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THE SNOW LEOPARD IN CAPTIVITY IN 1992

BY LEIF BLOMQVIST

Births and Deaths in 1992

A total of 100 (46.51.3) cubs were born in 40 litters at 35 different institutions in the global captive population in 1992. In two institutions, Krefeld, Germany, and Center Hill, Florida, U.S.A., litters with quadruplets were born. Although infant mortality in such litters is high, the eight cubs in both litters survived. The mortality rate for the 1992 breeding season was 29%. The number of cubs bred in captivity since the mid-1950s can be seen in Figure 1. In addition to the 30 (14.13.3) cubs that did not survive, 21 (10.11) subadult/adult snow leopards died during the year.

As no animals were wild-caught, the captive stock increased by 9% compared to the previous year (Blomqvist, 1994), reaching a total of 590 (297.293) snow leopards in 162 collections outside China.

Current population

The international studbook for snow leopards has been kept by Helsinki Zoo since 1976. The studbook data has recently been entered into the Single Population Analysis and Records Keeping System (SPARKS) software, available from the ISIS Office in Minnesota (Scobie, 1993) in order to increase the uniformity among studbook keeping systems. Data on 1,699 (815.786.98) snow leopards have been included in the register as of 1.1.1993. Due to insufficient information, this report excludes data of snow leopards kept in Chinese zoos.

At the end of 1992, 78% of the total of 590 animals were participating in various regional breeding programmes in North America (SSP), Europe (EEP), Japan (SSCJ), Australia/New Zealand (ASMP) and Russia. Of the 590 snow leopards alive, nine (4.5) are wild-caught, while the remaining 98.5% are captive-bred. Figure 2 shows the development of wild-caught versus captive-bred snow leopards since 1956. As can be seen from the figure, the captive stock depended on new acquisitions from the wild until the mid-1970s, and not until 1974 did the number of captive-bred snow leopards for the first time exceed the number of wild-caught specimens.

Table 1 presents the essential studbook data as of 1.1.1993. Of the 1,699 animals kept in captivity since the last century, 26% (214.233) have bred. The first successful breeding was recorded in Wrocław (Breslau) Zoo in July 1910. Almost one-third of all wild-born specimens kept in captivity have bred, whereas the corresponding figure for captive-bred animals is slightly less than one-quarter. However, it must be kept in mind that

roughly 98% of the present stock comprises captive-bred snow leopards (Figure 2), of which one-third are either too young to breed (< 3 years) or have passed their main breeding age (> 15 years) (Figure 3). Some have also been prevented from breeding to avoid increasing the captive stock beyond its carrying capacity.

Life span

Data based on 1,230 birth events to parents of known age show that the main reproductive life-span stretches from 3 to 17 years for males and 3 to 15 years for females (Figure 4). These data further indicate that reproductive success differs per age class and is not randomly distributed over the classes. Females younger than eight years breed better than males in all age classes (with one exception), while males have a higher fertility rate (Mx) in the age classes beyond nine years.

The mortality rate (Qx) of an age class is the proportion of individuals belonging to that age class who die before reaching the next. At the end of 1992, 884 snow leopard deaths of known age from the register have been tabulated for the mortality curves for males and females (Figure 5). The most vulnerable age group for both sexes is infancy, where the mortality is on average 4.7 times higher than in any other age class below 15 years of age. The analysis furthermore shows that 29% of the cubs die within 30 days after birth. After 15 years, Qx in both sexes increases rapidly, though males tend to live longer than females. The mortality rates for the older age classes are, however, always based on a relatively small number of animals, and these rates are therefore less reliable than those estimated for the younger classes.

Table 1. Snow leopard studbook data as of 1.1.1993.

	Males	Females	Unknown	Total
Total registered	815	786	98	1699
Total wild-caught	148	146	11	305
Total captive-bred	667	640	87	1394
Alive at 1.1.1993	297	293	0	590
Wild origin	4	5	0	9
Captive-bred origin	293	288	0	581
Breeding animals				
Total number that have bred	212	233	0	445
Wild-born that have bred	48	51	0	99
Captive-born that have bred	164	182	0	346
Total breeding animals alive	127	133	0	260
Wild-born	4	4	0	8
Captive-born	123	129	0	252

Demography

A critical statistic in the management of a captive population is the number of founders. The total number of wild-caught animals which have been kept in captivity outside China is 305. Of these, 99 have reproduced (Table 1) while the current gene pool derives from 43 founders (Figure 6). These are therefore the animals which have provided the genetic diversity of the present captive population.

The optimal situation in a small population is one in which each wild-caught individual would produce an equal number of male and female offspring. When the contribution of the wild-caught individuals is unequal, it results in less effective preservation of genetic diversity.

