 2) and keel-billed (mean ± SEM; n = 24, facilities = 1) toucans over the first 60 days of life.

The RBZ has led the zoo community in publishing data on toucan management, reproduction, and rearing. A good review of their hand-rearing efforts is available through the AZA *Toucan Husbandry Manual*.[2] Many of the features of the incubation and handrearing programs are equivelent to those used in psittacine rearing.[3,4] It is the nuances such as a modified feeding style that are critical to effective rearing of toucans compared to parrots. It is defining the differences in an objective manner that is needed to improve toucan hand rearing. All 3 facilities keep detailed notes on incubation and hand rearing. Further evaluations of these programs and their success and failures will be important in advancing aviculture.

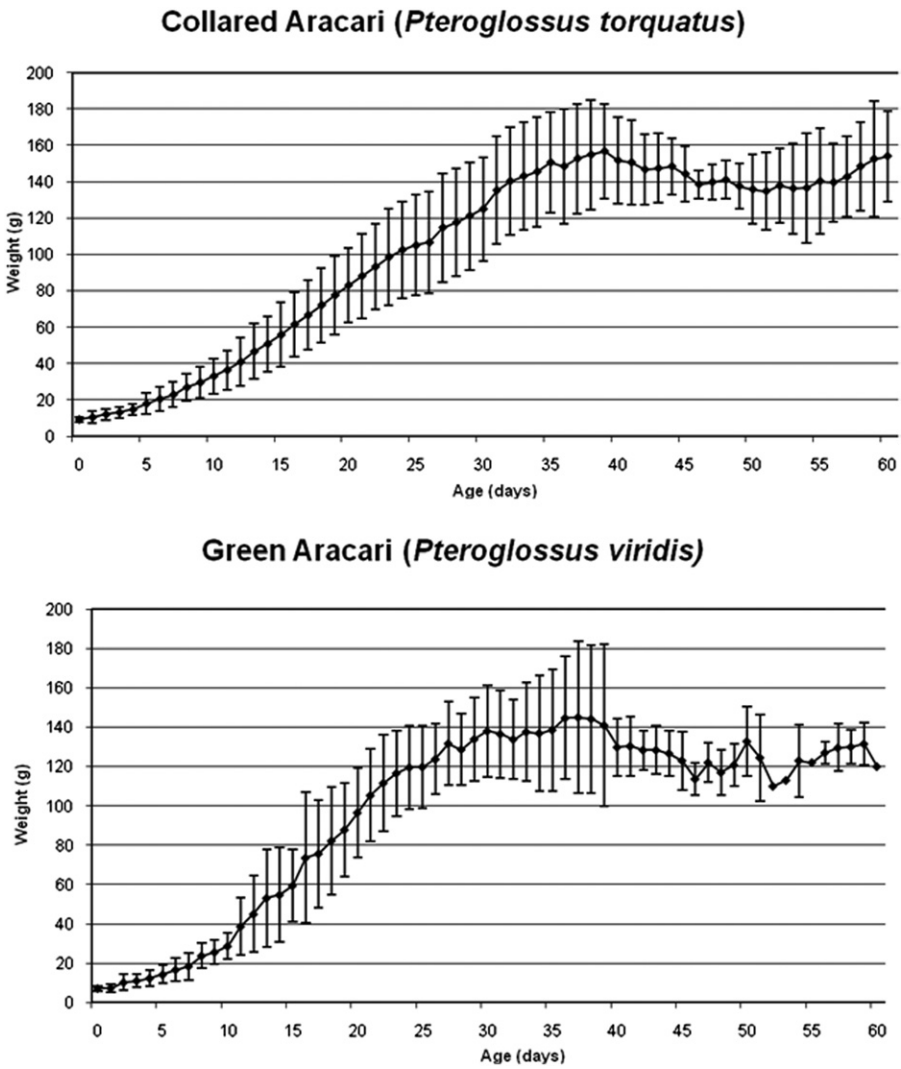

Fig. 4. Mean growth data for hand-fed collared (mean ± SEM; n = 24, facilities = 1) and green (mean ± SEM; n = 12, facilities = 2) aracaris over the first 60 days of life.

