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Breeding and hand-rearing Pesquet's parrot

Psittrichas fulgidus

at the Zoological Society of San Diego

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Pesquet's parrots *Psittrichas fulgidus* are rare in avicultural collections and successful breeding is uncommon and usually off-exhibit. At San Diego Zoo, however, two pairs of *P. fulgidus* which were on-exhibit have bred successfully. In the 1980s a pair of wild-caught adults nested in a natural palm log in their enclosure and eight chicks hatched from 17 eggs which were artificially incubated. In 1997 two hand-reared adults nested in an artificial nestbox laying seven eggs all of which were removed for artificial incubation and two of which hatched. The chicks from both pairs were hand-reared owing to the lack of parent-rearing success in the past. A review of breeding history since 1988 at San Diego Zoo is given and the methods used for artificial incubation and hand-rearing are described.

Key-words: artificial incubation, growth rate, hand-rearing, nestbox, Pesquet's parrot

Pesquet's parrot *Psittrichas fulgidus*, which is indigenous to New Guinea, has always been rare in avicultural collections and successful breeding in captivity is uncommon. At San Diego Zoo between 1984 and 1985 eight chicks hatched from 17 eggs which were artificially incubated. These eggs were laid by a pair of wild-caught birds which were on exhibit and nesting in a natural palm log *Phoenix canariensis*. These chicks were hand-reared (Low, 1987).

In 1986 a hand-reared ♂ was obtained from Bronx Zoo, New York, for pairing

with one of the hand-reared ♀♀ hatched in 1984 at San Diego Zoo. In 1988 this pair was introduced at the Avian Propagation Center (APC), an off-exhibit breeding area, and in 1994 they were moved to an on-exhibit aviary. Although in 1992 eggs were laid for the first time, successful breeding was not achieved until 1997 when two chicks hatched and were hand-reared.

HUSBANDRY AND REPRODUCTION

From 1988 to 1994 the hand-reared adult pair was maintained at the APC in enclosures measuring 4.27 m × 2.44 m × 2.13 m high. A 1.2 m section at one end of the aviary was enclosed to provide shelter. A natural palm log *P. canariensis* was provided but not used by the birds. By 1992 this log had deteriorated and was replaced with a nestbox measuring 91 cm × 76 cm × 91 cm deep. The pair was often maintained in separate enclosures because the ♂ was aggressive towards the ♀. In September 1992 two eggs were laid and, subsequently, three more two-egg clutches were laid, however, all the eggs were either infertile or broken (Table 1). An interval of 2–4 days between egg-laying was observed.

YEAR	EGG NO.	DATE LAID	DATE RECEIVED*	EGG MASS (g)	OUTCOME
1992	1	20 Sep	25 Sep	28.7	infertile
	2	25 Sep	25 Sep	26.8	no yolk
1993	3	27 Nov	11 Dec		infertile
	4	1 Dec	11 Dec		infertile; two yolks
	5	6 Feb	12 Feb		infertile; cracked
	6	10 Feb†			broken in box
	7	6 Apr	17 Apr		infertile
	8	8 Apr	17 Apr	21.5	no yolk
	9	30 Oct	31 Oct	29.6	laid off perch/broken
1994	10	11 Nov			laid off perch/broken
	11	19 Feb			laid off perch/broken
1995	12	21 Feb			laid off perch/broken
	13	5 Oct	15 Oct	13.9	infertile; no yolk
1996	14	9 Oct	15 Oct	24.7	infertile
	15	8 Apr†	17 Apr	27.4	hatched 7 May
1997	16	30 Sep	2 Oct	25.6	late dead
	17	2 Oct	2 Oct	24.3	hatched 1 Nov
	18	13 Nov†	13 Nov	26.7	infertile
	19	13 Nov†	13 Nov	25.5	late dead
	20	31 Dec†	14 Jan 98	24.2	late dead
	21	31 Dec†	14 Jan 98	22.6	late dead; malposition

* Date eggs were received at Avian Propagation Center for artificial incubation or analysis.

† Approximate dates.

Table 1. Egg-laying history from 1992 to 1997 for a pair of hand-reared Pesquet's parrot *Psittirichas fulgidus* adults at San Diego Zoo.

