UP, OVER THE TOP, OR DOWN? POPULATION DEVELOPMENT IN CLOSED CAPTIVE POPULATIONS OF WILD RUMINANTS

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Summary

The monitoring of a zoo population's development allows conclusions about a species' breeding and management success. Different parameters can be taken into consideration. In this paper we determined the mortality rates per year of 26 ruminant species in closed populations at the Al Wabra Wildlife Preservation and plotted the yearly mortalities against the total number of animals. Over the years, five different patterns were observed: 1 population increased and the mortality decreased ("complete success"); 2 population increased and the mortality was stable ("good success"); 3 population increased and the mortality increased ("limited success"); 4 population stagnated or decreased after a peak and mortality decreased with decreasing population size ("stagnation"/"over the top"); 5 population decreased and mortality decreased or, even worse, increased ("deterioration"). The categorical ranking of the species was significantly correlated to the initial population size indicating that populations that started below their carrying capacity can increase consistently whereas a high initial population size increases the danger of a population crash due to crowding phenomena. Our results demonstrate the importance of population monitoring and its management in order to optimize the breeding success of captive ruminant populations.

In most zoological institutions, animals are kept in small units such as breeding pairs or small harems. Female offspring either stays within the herds or is placed at other institutions, whereas males are usually removed from their parents at the onset of sexual maturity. This usually results in populations that are stable over time, as additions to the population are 'harvested' (taken out) or only left to replace one of the older population animals. Under such circumstances, monitoring demographic developments on a zoo-specific basis is unnecessary.

In a free-ranging overpopulated herd of white-tailed deer (*Odocoileus virginianus*), SAMS et al. (1996) demonstrated an increased risk of mortality in juveniles, and interpreted this finding as a 'crowding' phenomenon. In captivity, larger breeding herds of mammals regularly occur among the less charismatic ungulate hoof stock, such as cervids or antelopes. BESSELMANN et al. (2008) showed that in a herd of captive lesser kudu (*Tragelaphus imberbis*), juvenile mortality increased with the overall population size. As no additional space had been provided to the population as it grew, this effect was also interpreted as a typical 'crowding' phenomenon.

We used the data set on the development of a large population of captive wild ruminants consisting of 26 species from a closed facility (Al Wabra Wildlife Preservation) that did not control population development by consistent culling or by placing offspring at other institutions. Different categories of population and mortality development were defined and major causes for these developments were investigated.

Each of the 26 species kept at AWWP was considered one captive population. For each year the numbers of animals of a population that were alive for at least one day and of animals that died within this year were taken from the AWWP stock list and the mortality was calculated. Mortality patterns were explored by plotting the yearly mortalities against the total number of animals to check whether an increased population size was associated with higher or lower mortality rates. These data on population development and mortality rates do not only reflect reproductive potential of the total population and deaths due to disease, but also – in varying degrees for the different species – active management in the form of preventing animals from breeding (by housing animals in single sex-groups) and harvesting (to reduce population numbers). The varying degrees of active management represent conscious decisions on the effort invested in the different species that varied, for example, with the conservation relevance (threat status) of a species' breeding program.

The following categories were observed:

- A population development was considered as category 1 ("complete success") if the number of individuals increased steadily over the years and mortality decreased with increasing population size. Five species were classified into this category.
- A population development was considered as category 2 ("good success") if the number of individuals increased steadily over the years and mortality stagnated, i.e. did not change with varying population size. Seven species were classified into this category.
- A population development was considered as category 3 ("limited success") if the number of individuals increased steadily over the years but mortality also increased with increasing population size. Five species were classified into this category.
- A population development was considered as category 4 ("stagnation"/"over the top") if the number of individuals stagnated or even decreased after a peak and mortality increased with increasing, and decreased with decreasing population size. Seven species were classified into this category.
- A population development was considered as category 5 ("deterioration") if the number of individuals decreased steadily; in this case, mortality might either decrease with decreasing numbers of individuals or, in the worst case, even continue to increase with decreasing population size.

These different categories suggest the following interpretations of husbandry and epidemiology:

- Category 1 ("complete success") – more new space continuously provided, medical lessons learned; after initial losses, the species-specific problems were correctly addressed and hence population health was good even in the face of increasing numbers.
- Category 2 ("good success") – more new space provided; no improvement of the health situation (which might have been good to start with), but no deterioration of the epidemiological situation, either.
- Category 3 ("limited success") – typical for a population affected by crowding; such populations might become stable at carrying capacity, with a high mortality or intensive culling assuring that carrying capacity is not exceeded; however, due to a worsening of the epidemiological situation, such populations could also crash in the future.
- Category 4 ("stagnation"/"over the top") – typical for crowding effects and populations reaching or having passed maximum carrying capacity; reduction of numbers either due to disease or due to corrective culling.
- Category 5 ("deterioration") – indicative of a population shrinking (by disease or culling) to its 'right' size; the decreasing population size and the still increasing mortality indicate an epidemiological catastrophe that is not self-limiting but threatens to wipe out the entire population.

In order to investigate a potential cause for the state of a population development, we tested whether the categorical ranking of species was correlated to the initial population size. The correlation was highly significant. This suggests that a population that started out below its carrying capacity can still increase nicely, but that a population that starts out above its carrying capacity must be controlled (or will deteriorate) right away.
Our results underline the importance of population management, either by harvesting animals regularly (culling or placing at other institutions) or by contraception methods to maintain a population below its carrying capacity, or by increasing the space available for that population on a continuous basis. Zoological institutions are responsible for developing and instigating plans for managing the growth of their captive populations.

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