A variety of parameters were not specifically partitioned while deriving the growth curves. Sex determination was not available for many of the birds. Because of this, and because of the limited numbers of total birds, sex differences were not considered. It is likely that growth of chicks in the nestling phase is minimally impacted by chick sex. Facility differences in chick management and hand-feeding formulas were not considered in curve development. It is likely that this did impact the curves. However, by giving each facility an equal contribution based on chick production numbers and creating a weight band, it is hoped that the band realistically reflects expected fluxuations in chick weights. This band represents expected weights for chicks of the 8 species 95% of the time. Developing a band of expected chick weights is recognized as an effective way to create

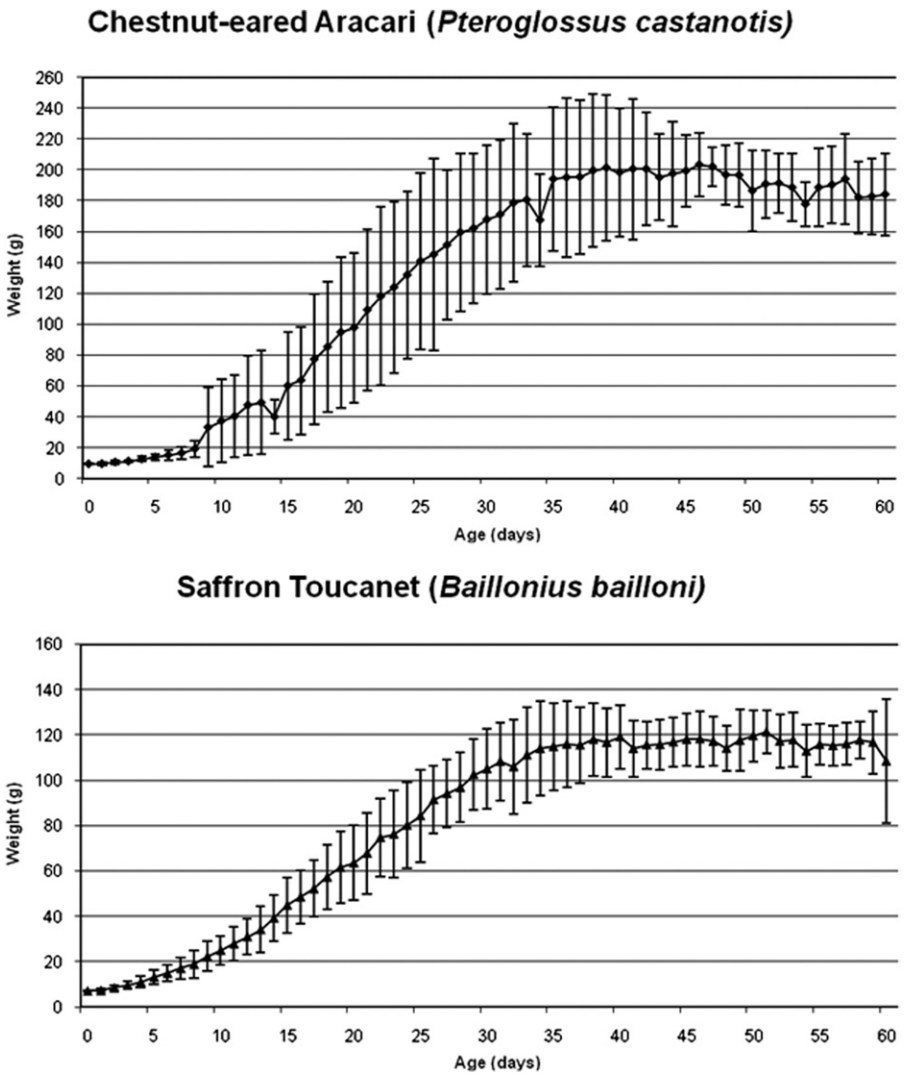

Fig. 5. Mean growth data for hand-fed chestnut-eared aracaris (mean ± SEM; n = 5, facilities = 2) and saffron toucanets (mean ± SEM; n = 24, facilities = 2) over the first 60 days of life.

a species weight chart.[5] As data from hand rearing of toucans expand, these growth curves can and should be enhanced to reduce band width and better evaluate variations in hand-rearing techniques.

Five of the 8 species had data from 2 facilities used in curve development. The keel bill toucan, collared aracari, and emerald toucanets were representative of the results of a single facility. None of the species selected were raised by all 3 facilities. Although absolute weight values varied, the shape of the growth curves was surprisingly similar for all species examined. Likewise, standard deviations did not expand when data from 2 facilities versus 1 were used for the construction of the growth curve.

