

# Reproductive Characteristics of the Ocelot (*Leopardus pardalis*) under Captive Conditions

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**Abstract** The ocelot *Leopardus pardalis* is one of the beautifully colored cats of family Felidae. Their successful reproduction under captive conditions are not very high. We studied the reproductive characteristics of ocelots from 1960 to 2010. The aim of study was to investigate the reproductive success of ocelots between continents. The following results were found: all continents: 139 captive females produced 576 litters with a total of 752 kittens of which 545 were successfully raised to adulthood. The number of successfully raised males was 295 compared to 250 females. Eighty-six were of unidentified sex. About 359 individuals were reared by the mother and 108 hand reared. Of the total births, 416 were single kittens, 146 were twins, 12 were triplets and two were quadruplets. Females had their first litter at a mean age of 4.2 years old and had a mean of four litters during her live. The mean number of kittens per female was 5.4 kittens, of which 3.9 were successfully reared. Comparison between continent – in America and Europe were born more than 350 kittens, in Asia 50. Reared were 278 kittens in America, 226 in Europe and 41 in Asia. Only some kittens were hand reared. Globally, the highest number of litters occurred during June and August, while the lowest number occurred during November and December. It was found that before 1990, most successful rearings were kittens raised by the mother but after 1990, the most successful rearings were hand reared kittens.

**Keywords** Ocelot, Reproduction, Captive Conditions

## 1. Introduction

The ocelot *Leopardus pardalis*, also called “tigrillo”, belongs to the beautifully colored and marked family Felidae. The ocelot is widely distributed from Mexico through Central and South America south to NE Argentina and southern Brazil and Uruguay, found in every country except Chile. Only a small remnant population is found north of the Rio Grande in the United States [21]. Ocelot territory and population numbers have been decreased and are

substantially influenced by the continuous deforestation, clearing and destruction of their habitat [8]. The species occupies a wide spectrum of habitats including mangrove forests and coastal marshes, savanna grasslands and pastures, thorn scrub, and tropical forest of all types (primary, secondary, evergreen, seasonal and montane, although it typically occurs at elevations below 1 200 m)[19]. Ocelots have been caught and bred as pets. Therefore the ocelot *Leopardus pardalis*, as well as most of the small Felidae family is in the Red Book list of endangered species, IUCN [2]. Reproduction in captivity is complex and only 71 % of males and 75 % of females able to reproduce. Of the females that have given birth to live young in captivity, only 63 % were able to care for their young after birth. Often not only exotic cats are maternal instincts worst with the first litter. Under captive conditions it often happens that the female, being nervous and restless with her litter, kills the kittens or stops care [22]. The ocelots are able to reproduce all year [18]. In wild populations [12] observed, 15 adult females gave birth from the middle of April to late December. According to [3] ocelots in the Yucatan in Mexico for the most part mated in October and delivered in January, and ocelots in Argentina delivered from October to January in wild. On the contrary, [21] observed that in Texas, ocelots born in the wild delivered in late summer and autumn. [3, 14], states, that the number of young in a litter is small, usually one rather, than two young and only sporadically three. [7, 16] found from one to three kittens in 168 litters of ocelots under captive conditions, of which triplets were born in three of the litters. Only one known case of a quadruplet birth has been recorded [12].

## 2. Material and Methods

The zoological gardens and private breeders in Czech Republic, as well as zoos in Europe, Asia and North America, were contacted to obtain data on ocelot reproduction under captive conditions. Data obtained was from 1965 to 2010. The data were from 21 zoos in Europe, 7 Czech private breeders, 2 zoos from Asia and 73 zoos from America. The

following data was available: kitten birthrate, number reared (to adulthood), mortality rate (all/males/females), number of unidentified gender, number of litters, mother reared, hand reared, unknown reared, the females age at birth of first litter. For data evaluation we used SAS 9.2© Mean procedure. The ANOVA – GLM procedure was used as well as the nonparametric Kruskal-Wallis test to detect statistically significant differences of observed characteristics of reproduction. Statistical differences of characteristics were at  $P \leq 0.05$ .

