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Abstract: The endangered status of the ocelot both as a native foreign species, the restraints imposed by government on importation, and the low recruitment rate from captive breeding in zoos, warrant a review of breeding biology and propagation. Referred to chapter "Estrous Cycle and Birth Interval", in both cheetahs and ocelot if they lost their litters after the average estrous cycle, then 2 estrous periods normal occurred between births. If they did not raise litters for more than 6 weeks, or lost them shortly after birth, an average of about 4 estrous periods occurred between births.

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Breeding Biology and Propagation of the Ocelot (*Leopardus [Felis] pardalis*)[1]

By Randall Eaton, Seattle

With 1 Figure

The endangered status of the ocelot both as a native and foreign species (Eaton and van Oosten 1975; Koford 1976), the restraints imposed by government on importation, and the low recruitment rate from captive breeding in zoos, warrant a review of breeding biology and propagation.

Reproductive Biology

Information on the reproductive biology of the ocelot is sorely limited. The best data have been collected by private breeders, several of whom have been quite successful in propagation of the ocelot in the past 5 years. The Hatfields (1973; pers. comm.) summarized their breeding data, which I have reorganized in Table 1. Length of estrous periods, dates of birth and size and sex of litters are tabulated. The dates of estrous periods in Table 1 include all the days in which actual mating occurred (K. Hatfield, pers. comm.).

The first 4 ♀♀ listed in Table were given no hormones, which are used to induce mating, control length of estrus or ovarian cysts. The data on ♀♀ which did receive hormone treatment are so similar to the ♀♀ that received none that hormones do not appear to affect length of estrus or gestation or litter size. Except for one exceptionally long estrous period of 23 days, it appears that the average length of estrus is quite similar for the first 3 ♀♀, for which there are more data. These estrous periods averaged about 5 days.

Lovell (1974) kept accurate notes on a breeding pair. The ♀'s first 8 estrous periods prior to the first birth lasted with one exception 5 days each; the last one in this series was 4 days and it resulted in conception. After the first birth, which was not raised, the ♀ exhibited 2 estrous periods of 5 and 6 days, the latter of which resulted in conception. Four more estrous periods occurred prior to the third birth, but these were more variable and followed a Cesarean section birth. They ranged from 3–12 days, and averaged 6.5 days. There was another Cesarean birth, followed by 2 estrous periods of 6 and 20 days which were not mated — the pair had been separated to prevent immediate pregnancy following surgery. Within one day after the ♂ and ♀ were integrated the 20 days long period ended and resulted in a birth.

It can be assumed from Lovell's (1974) report that only the last 2 estrous periods, 6 and 20 days, were not mated (except the last day of the 20-day period) and that in all other periods mating occurred. The estrous periods that were mated were less variable, averaging 5.3 days ($r = 3-12$, $n = 13$).

[1] Dedicated to the memory of Dr. R. F. Ewer, leading carnivore biologist and mammalian ethologist, who died Easter, 1975.

Table 1. Reproductive data of ocelots at Hatfields' compound, adapted from report published in 1973

♀	Estrous Period	Length	Birth	Gestation	Litter
I-"*Heidi*"	2/16—3/10/70	22	5/27/70	78	0:1
	6/24—26/70	2	9/15/70	81	2:0
	11/15—17/70	2	2/5/71	82	1:0
	2/5—12/71	8	5/1/71	77	1:0
	7/1—5/71	4	9/22/71	79	0:1
	5/5—12/72	7	8/1/72	80	0:1
	12/20—22/72	2	3/13/73	81	0:2
	Tot. 's/Ave. 7	6.7	7	79.7	1.28
II-"*Donna*"	9/20—29/70	9	12/19/70	82	1:0
	6/9—12/71	3	9/1/71	81	1:0
	12/6—7/71	1	2/24/72	80	1:0
	5/1—4/72	3	7/21/72	78	0:1
	?[1]	—	1/10/73	—	1:0
	Tot. 's/Ave. 5	4.0	5	80.2	1:0
III-"*Puggy*"	12/3—9/71	6	2/27/72	79	2:0
IV-"*Maya*"	4/18—22/71	4	7/11/72	80	1:0
	7/17—22/71	5	10/9/71	79	0:0
	11/20—23/71	3	2/11/72	80	1:1
	6/18—23/72	5	9/11/72	80	0:2
	12/15—19/72	4	3/10/73	80	0:2
	Tot. 's/Ave. 5	4.2	5	79.8	1.4
V-"*Twiggy*"[2]	?—7/25/71	—	10/12/72	79	2:0
	?—3/22/72	—	6/10/72	89	1:0
VI-"*Sherry*"[3]	7/2—10/72	8	2/24/72	77	1:0
VII-"*Tai*"[4]	6/26—7/1/72	4	9/27/72	79	1:1
VIII-"*Seena*"[5]	10/6—10/72	4	12/30/72	81	1 ?)
Totals/Ave.		5.35		79.7	1.3