In May 1994, in an attempt to provide an environment which might distract the ♂ and curtail his aggression towards the ♀, the pair was moved to 'The Wings of Australasia' exhibit which comprises 20 single-species and five mixed-species exhibits featuring the avifauna of Indonesia, Papua New Guinea and Australia. The exhibit is heavily landscaped with bamboo *Phyllostachys aurea*, fishtail palms *Caryota aurens*, sword fern *Nephrolepis obliterated*, staghorn fern *Platynerium* sp and tree fern *Cyathea australis*. The Pesquet's parrots were maintained in an enclosure measuring 4.57 m × 3.05 m × 3.35 m high and because no suitable palm log was available, a nestbox measuring 0.46 m × 0.46 m × 2.44 m high and packed with moistened pine-shaving substrate, was provided. The exterior of the box was disguised with vines and bark to resemble a natural tree trunk and an entry hole, 18 cm in diameter, was cut c. 30.5 cm

from the top of the box. The birds could use, as a ladder, a piece of welded-wire, 7.62 cm × 1.3 cm, which was attached to the inside wall below the entry hole and extended to the bottom of the box. Two inspection doors, 15.24 cm × 15.24 cm, were also placed 1.22 m and 1.83 m from the top of the box.

After the pair was moved to the exhibit the ♂ only occasionally displayed mild aggression towards the ♀. Initially the ♀ was reluctant to use the nestbox and the first two clutches were laid off the perches. After 4 months the pair accepted the nestbox and began excavating 1 month prior to egg-laying. Although both the ♂ and ♀ participated in the excavation the ♂ seemed to do most of the work. During the excavation, the birds tucked the pine shavings between the layers of their contour feathers and, after leaving the nestbox, released the material from their feathers by vigorously shaking their

plumage. (See also, Buay & Thirunavukkarasu, this volume.) The pair usually removed *c.* 0.46 m of substrate between clutches and the nestbox was repacked with pine shavings at the end of each season. The majority of incubation was carried out by the ♀ and once under way, she rarely left the nestbox. The ♀ solicited the ♂ to feed her, rather than feeding herself from the food pan, and the ♂ was observed feeding the ♀ both inside and outside the nestbox.

The diet for Pesquet's parrot at San Diego Zoo consisted of Scenic Birdfood® Psittacine Diet, Zu Preem® Dry Primate Diet soaked in Nekton-Lori, cooked carrots and sweet potato, freshly chopped ripe banana, apple, pear, grapes, melon and dried fig, and other fruit when available. Bonemeal and Super Preen, a multiple vitamin/mineral supplement, are added to the diet on alternate days.

Between 1992 and 1996 the pair laid 14 eggs but, with the exception of one fertile egg in 1994 which was an early embryonic death, they were all infertile, cracked or broken. In 1997, four clutches, totalling seven eggs, were laid in the nestbox (Table 1).

Incubation Owing to the losses incurred in previous years, all seven eggs were removed for artificial incubation between day 1 and day 10 of parental incubation (Table 1). The eggs were round and white with an average size of 41.2 mm × 34.5 mm (*n* = 5) and ranged in mass from 22.6 to 27.4 g (*n* = 7).

The eggs were placed in a Humidaire model 20 forced-air incubator with the thermostat set at 36.9°C. Wet bulb temperatures ranged from 29.5 to 30.5°C (*c.* 60–65% relative humidity). Automatic turners rotated the eggs every 2 hours and eggs were candled and weighed twice a week to monitor embryonic development and mass loss. When the embryos pushed through the air-cell membrane, the eggs were transferred to an AB Newlife Hatcher maintained at 36.3°C, with wet

bulb temperatures which ranged from 32.9 to 34.0°C (*c.* 83–90.5% relative humidity).

