Body mass and growth rates in a wild primate population

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Summary. We obtained data on body mass and growth rates for the immature members of two groups of wild baboons in Amboseli National Park, Kenya. Data were collected without feeding, trapping, or handling. The data were separated into cross-sectional and longitudinal components, allowing both the examination of body mass-age relationships and the calculation of growth rates for individuals. For animals less than three years old, body mass was well-predicted from age by a linear model. Differences based on social group membership were small but consistent, and their origins are discussed. We detected no differences in body mass based on sex or on maternal dominance rank. For older juveniles, those three to seven years of age, a better fit was obtained from log of mass than by mass in a linear model. This was also true for the cross-sectional data set over the whole age range (zero to seven years). For older juveniles, samples were too small for quantitative analysis of differences based on sex, rank, or group membership, but trends in the data are indicated. Growth rates derived from repeat measures of body mass for 38 animals are presented and discussed.

The growth rate values obtained in this study are consistent with data from cross-sectional studies of other wild baboon populations; these values for wild baboons are consistently one-half to one-third lower than growth rate values for well-provisioned captive baboons and equivalent to captive baboons fed a low-protein diet. Comparisons between primates and other mammals in the primate size range raise questions concerning ecological and behavioral constraints on primate growth rates; some possible mechanisms of constraint are suggested.

Key words: Baboons – Papio cynocephalus – Body mass – