

An overview of small felid hand-rearing techniques and a case study for Mexican margay

Leopardus wiedii glaucula

at the Zoological Society of San Diego

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Although parental rearing of young is preferred, occasionally it is necessary to hand-rear animals to ensure their immediate health and long-term well-being. The hand-rearing techniques used at San Diego Zoo have been developed over 25 years. In May and October 1995 0.2 Mexican margays *Leopardus wiedii glaucula* were hand-reared at the Zoo. This paper documents the formula and feeding technique used. Details on the growth rate of the Mexican margays are compared to those of other felids.

Key-words: captivity, Felidae, formula, growth, hand-rearing, Mexican margay.

Parental rearing has nutritional, developmental and behavioural benefits, however, in captivity the need for hand-rearing may occur occasionally. The rearing technique can affect the immediate and long-term physical and psychological health of the neonate. Hand-rearing techniques have been developed during the 25 years that nursery facilities have been available at the Zoological Society of San Diego. Although not the preferred method of managing neonatal felids, young are removed from the ♀ for hand-rearing in cases of maternal neglect, conspecific abuse or illness. Animals are never separated from the ♀ for exhibit purposes.

Small felids are hand-reared at the Primate Nursery where a diverse range of species are reared, including marsupials, primates and carnivores. The Nursery is staffed for 17 hours daily, although 24 hour care is provided for neonates when necessary. The Nursery is also an exhibit area where visitors can see the

young animals and observe the kind of care they receive.

HEALTH

Animals which are removed for hand-rearing are often affected by poor early nutrition and hypothermia. Hypothermic neonates are warmed up slowly and monitored for signs of subsequent infection because sepsis frequently follows hypothermia. Because an open umbilicus can be a route for infection it is treated with an iodine solution three times a day until it is completely healed. All animals are screened for *Salmonella* and *Campylobacter* on arrival at the Nursery and at 3 and 5 weeks of age. When appropriate, immunizations are administered at 6, 12 and 18 weeks of age.

The Nursery is also a quarantine area within the Zoo. There are footbaths throughout the facility and at entry and exit points. All enclosures, enrichment items and furniture are versatile, portable and easy to disinfect. Nursery attendants wear gowns and each animal's bedding is laundered separately.

Veterinary and laboratory staff provide daily medical support. Formulas, weaning diets and feeding practices are developed and/or evaluated with guidance from the nutritionist. If an animal dies, a full post mortem is carried out to obtain any information which might be valuable for care of animals in the future. Standardized but flexible procedures have enabled

NUTRIENT	KMR LIQUID		KMR POWDER	
	AFB	DMB	AFB	DMB
Moisture (%)	81.70	0.00	2.70	0.00
Gross energy (kcal/g)	0.92	5.03	5.12	5.26
Crude protein (%)	7.70	42.08	43.00	44.19
Crude fat (%)	4.68	25.57	29.51	30.33
Total CHO (%)	4.74	25.90	18.44	18.95
Ash (%)	1.18	6.45	6.35	6.53
Lysine (%)	0.58	3.17	ND	ND
Taurine (%)	0.01	0.50	ND	ND
Calcium (%)	0.19	1.04	1.01	1.04
Phosphorus (%)	0.16	0.87	0.89	0.91
Vitamin A (IU/kg)	23130.00	126393.44	110660.00	113730.73
Vitamin E (IU/kg)	22.00	120.22	124.08	127.52

Table 1. Selected nutrient composition of two forms of KMR (kitten milk replacer), expressed as: AFB, as fed basis; DMB, dry matter basis; ND, not determined.

the development of consistent hand-rearing practices so that each case can be reviewed properly, the techniques can be re-evaluated and reliable comparisons can be made either for conspecifics or between closely related species.

The behavioural needs of each animal are taken into account when hand-rearing and Nursery staff are trained to be consistent and empathetic in their handling techniques. Peer rearing is preferred but if this is not possible the neonate is offered a suitable surrogate, such as a stuffed toy. Arboreal animals are provided with elevated platforms for play and sleep. If the neonate is to be paired with a conspecific reintroduction is implemented at the earliest possible time. Animals which may be used for education are handled more intensively at an early age.

HAND-REARING MEXICAN MARGAYS

A pair of Mexican margays *Leopardus wiedii glaucula* at the Zoo had a history of eating their young, even when husbandry conditions were implemented to encourage the ♀ to care for her offspring. Two kittens of separate litters, born in May and October 1995, were removed for hand-rearing on day of birth. Both animals were ♀ and appeared to be in

good health on arrival at the Nursery. The mean birth weight was 95.05 ± 12.8 g. Until they were 1 month of age the kittens were housed in an incubator for 24 hours per day and were only removed for feeding. A hot-water bottle wrapped in flannel and a stuffed toy surrogate were provided.

FORMULA AND FEEDING

Canned, pre-mixed KMR (kitten milk replacer) was fed to both animals because its composition is similar to the milk of the domestic cat (Table 1). This formula is commercially available and it has been used to hand-rear non-domestic felids successfully (Barnes, 1976; Meehan, 1994).

DAY	NO. FEEDS
1	10
3	9
4	7
7	6
19	5
44	4
48	3
58	2
70	1

Table 2. Proposed feeding schedule for Mexican margay *Leopardus wiedii glaucula* kittens hand-reared at San Diego Zoo.

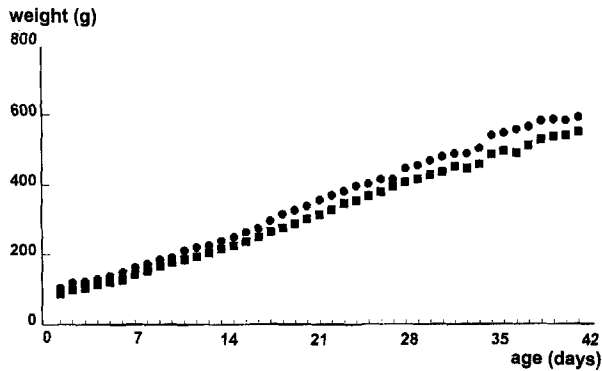


Fig. 1. Growth curves for 0.2 hand-reared Mexican margay *Leopardus wiedii glaucula* (0–42 days) at San Diego Zoo: circles born May 1995; squares born October 1995.

The formula is also manufactured in a powder form which can be mixed to the required concentration.

The same protocol was used to hand-rear both kittens. During the first 48 hours the animals were fed KMR formula diluted to a 1:1 ratio (9.2% solids) with distilled water. By day 3 the formula was fed at full-strength (18.3% solids). Approximately 2 ml of Lactaid, a lactase enzyme preparation, was added to every 100 ml of formula and the food was refrigerated for 24 hours prior to feeding to allow the Lactaid to break down the lactose. After 48 hours all remaining formula was discarded.

A target formula intake of 20% of body weight over a 24 hour period was used as a guideline. The number of feeds offered was dependent on the suckling response and formula intake of each animal (Table 2). During the first 24 hours between seven and ten feeds were offered. From day 7 six feeds and from day 19 five feeds were offered over a 24 hour period. Formula consumption and body weight were measured daily.

The formula was offered in a small pet nurser (Pet-Ag) fitted with the nipple provided. During feeding the animals were placed in a sternal recumbency so the front feet could move freely, the natural nursing position. The feeding position and the viscosity of the formula are especially

important for carnivores with a strong suckling response because of the risk of formula aspiration. From day 42 formula was offered in a shallow pan once a day.

After feeding elimination was stimulated with a damp cloth or towel. As the animals got larger and stool volume increased, elimination was accomplished by manual stimulation under running water. The sinks that were used for this purpose were separate from the food preparation areas and they were disinfected after each use. Manual stimulation was continued until the Mexican margays were urinating and defecating reliably, at c. 4 weeks and 6 weeks, respectively.

The mean growth rate from birth to 21 days and from 21 to 42 days was 11.43 and 11.32 g day⁻¹, respectively (Fig. 1). The mean gross energy intake from birth to day 21 was 186.98 and 171.18 kcal kg⁻¹ body weight, respectively.

The lactation period for domestic cats is 6 weeks (Loveridge, 1986) and, although kittens may continue to suckle, weaning begins at this age. Transition to solids is not forced but is encouraged and rate of transition depends on the individual. Using this as a guide the Mexican margays were offered solids from day 42. Zu Preem, a canned, nutritionally complete feline diet, was mixed with formula and this was offered as a single daily feed.

SPECIES	INDIV. GROWTH RATE (g day ⁻¹)	LITTER GROWTH RATE (g day ⁻¹)	♀ BODY WEIGHT (kg)	REFERENCE
Caracal <i>Caracal caracal</i>	25.0	75.0	9.7	Kralik, 1967
Jungle cat <i>Felis chaus</i>	21.5	64.5	6.7	Schauenberg, 1979
Sand cat <i>Felis margarita</i>	12.0	33.0	2.2	Hemmer, 1976
European wild cat <i>Felis silvestris</i>	12.0	39.6	4.3	Lindemann & Rieck, 1953
Mexican margay ¹ <i>Leopardus wiedii glaucula</i>	11.4		3.6	
Lynx <i>Lynx lynx</i>	35.7	82.1	17.8	Kunc, 1970; Hemmer, 1976
Leopard cat <i>Prionailurus bengalensis</i>	12.2	30.5	3.3	Frese, 1980
Rusty-spotted cat <i>Prionailurus rubiginosus</i>	11.0	27.5	1.3	Hemmer, 1976
African golden cat <i>Profelis aurata</i>	27.4	54.7	6.2	Tonkin & Kohler, 1978
Clouded leopard <i>Neofelis nebulosa</i>	25.0	46.0	17.0	Fellner, 1968

¹0.2 Mexican margays *Leopardus wiedii glaucula* hand-reared in this report.

Table 3. Rates of individual growth, litter growth and adult ♀ body weights as observed for several mother-reared small felids (modified from Gittleman & Oftedal, 1987).

DISCUSSION

KMR predigested with Lactaid proved to be a suitable formula for hand-rearing our Mexican margays. There were no gastrointestinal problems and formula consumption was excellent. The growth curves were similar to mother-reared cats of comparable body mass (Table 3). In addition, the ease of preparation and consistency of KMR formula composition reduced the potential for variability in the food offered to the two kittens.

Although felids have been hand-reared successfully with Esbilac, a milk replacer for canids (Armstrong, 1975; Quillen, 1981), this product is not formulated for the unique nutrient requirements of felids. The higher protein concentration and addition of taurine, a sulphur amino acid, in KMR reflect a known nutrient requirement of cats (MacDonald *et al.*, 1984; Meehan, 1994). Retinal degeneration and

blindness resulting from taurine deficiency has been reported in captive Leopard cats *Prionailurus bengalensis* (Howard *et al.*, 1987). The addition of the lactase enzyme Lactaid promotes the further reduction of lactose in the KMR through predigestion of the carbohydrate fraction of the formula. Lactose intolerance can cause gastrointestinal problems in species whose milk is naturally low in lactase. Diarrhoea which is not attributable to infectious organisms or overfeeding may be remedied by this pre-treatment (Meehan, 1994).

Detailed record keeping, consistent rearing procedures and reliable formulas have allowed us to refine and improve our methods of hand-rearing small felids. Although some species differences may exist, the techniques used for the Mexican margays could be applied to other felids, should the need arise.

PRODUCTS MENTIONED IN THE TEXT

Esbilac: canine milk replacer, manufactured by Pet-Ag, Inc., Elgin, IL 60120, USA.
KMR Kitten Milk Replacer: milk replacer, manufactured by Pet-Ag, Inc., Elgin, IL 60120, USA.
Lactaid: enzyme additive, manufactured by Lactaid, Inc., Pleasantville, NJ 08232, USA.
Zu Preem: canned Feline Diet, manufactured by Premium Nutritional Products 6820 Squibb Road, Mission, KS 66202, USA.