Six of the seven eggs were fertile but four embryos, one of which was not positioned correctly within the egg, died in the late stages of development. Two chicks hatched and were hand-reared successfully within 6 months of one another (Table 1). The first egg had been removed for artificial incubation after *c.* 10 days of natural incubation, and a mass (water) loss of 9.5% was recorded during the artificial incubation period. The second egg, which was artificially incubated from *c.* day 1, had a mass loss of 18.3%. The chicks pipped on *c.* day 29 of incubation and the pip-to-hatch intervals were 24–48 hours. Hatching occurred after *c.* 30–31 days of incubation, within the range noted at other institutions (Low, 1987, 1990, 1992; Thurslund & Paul, 1987; Cher, 1994).

HAND-REARING, GROWTH AND DEVELOPMENT

After drying in the hatcher for *c.* 12 hours, the chicks were moved to the brooder room where the yolk-sac seals were swabbed with Betadine solution. The chicks were weighed and given an identification number.

Brooders Chicks were placed in plastic containers lined with paper towels and tissue paper then maintained in Lyon's Animal Intensive Care Units at a dry temperature of 35.6°C. The temperature was gradually lowered to 28.3°C by day 20 when the chicks were placed in plastic tubs lined with felt and moved to box brooders for the next 3 weeks, during which time the temperature was gradually decreased from 28.3 to 26.7°C (Plate 1). On day 50 chicks were moved to floor brooders where they were maintained in felt-lined plastic tubs, 36 cm × 30 cm × 20 cm high, with heat lamps and by *c.* 90 days of age chicks were acclimated to ambient temperature (*c.* 21.1°C).



Plate 1. A 36 day-old Pesquet's parrot *Psittirichas fulgidus* chick at San Diego Zoo. Ken Kelley, Zoological Society of San Diego.

Diet Scenic Birdfood© hand-rearing diet was used as the nutritionally complete fraction of the formula. A 5:1 ratio of water to dry hand-rearing diet, producing a formula with 15.2% solids, was offered, beginning on day 1. The solids fraction of the formula was gradually increased by decreasing the ratio of water to dry hand-rearing diet, reaching 3:1 by day 25. On day 15, owing to the frugivorous nature of this species, strained banana was added to 10% of the total formula and this was gradually increased to 25% by day 21 (23.5% solids). At 30 days of age the growth rate of the first chick levelled off for *c.* 4 days (Fig. 1): at that time, the crude protein content was decreased from 5.0 to 4.5% (21.2 to 20.2%, dry matter basis) by increasing the fruit, offered as apple sauce, by another 10%. Subsequently, within 1 day of the change in diet, the chick began gaining mass at an acceptable rate of *c.* 10% per day. The

rate decreased again *c.* 4 days later but remained at 3–4% for another 2 weeks. The diet of the second chick was modified in a similar manner, however, the plateau in the growth rate at days 29–34 was not observed (Fig. 1).

From day 1, the chicks were fed using a syringe every 2 hours from 0630 to 1900 hours, with a gradual reduction in frequency over time (Table 2). Solids, in the form of banana chunks and soaked Scenic Birdfood©, were introduced by day 50 with the addition of soaked Zu Preem© on day 60. Additional fruits, such as papaya, melon and grapes, were introduced at *c.* day 70. Cooked yams and carrots, the remaining ingredients of the adult diet, were offered by 3 months of age. The chicks began to eat on their own by day 60 but were not fully weaned until *c.* day 120. (See also, Buay & Thirunavukkarasu, this volume.)

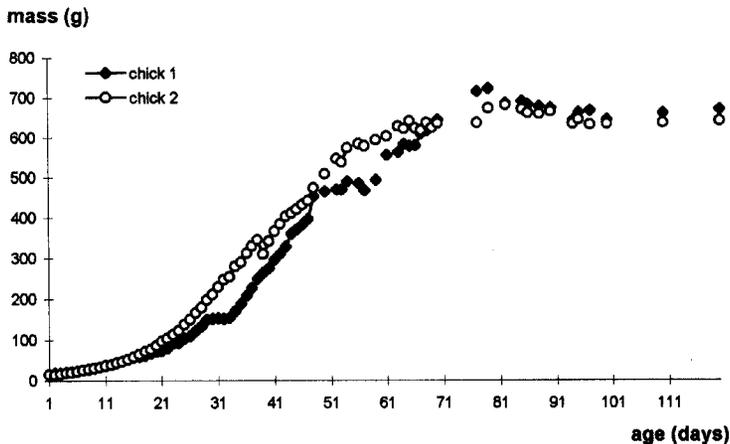


Fig. 1. Growth rates for two Pesquet's parrot *Psittichas fulgidus* chicks hatched at San Diego Zoo in 1997.

Development The two chicks developed morphological and behavioural characteristics at a rate similar to that described in the literature (Low, 1987, 1992; Thursland & Paul, 1987; Cher, 1994) and the key stages of development are summarized in Table 3. Red feathers could be seen on the side of the head behind the eyes by day 64 but this feature was not used to determine sex as, while it is inconspicuous or absent in adult ♀♀, both sexes may have this coloration as juveniles (Plate 2) (Thursland & Paul, 1987; Schubot *et al.*, 1992).

tions (Thursland & Paul, 1987; Low, 1990; Cher, 1994) but the breeding pairs at San Diego Zoo have been successful while on public display. Aggression between individuals is not unusual (Low, 1990) and appears to be a factor in the establishment of successful pairs, including the current pair at San Diego Zoo. Interestingly, aggression subsided after this pair was moved to a well-planted enclosure on-exhibit.

Los Angeles Zoo, Loro Parque (Puerto de la Cruz), Palmitos Park (Maspalomas)

DISCUSSION

Successful breeding of Pesquet's parrot has occurred off-exhibit at some institu-

AGE (days)	NO. FEEDS (12 hour day)
1	7 (every 2 hours)
4	5 (every 3 hours)
9	4 (every 4 hours)
46	3 (every 5 hours)
86	2 (every 6 hours)
107	1
119	weaned

Table 2. Feeding frequencies for Pesquet's parrot chicks hand-reared at San Diego Zoo.

AGE (days)	CHARACTERISTICS
1	body covered with long, sparse white down; beak horn-coloured
12	beak beginning to turn black
12-14	eyes gradually opening
40	red and black pin feathers emerging; secondaries beginning to open
46	primary pin feathers emerging; secondaries beginning to open
64	red feathers visible on sides of head behind the eyes
70	fully feathered except for back of neck
75	perching
90-100	first flights

Table 3. Key stages in development of hand-reared Pesquet's parrot chicks at San Diego Zoo.

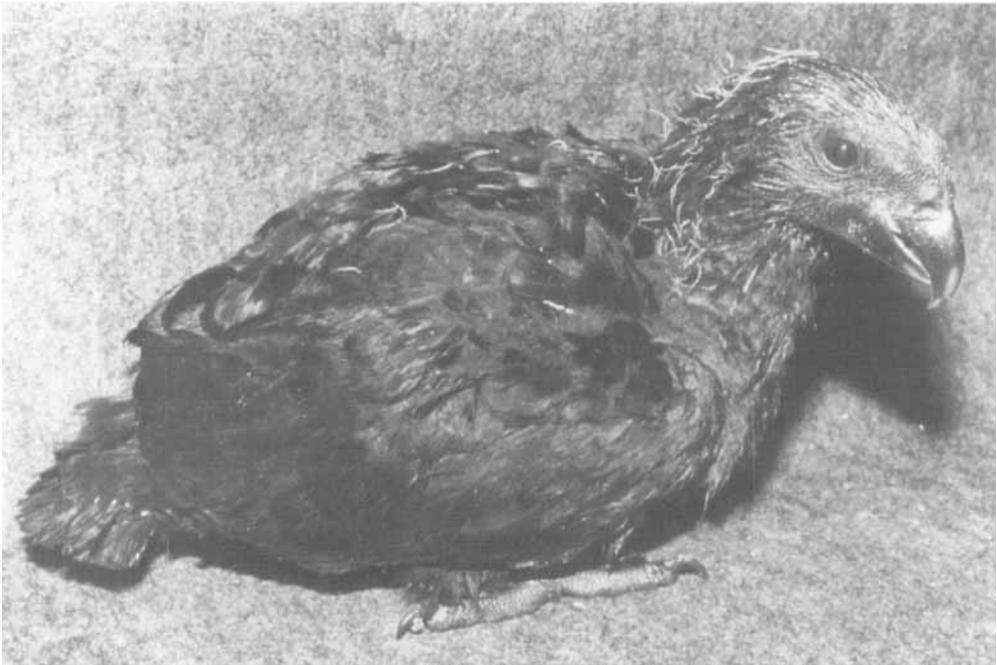


Plate 2. Pesquet's parrot chick at 65 days of age. Ken Kelley, Zoological Society of San Diego.

