IS THERE ANY RHYME OR REASON TO RHINOCEROS REPRODUCTION? - A SUMMARY OF REPRODUCTIVE CHARACTERISTICS, SPECIES-SPECIFICITIES AND CHALLENGES FOR THE FUTURE

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Abstract

Progress in characterizing the reproductive physiology of all four captive rhinoceros species has revealed interesting variation among species within this taxon and also has been useful in defining future challenges for ensuring the long-term stability of captive breeding programs. Our goal was to combine information from our large-scale study in which the reproductive cycles of Sumatran (n = 2) and African black (n = 15) and white (n = 11) rhinoceroses were monitored, with previous reports from other investigators to produce a concise summary of what is known today about rhinoceros reproductive physiology. Noninvasive fecal hormone metabolite monitoring has been the primary method used for characterizing reproductive cycles, and resulting data have provided a foundation of basic knowledge upon which we now can build by employing additional research tools. For example, ultrasonography already has proven useful for identifying reproductive characteristics that otherwise might have remained undetected.

The African black rhinoceros (*Diceros bicornis*) has been the most prolific and best studied of the captive rhinos.[1,2,9] Most female black rhinos are exhibiting reproductive activity. Their reproductive cycles average about 25 days, however, variable cycle lengths are common with approximately 50% of cycles <20 or >30 days. Although reproductive success has been relatively high, there are several animals that appear to be healthy and reproductively active but continue to breed without becoming pregnant. Identifying the cause of this apparent infertility is the primary challenge ahead for black rhinoceros reproductive research. However, the greatest threat to the captive black rhinoceros population is their unusual susceptibility to several uncommon diseases.

Similar fecal progesterone metabolite monitoring studies in the African southern white rhinoceros (*Ceratotherium simum*) have proven more difficult to interpret,[5,6,10] and reproductive success in this species is inferior to that in its close relative, the black rhinoceros. Approximately 50% of captive female white rhinos appear acyclic. The remaining female white rhinos can be categorized as exhibiting one of three different types of reproductive cycles: 1) 60-70-day cycles; 2) 30-35-day cycles; or 3) a mixture of long (60-70-day) and short (30-35-day) cycles. Several females with 70-day cycles are breeding without producing calves. These long cycles are characterized by an extended luteal phase, and fertility is questionable since no successful pregnancies have been documented in animals exhibiting long cycles exclusively. Determining the causes of both acyclicity

and extended cycles are research priorities for the southern white rhinoceros. Additionally, early pregnancy loss and uterine pathology have been documented by ultrasound[6] and further examinations of additional animals are necessary to determine their prevalence and potential association with reduced fertility.

The reproductive cycle of the Indian rhinoceros (*Rhinoceros unicornis*) has been characterized by both behavioral observations and urinary hormone metabolite monitoring.[3,4] The reproductive cycle appears to vary, ranging from 39-64 days. In this rhinoceros species, increases in urinary estrone conjugates are associated with estrus behavior and breeding. Recent research using serial ultrasound examinations in a regularly cycling female has revealed the development of extremely large follicles (>10 cm diameter) several days before ovulation which might explain the high levels of estrone produced by this species during estrus. Captive breeding of the Indian rhinoceros has been relatively successful, however, aggressive interactions between some male-female pairings, even during the female's estrus, have interfered with breeding success on several occasions. These behavioral incompatibilities between specific pairs limit our ability to genetically manage the captive population, and the development of artificial insemination may provide a useful method for overcoming this hurdle in the Indian rhinoceros captive breeding program.

The other Asian rhinoceros in captivity, the Sumatran rhinoceros (*Dicerorhinus sumatrensis*), has been studied intensively during the last few years. In the last century, captive breeding efforts with this species have been unsuccessful, in part, due to difficulties detecting estrus behavior and aggressive interactions between pairs when animals are introduced during the female's nonreceptive period. Long-term, serial ultrasound examinations and serum hormone analyses have revealed that the Sumatran rhinoceros experiences a 21-day reproductive cycle[7] and appears to be an induced ovulator, a characteristic not previously reported within the Perissodactyla family. Early pregnancy loss has been detected in one animal on three occasions[7] and uterine pathology has been reported in several other animals.[8] The reason for this uterine pathology is unknown and warrants investigation. Similarly, the cause of early pregnancy loss is a mystery and determining why it is occurring and how to overcome it will be research priorities as efforts to produce offspring in the captive Sumatran rhinoceros continue.

In summary, the reproductive cycle of each rhinoceros species differs, ranging from 21 days in the Sumatran rhinoceros to 70 days in some white rhinos. Similarly, ovarian activity differs among species. For example, preovulatory follicles in the Sumatran rhinoceros are ~25 mm in diameter, and breeding appears to induce ovulation. In contrast, preovulatory follicles in the Indian rhinoceros may grow to >10 cm in diameter and spontaneously ovulate. Challenges for the future include understanding the reasons for and overcoming the challenges of: 1) repeated copulations without pregnancy; 2) early pregnancy loss; 3) uterine pathology; 4) extended luteal phase cycles and acyclicity in the white rhinoceros; and 5) aggressive interactions between pairs of Indian and Sumatran rhinos introduced for breeding.

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