### 3. Results

#### *Evaluation of the reproduction of ocelots*

Data from the European and Asiatic zoos and from the North America Studbook, showed the following: from 1965 - 2010, 139 captive females had 576 litters with a total of 752 kittens of which 545 were reared. 295 were males, 250 the successfully reared kittens females (to adulthood) and 87 of them had unidentified gender. About 359 individuals were mother reared and next 108 were handreared. 416 were single births, 146 were twins, 12 triplets and 2 quadruplets of total births. The highest number of kittens per litter was 1 - 2. The female's average age for her first litter was 4.2 years and the number of litters per female was around 4. Comparisons between females from different continents (Table 1, 2) were investigated. The statistical differences of reproduction characteristics per female - comparison among Asia, Europe and North America were detected in reared kittens/males per female, mother reared per female and by twins. Most of the twins were born in North America 70, in Europe 61, in Asia 15 (table 1, 2).

In Asia 31 litters produced 50 kittens, 9 died and 41 were successfully reared. In Europe, both in zoos and in private breeding programs, the mean age of females at their first litter was 3.4 years (1 241 days).

In North America 87 females gave birth to 298 litters with a total of 378 kittens. Of these 278 were successfully reared while 100 died. 176 were males, 152 were females and 50 were kittens of unidentified sex. In North America 42 % were reared by the mother, 30 %, were hand reared, 28 % were unidentified rearing. The number of hand reared 30% (83) was the highest of all analyzed continents. Incidence of birth in America: singles 223, twins 70; triplets 5.

**Table 1.** Reproductive characteristics of captive ocelots between continents from 1965 - 2010 comparison among Asia, Europe and North America and together (number)

| Reproduction characteristics          | Asia | Europe | N. America | Total |
|---------------------------------------|------|--------|------------|-------|
| number of litters                     | 31   | 247    | 298        | 576   |
| Number of kittens born                | 50   | 324    | 378        | 752   |
| Number of male kittens born           | 23   | 158    | 176        | 357   |
| Number of female kittens born         | 22   | 134    | 152        | 308   |
| Number of kitten mortalities          | 9    | 98     | 100        | 207   |
| Number of male kitten mortalities     | 1    | 33     | 28         | 62    |
| Number of female kitten mortalities   | 3    | 33     | 22         | 58    |
| Number of kittens successfully reared | 41   | 226    | 278        | 545   |
| Number of males reared successfully   | 22   | 125    | 148        | 295   |
| Number of females reared successfully | 19   | 101    | 130        | 250   |
| Number of kittens: unidentified sex   | 5    | 32     | 50         | 87    |
| Number of kittens mother reared       | 41   | 201    | 117        | 359   |
| Number of kittens hand reared         | 0    | 25     | 83         | 108   |
| Number of unknown rearing method      | 0    | 0      | 78         | 78    |
| one young in litter                   | 14   | 179    | 223        | 416   |
| number of litters with twins          | 15   | 61     | 70         | 146   |
| number litters with triplets          | 2    | 5      | 5          | 12    |
| number of litters with quadruplets    | 0    | 2      | 0          | 2     |

Following are the degrees of frequency: one kitten per litters about 62 %, twins about 37 %, triplets about 1 %. Data collected and evaluated by author of this study were similar in all continents one kitten per of litter in 72.2 %; twins, 25.3 %; triplets 2.1 %. When comparing these data, it is evident that there are similar births and smaller litters in captive conditions than in the wild. When comparing the number of live births of males and females from Asia, Europe and North America, the sex ratio was 1.6:1 favor for males.

Average each female had 5.4 kittens and 3.9 were successfully reared (see Table 2).