[1] Were unaware that ♀ was in heat; had been 3 weeks earlier.
[2] Apparently has ovarian cysts-stays in heat unless pregnant, does not conceive unless given a series of hormone shots, usually 3.
[3] Given a hormone shot as "would not come into good estrus, or stay in long enough for ♂ to mate with her."
[4] Given hormones "because was coming into estrus, staying in a month or more, mating, but not conceiving. Has stayed in estrus for as long as 78 days."
[5] Given one large dose of hormones on 10/6, as "over 3 years old, does not come into estrus strong enough or long enough for ♂ to mate with her."

The estrous period of the ♀♀ at the Hatfield compound, in all of which conception occurred, is similar to the fertile estrous period described by Lovell, averaging 5.35 and 5.3 days respectively.

The Hatfields (1973) did not publish the estrous period data which were not followed by births, a practice common to zoos as well (Eaton 1975). This information is needed to compare fertile and sterile estrous periods and to arrive at a probability of conception.

Based on nearly twice as many births in an additional 2 years, the Hatfields (pers. comm.) said, "The average estrus for a normal ocelot is more like 7—10 days unless conception takes place, which reduces the period to a 5-day average". As Lovell's (1974) ♀'s nonconceived estrous periods were also longer than the conceived periods, the estrous period may be a reliable indicator of the probability of conception during an estrus. Eaton and York (1970) hypothesized that length of estrus correlated with occurrence or absence of conception in lions (*Panthera leo*); further research disproved the hypothesis (Eaton 1976), at least for the entire population of study (i.e., one pride did exhibit correlation between estrous period and probability of conception). In the ocelot, conception "turns off" estrus, or at least shortens it; estrous period is influenced by whether or not conception occurs. With physiological examination the temporal relationship between conception and the termination of estrus may be discovered. For example, if it is found that estrus ends within 24 hours of conception, then a more reliable measure of gestation would be available and preparations for parturition could be more effectively planned.

The ocelot's conceived estrous period appears to be at least 2 days shorter than found in larger felids studied to date, including the lion (Eaton 1974), leopard (Eaton in press), and tiger (Kleiman 1974), but the ocelot's non-conceived estrus is longer and comparable to those of larger species.

Estrous Cycle and Birth Interval

Cisin (1967) said that unmated ocelots may enter estrus every 2 weeks or every few days, but implied that such a frequency was caused by cystic ovaries. Cisin (1967) believed that ♀♀ kept with ♂♂ normally enter estrus every 4—6 months, which would not be expected from a tropical and semi-tropical felid, all of which studied to date are at least semi-polyestrous.

As suggested by Lovell's observations (1974), the estrous cycle of the ocelot may be relatively short. His ♀ exhibited 15 cycles which averaged 15 days. The interestrous period was less variable than the estrous period, and averaged 9.8 days ($r = 7-11$). The data on this single ♀ are not similar to the observed estrous cycle of many ♀♀ at the Hatfield compound, which exhibit inter-estrous periods of 6 weeks with some averaging a week or 2 less.

Birth intervals can be quite short when the litter is removed; ♀♀ sometimes parturate twice in a minimum period. A ♀ at Adelaide Zoo (see Table 2) came into heat, mated, conceived and gave birth within 100 days after loss of a newborn litter; one at the Hatfield's had 2 litters in 90 days. Since gestation is about 80 days, these ♀♀ had to enter estrus and conceive within 10 and 20 days respectively, following parturition. By computing the number of days from parturition to the first post-partum estrus in which conception occurred (Table 1), a ♀ at the Hatfields' compound began a fertile estrus 6 days after parturition, giving birth 90 days after the preceding birth. Another ♀ began mating

1 day after the litter was born and removed, and she parturated 82 days later. However, the data compiled in Table 2 show that the average interbirth period = 174.3 days (n = 15, r = 90—310); suggesting that most ♀♀ exhibit several estrous periods between conceptions as evidenced by births, and K. Hatfield (pers. comm.) says this is true.

Table 2. Number of days ♀♀ of the Hatfield Compound spent raising their consecutive litters and the period between successive births (data from K. Hatfield, pers. comm.).

♀	No. Days with Litter	No. Days between Births
"*Heidi*"	49	110
	41	144
	4	85
	30	143
	3	310
	2	225
	40	—
"*Maya*"	0	90
	0	126
	42	212
	42	181
	41	—
"*Donna*"	44	256
	43	177
	13	147
	41	174
	41	—
"*Twiggy*"	59	233
	44	—
"*Sherry*"	41	—
"*Tai*"	42	—
"*Seena*"	0	—
	Ave. = 30.1 (n = 22)	Ave. = 174.3 (n = 15)

The average period from parturition to the estrus preceding parturition for the first 3 ♀♀ in Table 1, was 93.3 days. If litters were removed at age 42 days on the average, and if the average estrous cycle is 38.5 days, then 2 estrous periods normally occurred between births, a probability of conception =0.50. From the data in Table 2, it can be seen that for all the ♀♀ that did not raise litters for more than 6 weeks, or lost them shortly after birth, an average of about 4 estrous periods occurred between births. While in the individual case, replacement of litters can occur rapidly, such high productivity is not typical. This same rule has appeared in studies of the lion (Eaton 1974), leopard (Eaton in press), cheetah (Adamson 1972) and housecats (Asdell 1964), but no explanation accounts for the low average probability of conception of captive felids (but see Eaton 1976).

Drawing on more complete information in Tables 1 and 6, I have tabulated the intervals between births comparing those cases where the young were removed or died within

50 days to the cases in which the mother raised the young for no less than 90 days (Table 3). 29 intervals in which young were lost or removed within 50 days averaged 6 months, compared with birth intervals averaging 9.1 months when the young were mother-raised at least 90 days. The shortest period between births when the ♀'s first litter was still present during conception was 6 months and 10 days, at the Adelaide Zoo. This ♀ averaged 9.04 months between births when the young were present at mating.

These data suggest that when young are lost or removed it is common for ♀♀ to reproduce twice in about 1 year, and when young are not removed, reproduction occurs

Table 3. Birth intervals when young were raised or lost within 50 days compared to when the young were raised at least 90 days

♀/Facility	Young Lost/Removed within 50 days	Young Raised 90 or more days
I Marlot	7 months	
	4	
	5	
	5	
	6	
	13	
II Marlot	3	
	7	
	6	
II, Woodl. P.		11.5
I Hatfields'	3.5	
	4.5	
	3.0	
	4.6	
	10.3	
	7.5	
II Hatfields'	9.3	
	6.0	
	5.0	
	5.8	
III Hatfields'	3.0	
	4.0	
	7.0	
	6.0	
II Adelaide	3.3	8.5
	3.6	8.6
	11.0	7.8
		6.3
		7.9
		8.2
		11.3
		11.7
		9.2
		10.8
		8.2
I Lovell's	13.0	
	5.0	
	4.2	
Ave.	6.1 (n = 29)	9.1 (n = 12)

about every 9 months. In more exceptional cases, a ♀ is capable of reproducing 3 times a year at most. Earlier, Cisin (1967) said that the majority of birth intervals between 25 births in which all young were removed for hand-rearing, was 1 year, though some were 6 months and the minimum was 4 months. It is likely that since Cisin (1967) collected data, nutrition and other factors have increased fecundity of captive ocelots.

There is little data to rely on but gestation would appear to be about 80 days. The Hatfields' ♀♀ ranged from 77—82 days in 22 periods, with an average of about 80 days counting from the last day of the mated estrus. The only other data are from Lovell (1974), whose ♀'s gestation periods were reported as 68, 63 (premature), 80 and 81 days in length, an average of 73 days. However, Lovell assumed that 2 additional estrous periods had occurred based on discovery of fetuses through X-ray examination. Considering that the ♀ was recyling about every 2 weeks and that he believed that gestation was about 70 days, shorter than the customary by about 10—12 days, I suspect that his data should be reinterpreted so that the last observed estrus is scored for conception, thus bringing the average closer to 80 days.

If the midpoint of the estrous period is counted as day 1 of gestation, these periods would average about 82 days. Many private breeders and zoos commonly accept that gestation is 82 days, but there remains a perpetual problem in communication because many reports do not state when the measurement is begun. I have preferred using the last day of estrus, as less variability results. This is particularly true in species which exhibit extreme variability in length of estrus, for example the lion (Eaton 1974). The Hatfields' ocelots (Table 1) generally exhibited less variability in length of estrus than some felids; however, 1 ♀ exhibited extreme length of gestation measuring from the last day of estrus: she averaged 95 days (Hatfield and Hatfield 1973). Until more is known about when fertilization occurs and any delay in implantation, a reliable measure of gestation will not exist.