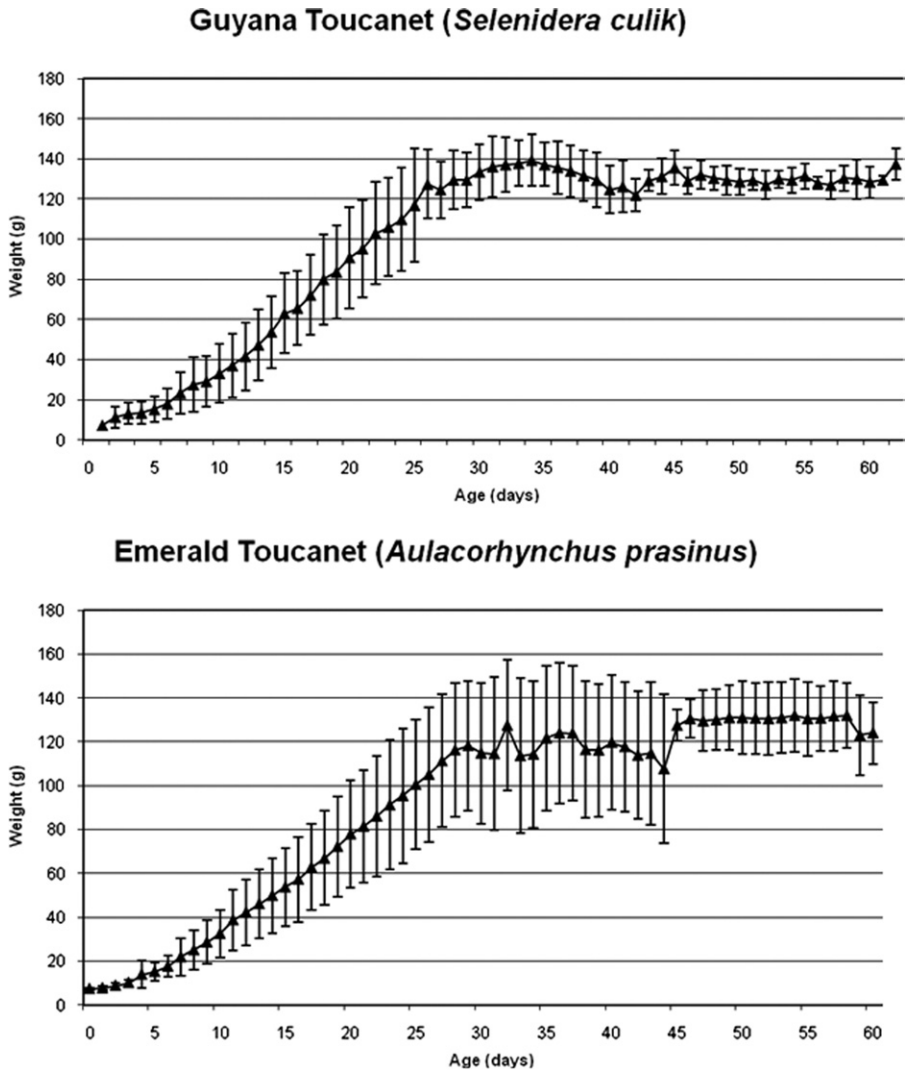

Fig. 6. Mean growth data for hand-fed Guyana (mean ± SEM; n = 8, facilities = 2) and emerald (mean ± SEM; n = 35, facilities = 1) toucanets over the first 60 days of life.

The limited number of birds used to produce the chestnut-eared aracari growth curve resulted in the largest percent standard deviation from the mean value curve. This limits the overall value of this curve as a comparison for any individual. It is hoped that as more of this species are produced and hand reared that a more focused curve can be produced.

The growth curves are all similar to previous curves produced for psittacine species based on growth data from 1 large facility.[4] The plateau phase approximates fledging with a later onset in the larger species. All weights from the plateau phase are lower than those published for free-living birds of the respective species.[1] It is likely that these are due to juvenile versus adult weights. There was a dip in weight for toco toucans around 50 days of age. Weight decreases at the time of fledging in other

species may have been masked by the standard deviation or may not have occurred. Many of the species have dips in the mean weight around 42 days. These changes may indicate the time of tranistition. The time of transition to solid food can be associated with weight loss and birds should be watched closely to assure that illness is not involved.

Variability of incubation methods (all nest, nest/incubator, or all incubator) was not evaluated as it related to hatching success, chick size, or growth rates. Changes in incubation temperatures and humidity can impact success dramatically.[6] Further evaluations in incubation parameters with detailed notes will likely improve incubation techniques and hatching rates for these species. Likewise, parent-reared chicks were not compared to hand-reared chicks respective to growth. It is known that in psittacines, parent reared chicks are generally larger than their hand reared cohorts until the time of weaning. At weaning, the 2 systems of chick rearing become equivalent.[5]

Administration of nystatin is common to both RBZ and EFBG. While it is not documented in this study, it is a well-accepted part of hand feeding for toucans in most programs. Overgrowth of oral, proventricular, and ventricular *Candida* is a common concern in toucans. Management with Nystatin administration is effective but improvements in the protocols are possible. As with all facets of toucan hand rearing, an objective evaluation may be helpful.

Poor weight gains are a concern in all hand-rearing systems. Possible causes include insufficient feeding (formula insufficiently concentrated, or feedings too small or infrequent), dehydration, especially if chicks have recently suffered parental neglect, insufficient brooder temperatures, or illness.[7] Chick evaluations should include a review of the situation and the chick itself in addition to comparing the chick's weight against the growth curves. These curves are a tool in chick monitoring. It is hoped that the basics of rhamphastid handrearing presented here are a sufficient foundation to improve toucan husbandry and rearing.

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