Due to different reproductive success among the individuals, an equal representation is hardly ever possible. The parity in the present population is 2.2, whereas ten animals have made a disproportionately large contribution to the gene pool (Figure 6). Although only 43 of the 305 wild-caught animals are represented in the stock of 1992, the population includes a sufficient number of founders and 97% of the genetic diversity of the species has been retained (Table 2). Three percent has therefore been lost during the last decades.

The growth pattern of a captive population is derived from a combination of reproduction, survival and imports from the wild. As can be seen from Figure 7, the number of captive-bred snow leopards has been steadily increasing since the 1980s, while the number of wild-caught started to decrease almost 20 years ago. The numbers of deaths and births were almost equal until the late 1970s. However, since the 1980s the birth rate has exceeded the death rate, and in 1992 the excess of births over deaths had reached a high point of 46 individuals.

Table 2. Carrying capacity of the captive snow leopard population as of 1.1.1993.

Generation Time (T)	7.15
Annual Growth Rate (λ)	1.05
Diversity Retained	97%
Effective Population Size (N_e)	260
Total Population Size (N)	590
N_e/N	0.44
Effective population size required	71
Actual population size required	161

Discussion

The goal of every *ex situ* breeding programme is to manage the captive population in such a way that after 100 years, there will be a viable population of the species with a minimum of 90% of the original genetic diversity retained. Of importance also is the number of animals needed

to achieve this goal. When studbook data are applied to both the *Genes* programme (Lacy, 1992) and the *Capacity* programme (Ballou, 1992), it is possible to estimate the size of a snow leopard population required to ensure its continuation within the determined criteria. Several factors affect the calculation of this statistic (Table 2). The generation time (T) is the average age at which animals produce offspring. The effective population size (N_e) is the present number of breeding animals, while N shows the total population, which naturally is higher than the effective population size.

The calculations result in a total population of only 161 animals. If we take into consideration a population disaster, it means that to retain 90% of the genetic diversity of the present snow leopard stock for the next 100 years, a global captive population of approximately 200 animals would be required. As the current population is almost three times as big, we would in fact be able to retain 90% of the present genetic diversity for 300 years, or alternatively 95% of it for the next century.

Snow leopards are today mainly managed on a regional level. Zoos in several regions have established co-ordinated breeding programmes. The goal of these programmes is to establish self-sustaining populations in the different regions. Because of the overall increased population and the effective population size, the captive population must now be demographically and genetically managed. Critical components will therefore include equalizing founder representation, where possible, by equalizing breeding success, stabilizing the age and sex distribution and minimizing inbreeding within the population. Greater reproductive success in under-represented lines can only be achieved through co-operative management programs involving all committed zoos. The goal includes not only a stable captive population, but eventually also production of animals useful for dispersal to the world's zoos as well as for reintroduction into the wild.

References

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Leif Blomqvist, International Snow Leopard Studbook Keeper, Helsinki Zoo, Korkeasaari, 00570 Helsinki, Finland.

Figure 1. Number of snow leopard cubs bred in captivity worldwide (excluding China) 1956-1992.

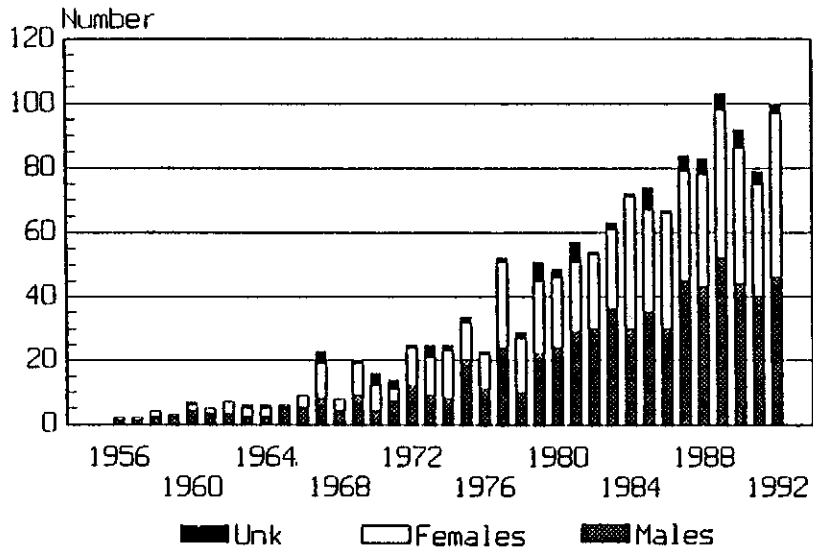


Figure 2. Ratio of captive-bred and wild-born snow leopards kept in captivity in 1956-1992 (animals in Chinese zoos excluded).

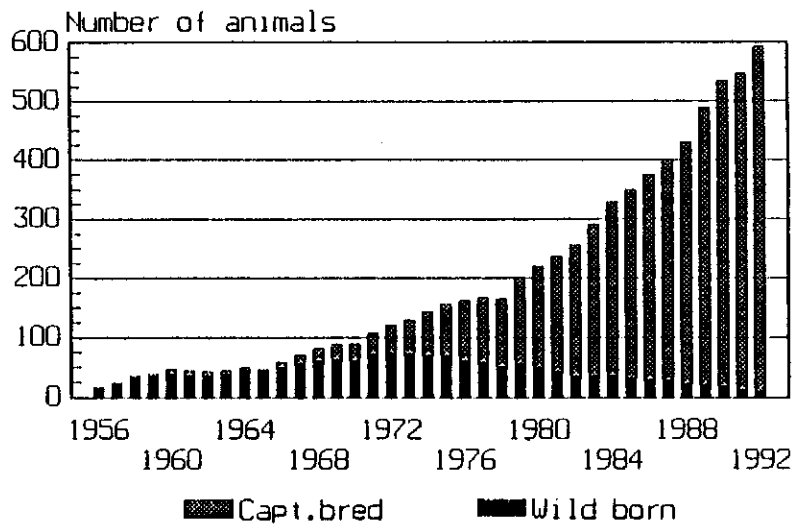


Figure 3. Age distribution of the captive snow leopard population outside China 1.1.1993.

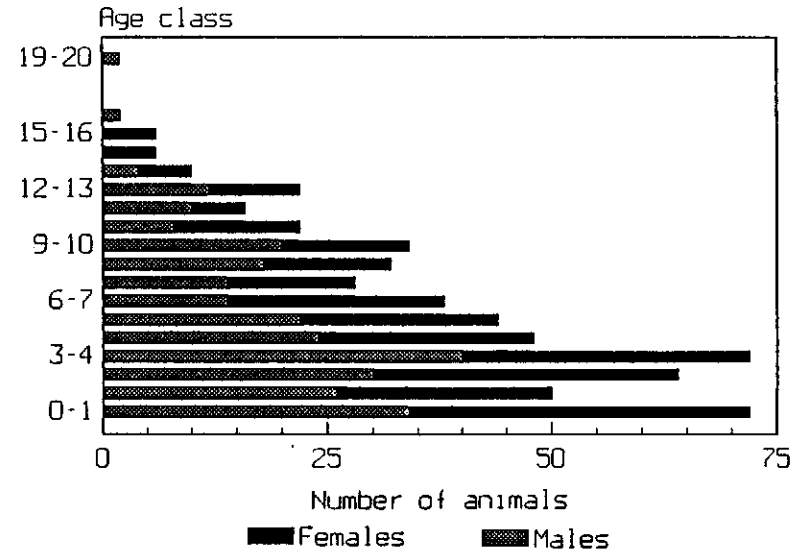


Figure 4. Fertility in the captive population of snow leopards outside China, 1.1.1900-1.1.1993.

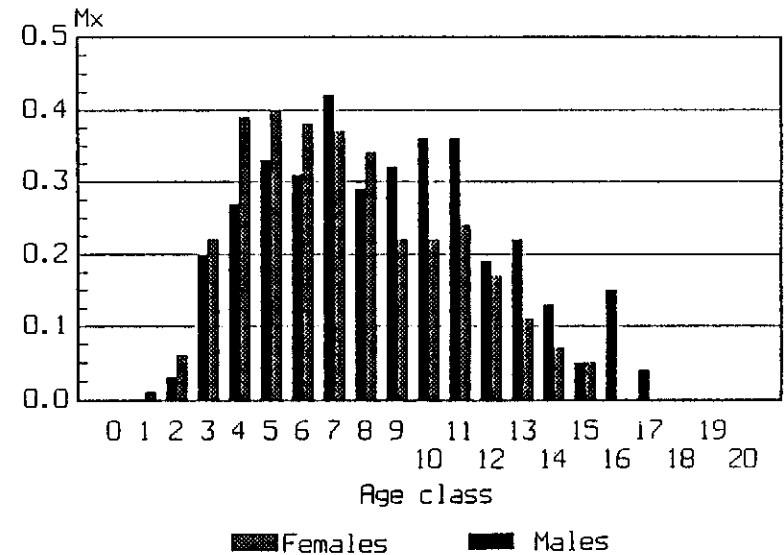


Figure 5. Mortality in the captive population of snow leopards outside China, 1.1.1900–1.1.1993.

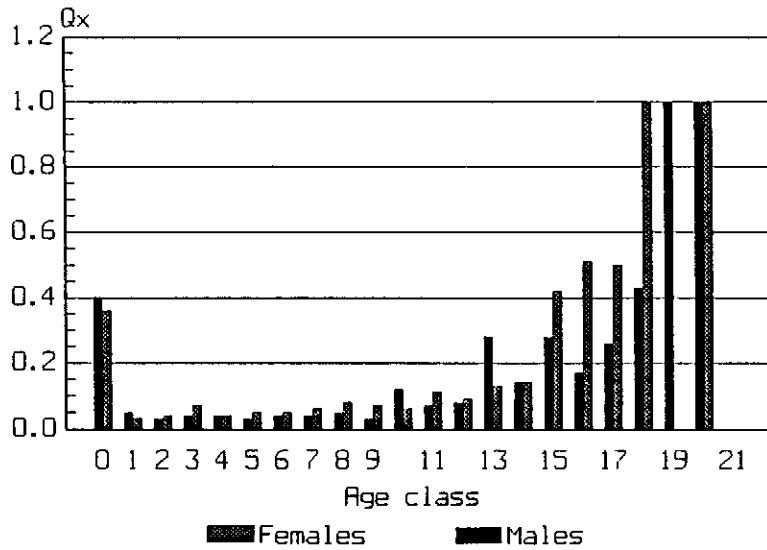


Figure 6. Founder representation in the global captive snow leopard population outside China as of 1.1.1993.

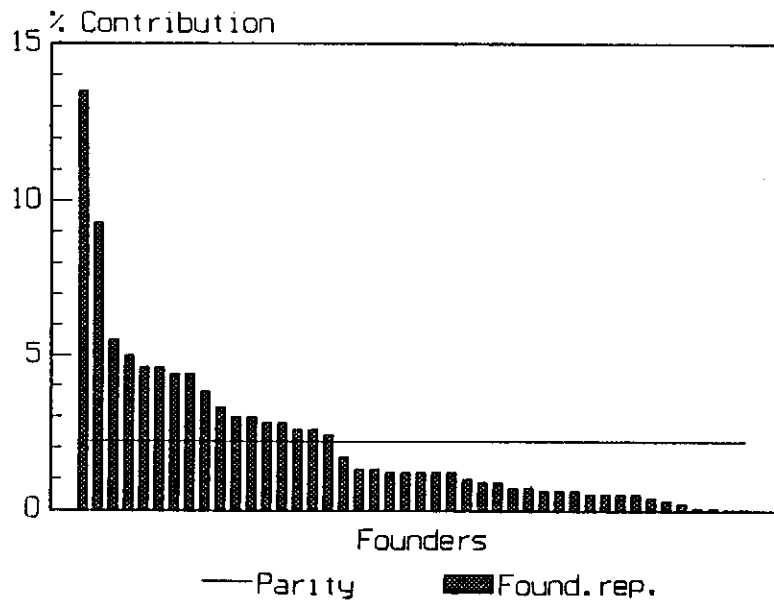
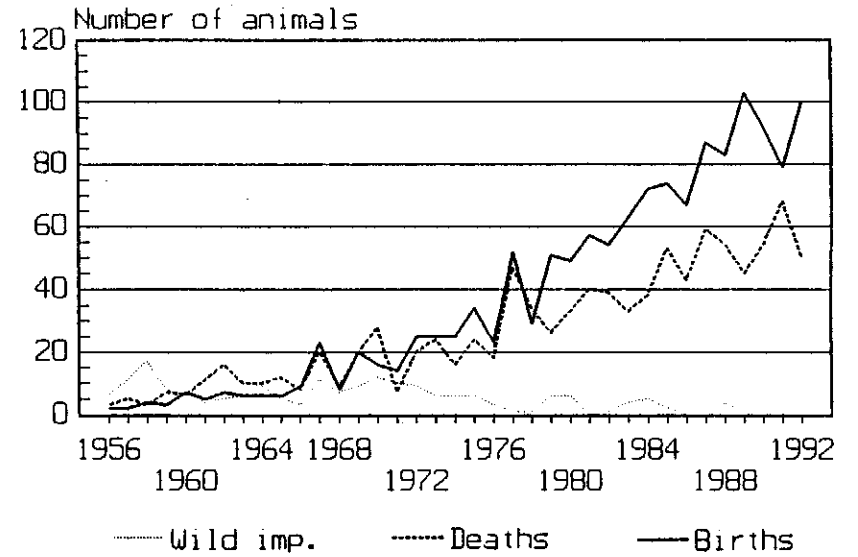


Figure 7. Snow leopard imports from the wild, births and deaths in captivity worldwide (excl. China) 1956–1992.



Tikapur and Nazar, December 1991, Linton Zoological Gardens, England. (Photo: S. Foster-Haverhill)