Breeding Age

The data on the Adelaide Zoo ♀ and her litters (W. Lancaster, pers. comm.) suggest that breeding age may be as young as 9 months. Many captive-born ocelots begin to exhibit estrus at 10 to 11 months of age, which would appear to be consistent with the mother reproducing at about this age of her previous litter. However, the growth of captive ocelot kittens may be accelerated compared with wild litters in which invariable food shortages must prolong age of sexual maturity.

The age of first parturition is given in Table 4 for several zoos and a breeding farm, the youngest being 2.5 years for 2 ♀♀ at Marlot. Lovell's (1974) ♀ began to cycle at 2 years of age and reproduced first at 2.5 years. A ♀ born and mother-raised at Woodland Park Zoo began to mate at 10.5 months of age. A mother-raised, zoo-born pair at Adelaide Zoo first conceived at just over 4 ears (W. Lancaster, pers. comm.); however, they had been kept together from birth and it is becoming more commonly suspected that sibling pairs kept together constantly may not become reproductive until older, partly as a result of lack of sexual experience with sexually experienced adults, and probably also as a result of childhood bonds and familiarity which amy interfere with normal onset of estrous cycling and/or the ♂'s ability to dominate the ♀ in courtship (Eaton 1976).

As to longevity of reproduction, the Adelaide pair was still reproducing when the ♀ was at least 10 years old and the ♂ at least 10 years, though W. Lancaster (pers.

comm.) said that the ♂ was showing signs of senility and deterioration. The ♀ born at Houston (Table 3) was still reproducing at an age of at least 13 years and the Calgary ♀ was at least 9 years old at her last birth.

Table 4. Origin, age at first parturition and mode of rearing of ♀ ocelots which bred in 6 facilities (from Eaton 1975)

Zoo	Origin Zoo	Wild	?	Age (years) at Parturition	Raised by Mother	Hand	?
Cincinnati		×		?			×
Central Park			×	3.5			×
Marlot		×		2.5	×		
		×		2.5	×		
Houston		×		7.0+			×
Calgary			×	4.0+			×
Tulsa			×	4.0+			×

While the age of first reproduction of wild-living ocelots would probably be affected by several factors including density of older ♀♀ in established territories, the availability of food, etc., I would guess that it is customary for wild ♀♀ to reproduce first at, or prior to 2.5 years. Similarly, since captive conditions are more conducive to longer life, wild-living ocelots, ♀ and ♂ alike, probably do not live or reproduce nearly as long. It would not be surprising if the longevity of reproductive life in feral populations were 10 years or less on the average. Concerning captive management, it would appear that a healthy ocelot should be expected to continue reproducing well beyond 10 years and probably as much as 15 for many specimens.

Litter-Size

42 litters born at Woodland Park Zoo, Adelaide Zoo and the Hatfields' compound consisted of 31:23, plus 4 unknown. The average littersize is known from 13 facilities (Table 4): the number of litters is 117 totalling 156 kittens, an average litter of 1.33. Only 3 litters consisted of 3 kittens, the largest litter-size. In addition, Brager Larsen (pers. comm.) reported that a breeding farm in Western Germany had produced 51 kittens with an average litter-size of about 1.5 kittens. There are many additional reports of number of kittens or number of litters but often not both. Incorporating the information from the Western German fur farm (Brager Larsen, pers. comm.), the average litter-size is about 1.4. This is probably below the average in the wild, which may be about 2.0, with 3.0 occurring more commonly.

Seasonality

Cisin (1967) reported that 25 captive-born litters were born every month of the year. Baudy (1972) said that there was seasonality of births in South America, in late autumn (apparently referring to the autumn season of the northern hemisphere), but that in Mexico, north of the equator, births occurred in early spring, January through March, which might be expected if his information on the southern hemisphere is correct. However, Koford (pers. comm.) suggests that other conditions, such as flooding and food abundance should affect local breeding seasons throughout much of Latin America.

Baudy also said that kittens were found in every month in Texas. It is possible for there to be births anytime of the year and still find birth peaks and a tendency towards seasonality.

I compiled all the birth months from the facilities of the northern hemisphere which have been discussed heretofore. All of them are either in Canada or the U.S. The 70 births show what may indicate a tendency to seasonality; there are peaks in March and May and in September-October. The lowest birth month is November. The births at Adelaide are plotted separately (Figure 1). The Adelaide data might exhibit a reverse of seasonality in the northern facilities, but there are too few births for a valid comparison.

