

and 22 February 1975 after a seven-week rearing period. The parents tolerated their cagemates until the young had fledged, but then they became so aggressive that the other species had to be separated. A month later they began to nest again and this time attacked the recently fledged juveniles.

Pair 2, which has so far shared its enclosure peacefully, laid no eggs until February 1975, but they also began tunnelling almost as soon as they had been placed in their new quarters.

DISCUSSION

It is apparent from our studies to date that tunnelling activity is an absolute essential for the formation of a proper pair bond in toucans. The mountain-toucans in particular maintained a continuous process of drilling, even when there were eggs and young in the nest. We have found palm logs especially suitable as a nesting facility because of their soft core and hard outer shell and their ready availability, but it is likely that other woods might lend themselves equally well. As to sexing, although certain morphological distinctions do occur, e.g. in bill length, we have based our determination largely upon behavioural observations of pairs engaged in mutual feeding and investigation of potential nest sites.

Diet has posed no serious problems, and the young seem to thrive on a variety of foods, including mynah pellets, fruits, Gaines Dog Meal and young mice, according to species. We have not yet encountered any instances of nutritional deficiency and feel that so long as the birds are presented with an adequate selection,

they are able to choose items which are acceptable to them and readily fed to the young.

A major consideration in exhibiting and breeding ramphastids is to house them in appropriate groups. Of the species with which we worked, it seems that only the Crimson-rumped toucanets can be kept and bred in a limited colony within a large, mixed-species aviary. The mountain-toucans, while generally peaceable, have proved not to tolerate other species during the fledging period, and will attack their own young as soon as nesting recommences. In any case our experience showed that mountain-toucans and aracaries, even when compatible with other birds, may become nest robbers and on these grounds are unsuitable in a mixed communal display. The larger toucans are by nature aggressive and if nesting occurs, the pair should certainly be kept apart from other toucans and from birds of similar size to themselves.

ACKNOWLEDGEMENTS

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PRODUCTS MENTIONED IN THE TEXT

Gaines Dog Meal: dry dog food, manufactured by General Foods Corp., 250 North Street, White Plains, New York, USA.

REFERENCE

TODD, F. S., GALE, N. B. & THOMPSON, D. (1973): Breeding Crimson-rumped toucanets *Aulacorhynchus haematopygius sexnotatus* at Los Angeles Zoo. *Int Zoo Yb.* **13**: 117-120.

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Breeding the Sulphur-breasted toucan

Ramphastos s. sulfuratus [Plates 17 & 18]

at Houston Zoo

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In August 1972 the Houston Zoo acquired three Sulphur-breasted toucans *Ramphastos s. sulfuratus* from an animal dealer in Florida, and a fourth in September from a private collection. The single

bird was approximately four years old; the others, recent imports, were estimated to be about one year of age.

Following routine quarantine, all the birds

were placed together on exhibit in the zoo's tropical bird house, where they remained until September 1973. At this time they were moved to a temporary holding facility in an old building no longer used for public display. Here the birds received no natural light, but were under continuous artificial light from a 1.8 m fluorescent tube fixture mounted in the cage ceiling. During the autumn and winter the temperature inside the building was maintained at between 13–24°C, with no internal control during the rest of the year. The cage in which they were now housed consisted of three plywood walls, one wall of wiremesh, a plywood ceiling and a wood floor covered with cane mulch. Overall dimensions of the enclosure were 3.6 × 2.1 × 2.5 m high.

The group had been kept in this environment for about a year when aggressive behaviour suddenly developed, making it necessary to remove two of the birds to a similar enclosure on the opposite side of the building. Here they were still within sight and sound contact of their former cagemates.

From observed differences in their gross morphology and behaviour, it was believed that the birds left in the original cage were a true pair. The following physical characteristics were especially significant in making the tentative distinctions: (1) a more extensive area of red colouration on the distal end of the upper mandible in the ♂; (2) a broader band of black circling the base of the mandibles in the ♀; and (3) a longer and more convex lateral curvature of the upper mandible in the ♂.

On the basis of the above criteria we judged the two incompatible specimens to be ♀♀, and this was later confirmed by chromosomal analysis (Mengden & Stock, 1976). The ♂ of the pair was the single bird acquired in September, the ♀ one of the original trio obtained in August 1972.

Late in September 1974, when the ♂ was noticed attempting to excavate a hole in the plywood cage wall, two identical wooden 'grandfather clock' style nestboxes were installed in vertical positions, one atop the other, in one corner of the cage. They were hexagonal in shape, with a circumference of 1.5 m and height of 94 cm. Each box was filled with cane mulch to a depth of 30 cm (Plate 17).

Several weeks later, hollow logs were placed in the enclosure, one mounted vertically, the

other horizontally. But the birds continued to investigate the original wooden boxes and showed little interest in either of the logs. As soon as they had appeared to make a definite choice of the upper box as their preferred nest site, keeper entry to the cage was limited to once a week, for cleaning purposes only.