REFERENCES

ARMSTRONG, J. (1975): Hand-rearing black-footed cats *Felis nigripes* at the National Zoological Park, Washington. *International Zoo Yearbook* **15**: 245–249.
 BARNES, R. G. (1976): Breeding and hand-rearing of the marbled cat *Felis marmorata* at the Los Angeles Zoo. *International Zoo Yearbook* **16**: 205–208.
 FELLNER, K. (1968): Erste natürliche Aufzucht von Nebel-parden (*Neofelis nebulosa*) in einem Zoo. *Der Zoologische Garten* **35**: 105–137.
 FRESE, R. (1980): Some notes on breeding the leopard cat *Felis bengalensis* at West Berlin Zoo. *International Zoo Yearbook* **20**: 220–223.
 GITTLEMAN, J. L. & OFTEDAL, O. T. (1987): Reproductive energetics in mammals. *Symposia of the Zoological Society of London* **57**: 41–77.
 HEMMER, H. (1976): Gestation period and postnatal development in felids. *The World's Cats* **3**: 143–164.
 HOWARD, J., ROGERS, Q. R., KOCH, S. A., GOOD-ROWE, K. L., MONTALI, R. J. & BUSH, M. (1987): Diet-induced taurine deficiency retinopathy in leopard cats (*Felis bengalensis*). In *Proceedings of*

the First International Conference on Zoological and Avian Medicine **1987**: 496–498. Omaha, NE: Association of Avian Veterinarians and Media, PA: American Association of Zoo Veterinarians.
 KRALIK, S. (1967): Breeding the caracal lynx *Felis caracal* at Brno Zoo. *International Zoo Yearbook* **7**: 132.
 KUNC, L. (1970): Breeding and rearing the northern lynx *Felis l. lynx* at Ostrava Zoo. *International Zoo Yearbook* **10**: 83–84.
 LINDEMANN, W. & RIECK, W. (1953): Beobachtungen bei der Aufzucht von Wildkatzen. *Zeitschrift für Tierpsychologie* **10**: 92–119.
 LOVERIDGE, G. J. (1986): Body weight changes and energy intakes of cats during gestation and lactation. *Animal Technology* **36**: 15.
 MACDONALD, M. L., ROGERS, Q. R. & MORRIS, J. G. (1984): Nutrition of the domestic cat, a mammalian carnivore. In *Annual review of nutrition* **4**: 521–562. Darby, W., Broquist, H. & Olson, R. (Eds). Palo Alto, CA: Annual Reviews, Inc.
 MEEHAN, T. P. (1994): Handrearing felids. In *AZA Infant diet notebook*: 16.1–16.6. Wheeling, WV: American Zoo and Aquarium Association.
 QUILLEN, P. (1981): Hand-rearing the little spotted cat or oncilla *Felis tigrinus*. *International Zoo Yearbook* **21**: 240–242.
 SCHAUENBERG, P. (1979): La reproduction du chat des marais *Felis chaus* (Guidenstadt, 1776). *Mammalia* **43**: 215–223.
 TONKIN, B. A. & KOHLER, E. (1978): Breeding the African golden cat *Felis (Profelis) aurata* in captivity. *International Zoo Yearbook* **18**: 147–150.

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Breeding and husbandry of the Margay

Leopardus wiedii yucatanica

at the Ridgeway Trust for Endangered Cats, Hastings

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The Ridgeway Trust for Endangered Cats obtained a young pair of confiscated wild-caught Margays *Leopardus wiedii yucatanica* from Belize. Kittens have been born in 1994 and 1995 and although the first died, the second was mother-reared to independence. Oestrous cycles, courtship, mating behaviour and the rearing of the infant are described. It is

concluded that total privacy for the ♀ and young is an important factor for successful breeding of this species.

Key-words: courtship behaviour, enclosure design, margays, privacy, successful reproduction