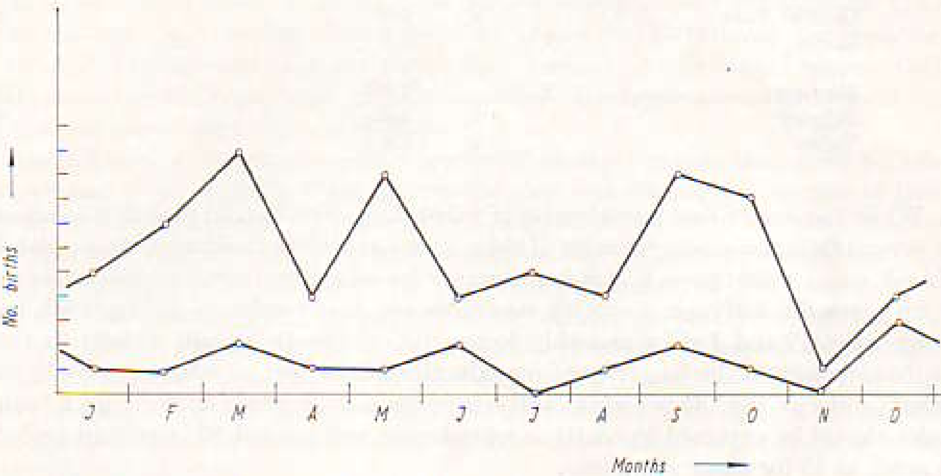

Fig. 1. Births of ocelots in captivity.
Top line-Central Park, Tulsa, Marlot, Hatfields', Woodland Park, Houston, Calgary, Lovell's, Olympic Game Farm Bottom line-Adelaide

Propagation

In 1966, Jones conducted a survey of felids in the zoos of North America. He found ocelots in 31 of 68, or about 45%, of the zoos sampled. In a 1974 survey (Eaton 1975) 32 or 27% of the 115 zoos and feline breeding facilities reported ocelots. The number of zoos with ocelots in both surveys is nearly identical, but a larger survey response in 1974 indicates that relatively fewer zoos keep ocelots now compared with 1966. However, there has been an increase since 1966 in the number of ocelots, from 55 in 31 zoos, to 70 in 32 zoos in 1974. The average collection was 1.45 in 1966, 2.1 in 1974.

An arbitrary reproductive score was developed by Eaton (1975) that was based on the percentage of zoos which reported reproduction. By this scale, 66.6% or higher received a score of 3, 33.3% a score of 1 and inbetween was scored as 2. A score of 3 was designated as a "good breeder", 2 as satisfactory and 1 as a "poor breeder". Ocelots ranked as a poor breeder. An index of status in captivity was derived by multiplying the reproductive score by the number of zoos with ocelots (32). The analysis suggested that while ocelots were more abundant than some smaller species, for example, caracal and golden cat, the ocelot's lower reproductive score effected a lower index of status. The final phase of this evaluation of status in captivity concluded that any species with either a reproductive score of 1, or an index of less than 20, should be classed as endangered in captivity, excluding recruitment other than breeding within the existing zoo population. The ocelot was therefore ranked as endangered, as were the majority of smaller felids.

However, reproduction — the mere occurrence of a birth — is of course quite different than survivorship. While 10 (31.2%) of the 32 zoos which had ocelots reported reproduction, fewer apparently produced surviving offspring.

The total zoo population reported in 1974 was 70 ocelots, including at least 3 neutered ♂♂ (Table 5). If we assume that there were 26 potentially reproductive pairs, and that the expected minimum production per year is one cub which survives, then the least number of subadults after one years' breeding period should have equaled 26. This population apparently produced only 2 surviving offspring in the year prior to the survey, or 7% of the projected minimum.

The ratio of adults to subadults (all classes except adults) was 7.75, indicating a recruitment rate far too low to sustain ocelots in zoos without further importation, or supplies from private breeders. Only the margay, jaguarundi, Canadian lynx and bobcat have higher age ratios among smaller species kept in zoos (Eaton 1975).

In the adult segment of the zoo population surveyed by Eaton (1975) 6 ocelots (9.6%) originated from zoos; 32 (51%) from the wild; and, 24 (39.4%) from unknown origins (Table 6). It can be safely assumed that most of the ocelots reported as originat-

Table 5. Captive litter-size

Facility	No. Litters	No. Kittens	Ave.	Largest Litter
Adelaide	16	24	1.5	3 (n = 1)
Woodl. P. Zoo	4	5	1.25	2 (n = 1)
Hatfield's	22	30	1.31	2 (n = 7)
Cincinnati	2	3	1.5	2 (n = 1)
Central Park	4	7	1.75	2 (n = 3)
Marlot	12	18	1.5	3 (n = 1)
Houston	12	12	1.0	—
Calgary	7	7	1.0	
Tulsa	2	2	1.0	
Olympic Game Farm	1	1	1.0	
Lovell's	4	4	1.0	
Cisin (1967)	23	31	1.24	3 (n = 1)
B. Bond (pers. comm.)	9	12	1.33	2 (n = 3)
14	117	156	1.33	3 (n = 3)

Table 6. Sex and age structure of the ocelot population and its origin, in 32 zoos of the western hemisphere (data from Eaton 1975)

	Sex		Origin	
	♂	♀	Wild	Zoo
Adults	26 + 3*	33**	32	6
Subadults	7	1	5	2
Totals:	33 + 3	34	37	8

* = neutered
** = some probably neutered, impossible to detect without surgical examination.

ing from zoos and unknown sources came originally from the wild, even if they passed through pet owners' hands in the interim. The ocelot population in zoos ranked third lowest in zoo origin among smaller felids. The margay was lower, with 7% from zoos; the Pallas cat was lowest, 5% originating from zoos. Origins of ocelots reinforce the obvious conclusion that captive breeding has been a low source of recruitment, and that it is reasonable to consider the North American zoo population as threatened. While fewer zoos apparently care to exhibit ocelots today than in 1966, the zoos that now have them are keeping pairs, an indication of intent to breed.

In a follow-up survey, Eaton (1975) collected data from zoos and breeding farms on ocelot propagation. 10 zoos and breeding facilities responded, of which 6 reported reproductive success. A total of 37 litters were born to 7 ♀♀ in these facilities. At least 16 kittens were successfully mother-raised; 1 was born dead; 2 were eaten, 1 by the sire. 2 more kittens were mother-raised but died as a result of falling in the cage. Among the 25+ kittens removed and raised by hand, only one died, from an unknown virus. One litter was suckled by a domestic housecat and survived (Table 7). Table 7 also includes information collected from Adelaide Zoo (W. Lancaster, pers. comm.) and Woodland Park Zoo. Both zoos have had reproductive success, resulting in 20 litters. The addition of these data gives a better picture of survival of young and causes of mortality than reported by Eaton (1975). In summary, 11 ♀♀ in 7 zoos and one breeding farm produced 57 litters. Of the 45+ kittens left with their mothers (and rarely, the father), 33+ or 67% survived to young adulthood or older. Of the 26+ removed for hand-rearing, 24+ or 92% survived. While these results suggest that probability of survival is higher from hand-rearing, it should be considered that the most common cause of death is predation, primarily by the ♂ present at birth. It should also be recognized that hand-rearing requires considerable time and skill on the part of the staff.

In order to relate the mode of rearing to breeding success, Eaton (1975) queried these same zoos as to the origin and mode of rearing of the ♀♀, whether or not they had been reproductive. Unfortunately, the zoos that had not bred ocelots provided little of any data; consequently, the information collected applied primarily to reproductive ♀♀.

In Table 4, it is interesting to note that the Marlot ♀♀ were mother-raised in the wild and reproduced at an early age but the Marlot facility prefered hand-rearing. Many of their cats are sold to private owners s apets, so it is understandable that they would prefer hand-rearing. All the other zoos in Eaton's survey expressed a preference for mother-rearing for sevderal reasons, including better health and better breeding success as adults. There is inadequate data at this time to evaluate the modes of rearing, though the Hatfields (pers. comm). have found that survival of mother-raised kittens increases as the mother gains experience; most of their losses are attributed to inexperienced mothers.

It is obvious from Table 4 that even the successful breeding zoos know very little about the origins and history of their ocelots, though the "unknown" responses under origin were probably born in the wild, as discussed earlier. While these data are scanty, it is tempting to speculate that mother-raised young reproduce at earlier ages on the average than those raised by hand, particularly, I would guess, when the ocelot was raised by its mother in captivity, thus alleviating the stress of adaptation experienced by a wildborn, mother-raised cat brought into captivity.

Eaton (1975) acquired data on the housing of breeding ♀♀. At all the zoos listed in Table 7, except Houston, births occurred in nest boxes placed in the cage. Houston pro-

Table 7. Data from Eaton (1975) combined with data from Woodland Park Zoo and Adelaide Zoo, on disposition of litters born

Zoo	Litters No.	Born Year	♀♀	Born Dead	Killed, eaten	Mother-raised: Uncared for, died	(Left with mother): Cared for, died	Died cause?	Lived	Hand-raised: Died	Lived
Cincinnati	3	63	I								2
	1	65	I								1
Central Park	4	71	I		1		1				
	8	71	I				1				1
	7	72	I						1		
	3	73	I						2		
Marlot	6	70	I								1+
	1	71	I								3
	5	71	I								2
	10	71	I								2
	3	72	I								1
	9	72	I								1
	10	73	I								1
	7	72	II								1+
	10	72	II								
	5	73	II	1						1	
	11	73	II								
Houston	12	64	I						1		
	4	65	I						1		
	10	65	I						1		
	3	66	I						1		
	9	66	I						1		
	2	67	I						1		
	9	67	I						1		
	3	68	I						1		
	8	68	I						1		
	6	69	I						1		
	10	69	I						1		
	3	70	I						1		
Calgary	5	68	I								1
	1	71	I		1						2
	4	71	I								1
	12	71	I								1
	7	72	I								1
	1	74	I								1
Tulsa	8	72	I								1+
	4	73	I						1+		
Subtotal:	6/	37	7	1	2	0	2	0	16+	1	24+
Woodl. Park	2	61	I		1						
	?	61	I		1						
	6	73	II						2		
	5	74	II						1		
Adelaide	2	55	I					1			
	4	63	II					1			
	3	64	II						1		
	12	64	II					1			
	3	65	II						1	1	

2*

Table 7 (continued)

Zoo	Litters No.	Born Year	♀♀	Born Dead	Killed, eaten	Mother-raised: Uncared for, died	(Left with mother): Cared for, died	Died cause?	Lived	Hand-raised: Died	Lived
	12	65	II						1		
	8	66	II					1			
	12	66	II						1		
	6	67	II		2				1		
	2	68	II						2		
	10	68	II						2		
	9	69	II					1	1		
	9	70	II						1		
	6	71	II						1		
	5	72	II						2		
	1	73	II		1				1		
Totals:	8/	57	11	1	7	0	2	5	33+	2	24+

Summary: 11 ♀♀ of 7 zoos and a breeding farm (Marlot) produced 57 litters. Of 48+ kittens left with mothers (and sometimes the sire), 33+ (67%) survived to subadults or older. Of 26+ removed for hand-raising, 24+ (92%) survived. The most common cause of death of mother-raised young was predation by the ♂ present at and after birth.

vided no den box, but they reported a complex cage, with rocks, logs and a tree. Their response indicated that the ♀ may find seclusion within the cage for parturition and early rearing. All litters were born in the absence of the sire except at Tulsa, where the ♂ was present at birth of the first litter. In every facility a ♀ and ♂ were housed together all the time until pregnancy was detected or birth suspected, in which case the ♂ was separated.

As mentioned above, Eaton was unable to get information supplied by zoos that had ocelots which had not bred. Several zoos simply reported "no breeding" and failed to complete items on the ♀'s first estrus, housing, social organization, etc., which might have given a comparative picture of breeding and non-breeding ♀♀, as a means of isolating variables that might relate to success or failure.

Behavior and Propagation

It is interesting to examine the history of the breeding pair at Adelaide Zoo (Table 6), as I believe it represents the level of success one should expect without tremendous effort and attention. 15 litters totalling 23 kittens were born in 10 years, of which the ♀ raised 15. I might comment that 19 of the 23 kittens born might have survived if the ♂ had been separated prior to birth. The simple addition of a wooden crate to what was described as a small, barren cage, has obviously been important as all births occurred there. It is not unreasonable to suppose that the presence of a den box and the possibility for seclusion is a critical factor in breeding success, and conversely, for failure.

The Hatfields (pers. comm.), who have been very successful in breeding ocelots and achieving mother-rearing, recommend that 2 den boxes be furnished to allow the mother to move kittens, particularly when one box becomes contaminated. They use boxes with removable floors to allow cleaning and sunning while the other box is in use. The mother moves her litter to a second, clean box when the first is dirty or odorous, which suggests an instinctive adaptation that prevents or reduces location of a den site by predators. The mother's inability to locate her litter where she feels it is secure probably causes abandonment or injuries to offspring, for example as the mother continues to carry a kitten in search of a suitable den, and becomes frantic.

