

farms (114), with the total number in Namibia estimated to be 991. The main threat to rhino in Etosha is encroachment of human settlements and associated poaching risks on the northern borders. The rhino population in Etosha appears to be breeding well. In contrast, the population growth in Kunene has decreased over the past twenty years. The advantages of conserving rhinos in small populations include the following: (i) many prime habitats can be utilised; (ii) rapid population growth can be achieved; (iii) founder populations can be established; and (iv) risk of disease or poaching affecting the whole population is diminished. The disadvantages are that: (i) some populations are in marginal habitat; (ii) management is intensive; and (iii) costs are great because there is no economy of scale. Namibian policy is that active management of small populations is required. Breeding bulls should be swapped between areas and populations should be supplemented with unrelated females to ensure gene flow. In small populations, one to two animals should be moved per generation to prevent manifestation of social problems within the population. Populations should not be skewed towards male biased sex ratios or older animals. Conflicts with elephants (monopolization of preferred habitats by elephants or direct disturbance of cows with young calves) should be avoided if possible. Human disturbance from tourists and researchers should be minimized. Non-breeding animals can be translocated and used for testing the suitability of untried habitats. A founder population should be in excess of twenty animals. Based on experience in Namibia, recommendations for effective management and long-term conservation of black rhino in Ngorongoro include: (i) excluding tourists from prime habitat by closing roads; (ii) excluding elephant from the Lerai Forest using a electrified strand of wire erected at a height of 2 m; (iii) minimizing excessive disturbance from research and monitoring; and (iv) supplementing the population with unrelated breeding animals to reach as size of at least 20 individuals.

3.2 Ngorongoro black rhino population dynamics: what does the data tell us?

Richard Emslie, IUCN African Rhino Specialist Group, South Africa

The Tanzanian rhino management plan developed in 1998 set a goal of increasing the current population of *Diceros bicornis michaeli* of 60 individuals to 100 individuals by 2018 through active metapopulation management. Between 1964 and 1966, 108 individually recognizable black rhino were observed in the Ngorongoro Crater. Research at this time indicated that calf mortality was low and that low fecundity prevented the population from growing. Following a wave of poaching in the late 1960s and early 1970s rhino numbers in the Crater have been low (~20) and the female:male sex ratio has been high (2.27:1). Excluding one female (Fausta) who has not produced a calf since 1984 from calculations, the inter-calving interval of rhinos in the Crater during 1993-2003 was 2.88 years. This inter-calving interval is moderate to good and suggests that fecundity and/or nutrient deficiencies are not limiting population growth. The average age of first calving (6.9 years) is also moderate to good in comparison to other populations. The proportion of calves in the population is acceptable, but is a biased measure due to the skewed sex ratio of adults. Overall breeding patterns are therefore within expected ranges. Adult mortality of rhino was high during 1975-2003 (6.8%) and even higher during 1993-2003 (8.3% - mainly as a result of disease). Without the sex ratio being skewed to females the population have been extirpated as this level of mortality is unsustainable. Continued high levels of security in the Crater should reduce mortalities to poaching to a minimum and enable greater population growth. Neonatal mortality is estimated to be between 25% (minimum estimate based on observed mortality) and 45% (maximum estimate based on intercalving intervals and calves presumed predated before being observed). These levels of neonatal mortality are extremely

high and are believed to be due to predation by spotted hyenas. If man-induced mortalities are treated as removals, the estimated population growth over 1993-2003 was 8.03%, which if achieved over the next 10 years would result in a population of 35 individuals. The threat of inbreeding and loss of genetic diversity requires further research and possible intervention through the replacement of the dominant breeding bull. A conservation plan for black rhino in the Crater should aim to achieve maximum growth and through supplementation a minimum population of 20 animals. Some restoration of the Lerai Forest and controlled burning to improve browse availability may be necessary before new animals are introduced to the Crater.



3.3 Habitat and nutritional conditions for black rhino in the Ngorongoro Crater

Keryn Adcock, African Rhino Specialist Group, South Africa

The quantity and dynamics of browse available to black rhino in the Ngorongoro Crater is unknown and it is consequently difficult to determine the potential black rhino carrying capacity. It is, however, suggested that the rhino carrying capacity of the Crater has decreased since the 1960's. Several habitats frequented by rhino have changed in structure and become less suitable for rhino. These include: (i) the Lerai Forest where trees and understorey have died back; (ii) the Gorigor and Mandusi Swamps which appear to have decreased in area and lost much of their leguminous shrub cover possibly due to increased herbivore pressure; (iii) the slopes of the Crater where non-palatable bushes (*Lippia*, *Lantana* and *Clausena* species) have encroached into prime rhino habitat that previously comprised short *Acacia lahai* and leguminous shrubs/forbs; and (iv) grasslands where there has been an apparent decline in palatable forbs and an increase in "tall" unpalatable grasses over large areas of the Crater floor. Availability of browse may also have decreased due to: (i) the decrease in mean annual rainfall (~950 to ~800 mm over the period 1963-2000 at the NCA HQ); and (ii) the increase in other ungulates in particular the buffalo population. The intensity of browsing (measured in black rhino equivalents) in the Crater has increased from