

Cheetah Case Study

- Of 37 species in *Felidae* (cat family) all except the domestic cat are listed as threatened or endangered!
- Cheetah (*Acinonyx jubatus*) is only remaining member of genus *Acinonyx*, and is markedly different from all other cats in anatomy and behavior
- Population estimates range from 1,500-25,000 in two remaining populations in southern and eastern Africa

O'Brien et al. 1983. The cheetah is depauperate in genetic variation. *Science* 221: 459-461.

(ohead – Table 1, O'Brien et al. 1983)

- Sampled 55 cheetahs from 2 populations
- Protein electrophoresis
- 47 allozymes ... $H=0$ (included 18 “polymorphic cluster” genes – polymorphic in most species)
- 155 soluble proteins... $H=0.013$
- Both H estimates dramatically lower than for other mammals (and cat spp)
- low H also noted for elephant seal, moose, polar bear, and Yellowstone elk. e.g., elephant seal: $H=0$ for 24 loci; Scandinavian moose: $H=0.020$.

Explanation for low diversity in cheetah? - hypothetical population bottleneck followed by intense inbreeding by survivors – FOUNDER EFFECT

O'Brien et al. 1985. Genetic basis for species vulnerability in the cheetah. *Science* 227: 1428-1434.

- 1981 – 40 semen samples from 18 males showed sperm concentration 1/10 that of domestic cats with 71% morphologically abnormal (vs 29 for cats)
- Cheetah has low polymorphism and heterozygosity compared to other cats, so monomorphism is not typical of all cat spp.

(ohead – Table 2, Fig. 2 – O'Brien et al 1985)

- Juvenile mortality is high in captive-bred cheetahs – very difficult to successfully breed cheetahs in captivity (10-15% success rate)

(ohead- Table 1 – O'Brien et al. 1985)

- no significant difference between success of inbred and non-inbred juvenile mortality for captive cheetahs, and very high rate overall

(ohead – Fig. 1 – O'Brien et al 1985)

- inbred mortality usually higher than noninbred in most spp.
- cheetah mortality at high end of distribution, but inbred & noninbred

rates are the same – not much current inbreeding depression – evidence of historical inbreeding (deleterious recessives previously exposed to selection?)

- MHC uniformity – skin allografts not rejected (MHC is highly polymorphic in vertebrates – recognition of foreign proteins)

(ohead – Fig. 4 – O'Brien et al. 1985)

(ohead – Fig. 3, Table 3 – O'Brien et al. 1985)

- humans typically reject allografts in 10.5 days, domestic cats in 7-13 days
- cheetahs rejected xenografts from cats in 9-16 days, but only 3 of 14 (21%) ever clearly rejected allografts from other cheetahs

Conclusions: Cheetah is far less genetically diverse at important loci than most wild species. Lack of diversity makes the species vulnerable to extinction from environmental sources – e.g., coronavirus (feline infectious peritonitis) in Oregon felid colony killed 43-60% of captive cheetahs – lions in same colony unaffected. Probably a result of low MHC diversity in cheetahs.

Caro & Laurenson. 1994. Ecological and genetic factors in conservation: a cautionary tale. *Science* 263: 485-486.

- although inbreeding has been shown to have fitness costs in captivity and the wild, it has yet to be shown that inbreeding depression has caused the decline of any wild population
- cheetahs do show variability in immune response to various natural pathogens – evidence of some genetic diversity
- variation in husbandry practices accounts for variation in success of captive breeding programs for cheetahs

(ohead – Table 18.1, 18.2 – Laurenson 1995)

- wild cheetah offspring mortality VERY high
- only 4.9 % due to possible offspring inviability
- 73% due to predation, 78.6% of predation due to lions
- cheetah biomass/area shows clearly negative relationship to lion biomass/area (abundance)
- Ecological factors extremely important in demographics of cheetah-