The Hatfields (1973) prefer removal of kittens from ♀♀ when they are 6 weeks old; otherwise the kittens exhibit an irreversible socialization to their own species and cannot be marketed as pets. They (pers. comm.) normally remove younger kittens only under unusual circumstances — illness or injury. Only one of their adult ♀♀ (in 1975) does not raise kittens; she kills the kittens at age 4 days unless they are removed. Some of "*Heidi's*" litters died as a result of injuries incurred as they were being carried. "*Heidi*" has no canines (was defanged) and in moving kittens she is unable to grip them properly in the mouth. Without canines, the mother has to grip the kitten more strongly, and sometimes injures it.

Originally, the Woodland Park Zoo had 2 pairs of ocelots; each pair was housed together but there was no mating. The ♀, "*Rose*", of one pair, appeared to be in heat but was ignored by the ♂ she lived with constantly. "*Rose*" was taken to the cage of the other pair and released there. The foreign ♂, "*Jeff*", immediately mated "*Rose*": the mating was aggressive as the ♂ vigorously bit the ♀ nape. They were not disturbed and the ♀ housed with the mating pair was ignored until the heat period was over, when the ♂ became aggressive to both ♀♀. The ♀♀ were left together and the ♂ was removed.

"*Rose*" did not appear to be pregnant; however, high-pitched cries on the evening of 12 June, 1973, alerted the night keeper who discovered 2 kittens with the ♀ in the exhibit cage. When the keeper raised the door to the adjoining maternity cage, "*Rose*" carried her kittens into it and placed them in a wooden crate. The litter was raised successfully. The mother was separated from her young after they weaned, and over several weeks was periodically placed with 2 different ♂♂ for varying periods of time, and occasionally just after the onset of heat behavior. She gave birth in 1974 to a single kitten, again in a den box, only this time the box was viewed via closed circuit television. The kitten was raised successfully.

The Hatfields (1973) kept one ♂ with two ♀♀ for 3 years before the ♂ was sired. I studied a similar group (1,2) at the Olympic Game Farm. The ♂ was separated from the 2 ♀♀ with which he had been kept prior to arrival; there had been no mating. While I was there, one ♀ came into an intense heat, and after being placed into the ♂'s cage, excessively courted the ♂. The ♂ avoided the ♀ and exhibited no mating behavior. The error here may have been keeping the trio immediately adjacent and in full communication through chain-link fence.

The Hatfields (pers. comm.) have observed that an estrous ♀ introduced to a ♂ can be dangerous for the ♀. They know of several instances in which the ♂ killed or severely injured the ♀ when the latter was introduced during estrus. The estrous ♀'s mood appears to inhibit defensiveness. Therefore, it appears preferable to place the pair together prior to the ♀'s expected estrous period.

Keeping ♂♂ and ♀♀ together constantly may inhibit breeding. I suspect that many zoos would improve propagation by separating the sexes until the ♀ is just about in estrus. Such an approach may duplicate the natural social organization of the species which probably lives a solitary existence for the most part. The adage, "distance makes the heart grow fonder" is now used to explain success in breeding cheetahs. It may apply to most species of felids (Eaton 1976b).

One of the most successful ocelot breeding facilities to date is a fur ranch, where the ♂ is separated from the ♀ as soon as the heat is over and mating has occurred (Brager Larsen 1974). The evidence clearly indicates that a ♀ will enter heat on schedule without the presence of a ♂. However, if a ♀ is pregnant and the ♂ is present, losses probably occur in utero. Removal of the ♂ 3—4 weeks prior to birth may be too late as some ♀♀ may abort or resorb fetuses. The low probability of conception being discovered in many felids in captivity may indicate that unborn litters die from stress during early pregnancy because the ♂ is still present. Therefore, in addition to good nutrition, separation of the sexes except for mating and secluded den sites are recommended as possible means of enhancing breeding success.

Additional Observations

Seager (1973) has been developing the technology to extract and store semen. One of the problems with ocelots is the highly specialized penis of the ♂ (Ewer 1973). It is barbed (Seager 1973), its shape being distinct among felids (Ewer 1973). Successful artificial insemination may require duplication of the ♂'s penis shape and/or accomodation for the longitudinal shape of the ♀'s reproductive tract.

The Hatfields (1973) first used Testosterone to stop continual heat. Later, they used chorionic gonadotropin. 2 or 3 ♀♀ conceived either during or just after the use of this latter hormone.

K. Hatfield (pers. comm.) uses Cap-Chur syringes propelled by aluminum tubing blow-gun for remote injections. The technique is preferred to modes of restraint that may inflict stress.

Lovell (1974) used X-ray to examine ♀'s for pregnancy: the technique worked well.

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