Copulation was first observed on 16 October. Two eggs and broken shell pieces were discovered in the nest cavity on 22 October during regular cage cleaning. On the next inspection, a week later, no eggs were seen and it was assumed that they had all been broken. Both adults, however, remained very attentive to the nestbox. Finally, on 19 November, squeaking sounds were heard from the nest and on further investigation two newly hatched toucan chicks were discovered. The parents had evidently been hiding the eggs with nest litter before leaving the box (Plate 18).

Owing to the adult birds' shy temperament, nestling development was not monitored on a regular basis. It is interesting to note that, perhaps because of the 24-hour light cycle coupled with their timidity, the parents reversed their normal activity cycle and slept for most of the day. They were offered a wide variety of foods, including diced papaya, apple, cantaloupe and honeydew melon, Purina dog chow pre-soaked in water, quartered cherry tomatoes, soaked raisins, chopped endive and small pieces of Zu/Preem Bird of Prey diet. Both parents shared in feeding the young.

The ♀ regularly cleaned the nest by carrying soiled nest material from the box and scattering it over the cage floor. This resulted in the box being quite bare by the time the chicks were ready to fledge, so that to reduce the interior depth and facilitate their leaving we had to add more cane mulch. The first chick fledged on 1 January 1975, the second a day later. They resembled the adults, but were slightly smaller, with faded yellow breasts, dull reddish vents and pale blue eyes. The mandibles were grey-blue and much reduced in size, relative to body length, as compared to the parents. The eye-ring was the same grey-blue as the mandibles.

Immediately after the second fledging the ♀ repeatedly entered the nest, and on 9 January inspection revealed another clutch of five eggs. Surprisingly, this time the ♂ performed most of

the incubation, the ♀ meantime feeding the two fledglings. It was also observed that the ♂ would soak himself in the water bowl before entering the box, this presumably providing moisture for the incubating eggs. Hatching began on 20 January. The first two fledglings, now able to feed themselves, were removed, and three of the five eggs hatched and were successfully reared; the remaining two were infertile. The three chicks left the nest on 3, 4 and 5 March.

As soon as the second clutch had fledged, the ♂ once more began courting the ♀. This time she was not responsive, and to avoid possible injury from his aggressive pursuit she was removed from the enclosure. He continued to feed the fledglings until 8 April, when they began to eat by themselves. They were then

taken from the cage and introduced to the two offspring of the first clutch. The five have proved to be compatible and at time of writing are in good health.

PRODUCTS MENTIONED IN THE TEXT

Purina Dog Chow: manufactured by Ralston Purina Company, St Louis, Missouri 63188, USA.

Zu/Preem Bird of Prey Diet: manufactured by Hill's Division Riviana Foods, Inc., Topeka, Kansas 66601, USA.

REFERENCES

MENGDEN, G. A. & STOCK, A. D. (1976): A preliminary report on the application of current cytological techniques to sexing birds. *Int. Zoo Yb.* **16**: 138-141

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Maintenance and breeding of the Common marmoset

Callithrix jacchus [Plates 10 & 11]

with notes on hand-rearing

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The colony was founded in April 1973 with four pairs of Common marmoset *Callithrix jacchus* (Table 1) for studies in social behaviour. Each pair was caged separately and allowed to reproduce naturally; by April 1975 the numbers had increased to 33 individuals, which included three hand-reared from birth.

CAGING

The cages are housed in a prefabricated timber outhouse with an external cladding of cedarwood, a rubberoid roof and internal insulation with hardboard walls. Daylight enters through clear glass windows kept slightly open and additional fluorescent lighting is provided between 0900 and 2100 hours on a time-switch mechanism. The temperature is maintained at 20-30°C by electric fan heaters and storage heaters. Two humidifiers keep relative humidity at an average of 50% (range 40-60%).

Personnel enter the outhouse through double doors and walk through a Stericol disinfectant

footbath before entering the animal room. Admission is restricted and all visitors are required to wear a white coat.

Initially, two large (2 × 1.5 × 2 m high) and two smaller cages (one 1 × 0.7 × 1.5 m high and the other 1 × 1 × 1.3 m high) were provided. Subsequently, three more large cages were added and the present colony (May 1975) is composed of six groups of adults (two of colony born animals) and one group of juvenile hand-reared animals. The cage sides are made of 26 × 26 mm weldmesh and the fronts of 6 mm transparent perspex. They are furnished with substantial branches of oak and beech, perches of 26 mm softwood dowelling, platforms, wooden swings, small wooden boxes (15 × 8 × 30 cm high) and a wooden nestbox (28 × 22 × 26 cm high) with an entrance hole 10 cm in diameter. Nestboxes are made of wood so as to absorb any urine and sebaceous secretions deposited by the marmosets when scent marking; they are normally used for overnight sleeping.