**Table 2.** Reproductive characteristics of ocelots per female (Mean, SD and CV) - comparison among Asia, Europe and North America (\*statistical difference at  $P \leq 0.05$ ) and together

| reproduction characteristics   | all (n=139) |     |        | Asia (n=6) |     |       | America (n=47) |     |       | Europe (n=86) |     |       |
|--------------------------------|-------------|-----|--------|------------|-----|-------|----------------|-----|-------|---------------|-----|-------|
|                                | $\bar{X}$   | SD  | CV     | $\bar{X}$  | SD  | CV    | $\bar{X}$      | SD  | CV    | $\bar{X}$     | SD  | CV    |
| born kittens per female        | 5.4         | 4.7 | 86.7   | 8.3        | 7.7 | 92.2  | 4.4            | 3.6 | 81.5  | 6.8           | 5.5 | 80.3  |
| reared kittens per female*     | 3.9         | 3.5 | 87.7   | 6.3*       | 5.4 | 85.7  | 3.3*           | 2.9 | 88.5  | 4.8*          | 3.8 | 79.6  |
| mortality kittens per female   | 1.5         | 2.4 | 162.0  | 2          | 3.1 | 154.9 | 1.1            | 1.7 | 152.2 | 2.1           | 3.2 | 153.7 |
| born males per female          | 2.6         | 2.3 | 90.9   | 3.8        | 3.1 | 81.5  | 2.1            | 1.9 | 94.3  | 3.3           | 2.6 | 79.4  |
| reared males per female*       | 2.1         | 1.9 | 93.8   | 2.6*       | 2.1 | 79.8  | 1.7*           | 1.7 | 97.8  | 2.7*          | 2.2 | 84.2  |
| mortality males per female     | 0.4         | 0.9 | 205.5  | 0.2        | 0.4 | 223.6 | 0.3            | 0.6 | 196.8 | 0.3           | 1.2 | 188.9 |
| born female per female         | 2.2         | 2.3 | 106.4  | 3.7        | 4.8 | 130.9 | 1.8            | 1.6 | 92.9  | 2.8           | 2.8 | 100.6 |
| reared females per female      | 1.8         | 1.8 | 102.9  | 1.8        | 1.6 | 91.3  | 1.5            | 1.6 | 107.8 | 2.1           | 2.0 | 94.8  |
| mortality per female           | 0.4         | 0.9 | 246.4  | 0          | 0   | 0     | 0.3            | 0.6 | 233.7 | 0.7           | 1.4 | 207.9 |
| unidentified gender per female | 0.6         | 1.4 | 204.4  | 1          | 2.2 | 223.6 | 0.6            | 1.2 | 209.2 | 0.7           | 1.4 | 194.9 |
| litters per female             | 4.1         | 3.4 | 81.6   | 5.2        | 4.8 | 93.6  | 3.4            | 2.6 | 75.9  | 5.2           | 4.1 | 77.6  |
| mother reared per female*      | 2.5         | 3.3 | 130.6  | 6.3*       | 5.4 | 85.7  | 1.4*           | 1.9 | 143.9 | 4.2*          | 2.2 | 229.2 |
| unknown reared per female      | 0.8         | 1.8 | 301.2  | 0          | 0   | 0     | 4.8            | 2.2 | 229.2 | 0             | 0   | 0     |
| 1 young per female             | 4.2         | 2.8 | 92.7   | 2.3        | 2.2 | 92.6  | 2.5            | 2.3 | 88.4  | 3.9           | 3.5 | 89.0  |
| twins per female*              | 3           | 1.4 | 135.7  | 2.5*       | 2.9 | 115.2 | 0.1*           | 1.1 | 132.6 | 1.3*          | 1.6 | 124.8 |
| triplets per female            | 1           | 0.4 | 458.0  | 0.3        | 0.8 | 244.9 | 0.1            | 0.4 | 610.8 | 0.1           | 0.3 | 331.4 |
| quadruplets per female         | 0.1         | 0.2 | 1178.9 | 0          | 0   | 0     | 0              | 0   | 0     | 0.1           | 0.3 | 682.6 |

*Comparing the number of litters by months of the year*

When evaluating the number of litters by month, the highest number occurred in June and August, while the lowest number was noted in November and December. In May there were 55 (10 %) litters, June 60 (11 %) and August 73 (13 %). Conversely, the smallest number of litters was realized in November, with a total of 11 litters and in December with 33 litters. The most “prolific” months were May, June and August. The percentages were similar – May and June both 10% and August 15 %. The lowest number was in the winter, November and December – 6 %. These data correspond to the data published in the Studbook of North America [1]. According to both results and the Studbook, we can confirm the hypothesis that seasonality affects the number of litters. When comparing the data of litters in Europe with the data by [1] in the Studbook of North America, we can see the difference in November, Evaluation the ratio is 5:8 for Europe. Data are presented in Tables 3.

There was a trend towards an decrease in ocelot populations in captivity between 1960 and 2010. During these past two decades successful breeding as well as hand rearing of the species has increased (Table 4). From 1960 do 1999 increased number of born and reared kittens, in litter were 1 young and twins. Better reproduction ability [rearing, number of animals] is in the wild.

You can also discuss why there is such a difference

between countries – is it number of females available for breeding or are there other factors involved? – The differences between countries can be by the number of available females, some zoos have only very young or old animals, some zoos have ocelots as exposition and no for reproduction.

**Table 3.** The number and percentage of litters between months in Asia, Europe, North America

| Month                   | Asia |    | Europe |    | N. America |    | Σ  |
|-------------------------|------|----|--------|----|------------|----|----|
|                         | Σ    | %  | Σ      | %  | Σ          | %  |    |
| January                 | 1    | 3  | 19     | 8  | 23         | 8  | 43 |
| February                | 3    | 10 | 17     | 7  | 22         | 7  | 42 |
| March                   | 5    | 16 | 11     | 5  | 28         | 9  | 44 |
| April                   | 7    | 24 | 16     | 7  | 20         | 7  | 43 |
| May                     | 6    | 19 | 22     | 10 | 27         | 9  | 55 |
| June                    | 3    | 10 | 29     | 13 | 28         | 9  | 60 |
| July                    | 1    | 3  | 19     | 8  | 26         | 9  | 46 |
| August                  | 1    | 3  | 27     | 12 | 45         | 16 | 73 |
| September               | 1    | 3  | 19     | 8  | 27         | 9  | 47 |
| October                 | 2    | 6  | 17     | 7  | 21         | 7  | 40 |
| November                | 1    | 3  | 18     | 8  | 12         | 4  | 31 |
| December                | 0    | 0  | 17     | 7  | 18         | 6  | 35 |
| Total number of litters | 31   |    | 247    |    | 298        |    |    |

