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Hormonal Assessment of Sexual Maturation in Four Captive Lowland Gorilla Males

Monozygotic twins Mosuba and Macombo were born at the Columbus (Ohio) Zoo in 1983. During their first year, weight and skeletal growth indicators were virtually identical. The twins lived together continuously until age 7, when they were permanently separated. Mosuba joined a group of males and elderly, non-breeding females in the Henry Doorly Zoo of Omaha, Nebraska. He sired an infant by artificial insemination at age 12. At age 16, Mosuba had the appearance of a fully mature silverback, with prominent sagittal and nuchal crests and typical large body size, consistent with his age.

At age 16 Macombo lived in a social group that includes three other males and five females ranging in age from 5 to 35 years. Mumbah, then age 34, was the dominant silverback, weighing 200 kg. He is a wild-born male from Cameroon who was transferred to Columbus from Howletts Zoo Park in 1984. Mumbah sired an infant at Howletts but not in Columbus, although he copulated with several young females. The third male was 8-year old Nkosi, Macombo's first cousin weighing 75 kg at the time. Nkosi indicated sexual interest in some of the group's older females, but had not copulated with them. Macombo had not copulated with any of the females, although he was observed occasionally following females, inspecting their genitals, positioning, mounting, and thrusting. He did not respond to female solicitations. In contrast to his twin brother, Macombo's physical appearance was that of a maturing male, with partially silvered back and incomplete development of sagittal and nuchal crests. His weight was 150 kg.

The objective of our study was to determine whether Macombo's hormone levels were consistent with fertility. Urine samples collected from Mumbah, Macombo, and Nkosi were analyzed for testosterone and cortisol levels, indicators of male sexual maturity and stress, respectively. Since none of these males had reproduced in the previous 15 years, and since samples from Mosuba were unavailable, urine samples from Annaka, a fertile 16-year old male from another Columbus Zoo group, were also analyzed. Annaka sired three infants with two of the fe-

Gorilla Characteristics and Urine Samples

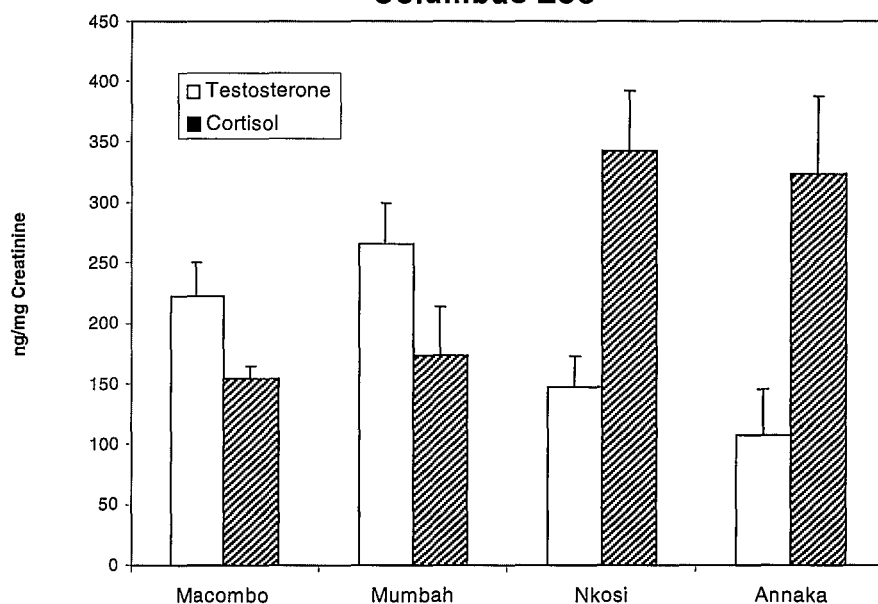
Gorilla	Age Group	Age (years)	Samples (Number)	Sampling Duration (Days)
MACOMBO	Young adult	16	10	40
NKOSI	Juvenile	8	11	36
MUMBAH	Adult	34	9	30
ANNAKA	Young adult (fertile)	16	4	38

males in his group, the most recent birth occurring two months before urine collection.

First void morning urine samples were collected from the four males over periods ranging from 30 to 40 days. Samples were frozen and shipped by overnight mail for analysis at the University of Nebraska Omaha Endocrine Bioservices Laboratory. Urinary testosterone and cortisol concentrations were estimated using enzyme immunoassay. All hormone concentrations were expressed as mass hormone per mass urinary creatinine to control for variable fluid intake and output.

Annaka was fertile despite significantly lower testosterone than Mumbah. Annaka's cortisol did not differ significantly from the cortisol levels of the other study gorillas. Consistent with his developmental stage, juvenile Nkosi had significantly lower testosterone than the adult Mumbah and significantly higher cortisol than young adult Macombo and adult Mumbah. Although Mumbah's testosterone was higher than Annaka's, he had not sired an infant for more than 15 years. His infertility appeared to be independent of gonadal insufficiency. Macombo's hormone profile was consistent with fertility. His testosterone level was higher and his cortisol level was lower than Annaka's. Macombo's hormone profile was similar to Mumbah's, the group's silverback. Therefore Macombo's delayed somatic and behavioral maturation was independent of gonadal suppression and stress-induced hypercortisolism.

Gorilla Urinary Testosterone and Cortisol Columbus Zoo



The possibility that Mumbah's proximity may have induced Macombo's delayed maturation should be considered. Male bimaturism has been documented for orangutans. A mature male's presence appears to suppress the development of secondary sexual characteristics in younger males. The appearance of large cheek flanges and throat pouches characteristic of adult male orangutans may be delayed for up to ten years, while testosterone levels are normal and the "underdeveloped" males are

fertile. This delay is adaptive for younger orangutan males because their immature appearance fails to provoke aggression from dominant, mature males. Whether social suppression of male maturation also exists in gorillas is unknown.

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