and Jurong BirdPark have all used natural palm logs as a nestbox for *P. fulgidus* (Thurslund & Paul, 1987; Low, 1990, 1992; Cher, 1994; Buay & Thirunavukkarasu, this volume), as did San Diego Zoo in the 1980s. In 1994, however, a natural palm log was not available and a substitute, artificial log was successfully used as a nestbox.

While natural incubation of eggs and parent-rearing of chicks are preferred, artificial incubation and hand-rearing have been the only methods which have been successful for *P. fulgidus* at San Diego Zoo. It should be noted that the Pesquet's parrots which bred successfully in 1997 were hand-reared and, therefore, the chicks at San Diego Zoo may represent the first *P. fulgidus* offspring from a pair of hand-reared adults.

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PRODUCTS MENTIONED IN THE TEXT

AB Newlife Hatcher: forced-air hatcher, manufactured by A.B. Incubator Ltd, PO Box 215, Moline, IL 61265, USA.

Betadine solution: povidone iodine solution, manufactured by Boehringer Ingelheim GmbH, Binger Strasse 173, D-55216 Ingelheim am Rhein, Germany.

Humidaire model 20: forced-air incubator with an automatic turner, manufactured by Humidaire Inc., 217 W. Wayne Street, PO Box 9, New Madison, OH 45346-0009, USA.

Lyon animal intensive care unit: brooder, manufactured by Lyon Electric Co. Inc., 2765-A Main Street, PO Box 3307, Chula Vista, CA 92011, USA.

Nekton-Lori: nectar source, manufactured by Gunter Enderle, D-75177, Pforzheim, Germany.

Nystatin: antifungal oral suspension, manufactured by Schein Pharmaceuticals Inc., Florham Park, NJ 07932, USA.

Scenic Birdfood® hand-rearing diet for macaws: formula for macaws, manufactured by Marion Zoological, 13803 Industrial Park Boulevard, Plymouth, MN 55441, USA.

Scenic Birdfood® psittacine diet: an extruded avian pellet, manufactured by Marion Zoological, 13803 Industrial Park Boulevard, Plymouth, MN 55441, USA.

Super Preen: vitamin/mineral supplement, manufactured by RHB Enterprises Inc., 1640 East Edinger Avenue, Santa Ana, CA 92705, USA.

Zu Preem® dry primate diet: monkey biscuits, manufactured by Zu Preem, PO Box 2094, Mission, KS 66202, USA.

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Contribution of captive management of Orange-bellied parrots

Neophema chrysogaster

to the recovery programme for the species in Australia

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The Orange-bellied parrot *Neophema chrysogaster* overwinters on the Australian mainland and breeds on Tasmania, more than 200 km away. The Orange-bellied Parrot Recovery Team, established in 1983, guides and initiates conservation measures to protect this threatened species and its natural habitat. The first captive-breeding programme for the species was established near Hobart and the second was at Healesville Sanctuary. The aim is to breed Orange-bellied parrots, retaining as much genetic heterozygosity as possible, for release into the wild and to study the species to obtain biological data. At Hobart between three and 37 young have been reared to independence annually and at Healesville between two and 36 annually. Health issues which affect this species, such as parrot beak and feather

disease and zinc toxicity, are addressed. Details about techniques for successful reintroduction of captive-bred parrots and the subsequent monitoring of the released birds are also described. Between 1991 and 1996 68 birds have been reintroduced.

Key-words: orange-bellied parrot, radio-telemetry, recovery programme, reintroduction

The Orange-bellied parrot *Neophema chrysogaster* is one of a number of bird species which annually migrate between wintering on the Australian mainland and breeding on the southern island state of