**Table 4.** Reproduction trends in decades

| Trend of reproduction | 1960 – 1969 (n=1) |           |    |    | 1970 – 1979 (n=23) |           |     |       | 1980 – 1989 (n=30) |           |     |       | 1990 – 1999 (n=49) |           |     |       | 2000 - May 2010 (n=36) |           |     |       |
|-----------------------|-------------------|-----------|----|----|--------------------|-----------|-----|-------|--------------------|-----------|-----|-------|--------------------|-----------|-----|-------|------------------------|-----------|-----|-------|
|                       | $\Sigma$          | $\bar{X}$ | SD | CV | $\Sigma$           | $\bar{X}$ | SD  | CV    | $\Sigma$           | $\bar{X}$ | SD  | CV    | $\Sigma$           | $\bar{X}$ | SD  | CV    | $\Sigma$               | $\bar{X}$ | SD  | CV    |
| born kittens          | 10                | 10        | 0  | 0  | 135                | 5.9       | 6.0 | 100.2 | 197                | 6.6       | 4.4 | 70.5  | 246                | 5.0       | 4.3 | 90.3  | 163                    | 4.5       | 3.1 | 68.8  |
| reared kittens        | 9                 | 9         | 0  | 0  | 98                 | 4.3       | 4.3 | 95.9  | 149                | 4.9       | 3.8 | 88.6  | 181                | 3.7       | 2.9 | 82.8  | 110                    | 3.1       | 1.8 | 53.1  |
| mortality of kittens  | 1                 | 1         | 0  | 0  | 37                 | 1.6       | 2.1 | 121.4 | 48                 | 1.6       | 2.3 | 142.3 | 65                 | 1.3       | 2.7 | 208   | 52                     | 1.4       | 2.2 | 204.7 |
| number of litters     | 10                | 10        | 2  | 0  | 98                 | 4.3       | 4.1 | 92.1  | 148                | 4.9       | 3.7 | 79.0  | 197                | 4.0       | 2.8 | 78.3  | 122                    | 3.4       | 2.4 | 69.2  |
| mother reared         | 0                 | 0         | 0  | 0  | 35                 | 1,5       | 3.9 | 186.3 | 131                | 4.4       | 3.7 | 110.9 | 119                | 2.4       | 2.5 | 117.9 | 69                     | 1.9       | 1.9 | 72.1  |
| hand reared           | 0                 | 0         | 0  | 0  | 6                  | 0.3       | 0.6 | 159.8 | 8                  | 0.3       | 1.4 | 199.7 | 60                 | 1.2       | 2.5 | 179.8 | 40                     | 1,1       | 1.3 | 201.3 |
| 1 young in litter     | 10                | 10        | 0  | 0  | 101                | 4.4       | 2.5 | 50.3  | 152                | 5.1       | 8.3 | 130.2 | 165                | 3.4       | 1.9 | 150.8 | 126                    | 3.5       | 1.3 | 150.2 |
| twins                 | 0                 | 0         | 0  | 0  | 31                 | 1.3       | 1.8 | 121.4 | 43                 | 1.4       | 1.2 | 123.7 | 25                 | 0.7       | 1.2 | 145.1 | 35                     | 0.9       | 1.1 | 105.8 |
| triplets              | 0                 | 0         | 0  | 0  | 3                  | 0.1       | 0.6 | 465.0 | 2                  | 0.1       | 0.3 | 355.7 | 54                 | 0.8       | 0.4 | 356.4 | 2                      | 0.1       | 0.2 | 418.2 |
| quadruplets           | 0                 | 0         | 0  | 0  | 0                  | 0         | 0   | 0     | 0                  | 0         | 0   | 0     | 2                  | 0.0       | 0.3 | 692.8 | 0                      | 0         | 0   | 0     |

$\bar{X}$  - mean, SD – standard deviation, CV – coefficient of variance, n=number of females

## 4. Discussion

In comparing continents the following of births was found: single were most frequent; less frequent twins; infrequent triplets; rarest quadruplets - two sets were born in Zoo Dortmund. As well [5, 6, 17] argue that the number of kittens in a litter can be from one up to four. This implies that the birth of two sets of quadruplets is an exceptionally rare event. According to [9, 10]. According to results of [12] were born more males than females which agree with our conclusions and hypothesis. When was evaluated the age of females at their first litter by [13, 15] the females had their first litter at 18 to 45 months of age. One female from our study had her first litter at 1.5 years. Other females had litters later mean in 4.2 years. In the Studbook of ocelots [1] states that the average age for first litter of the ocelot in America was about 4.2 years. Europe had the lowest age of female first birth at 3.4 years and in Asia the highest, 4.7. Our results for America show 4.8 years. The highest number of litters by month occurred in June and August, while the lowest number was in November and December. By [12] kittens were from the middle of April to late December. [4] wrote that ocelots delivered from October to January. Ocelots births observed [20] in the wild in late summer and autumn. These data do not confirm the hypothesis that the ocelots reproduce mostly in the summer months, because the data involved the evaluation of ocelots living in the wild.

## 5. Conclusions

Under captive conditions, their natural survival instincts are in captivity either poorly developed or absent. This fact is reflected in the challenges of educating the young where it becomes necessary to hand rear them. Another reason for the necessity of hand rearing was due to orphaned wild kittens were often found after their mother had been killed or when the parental bond was broken by interactions with people.. showed an increasing trend of reproduction characteristics. From 1960 – 1999 there was an increase in reproductive rates both for ocelots hand reared under captive conditions. Breeding is not threatened but during the last two decades, 1990-2010, this increase in hand rearing has created bond between the humans involved and the animals. Although efforts have been made to obtain unrelated animals, for example from the wild, success can be limited. Despite good management of breeding programs, the mothers often develop a complex of behavior, this may lead to problems of young females subsequently adequately caring for their litters.

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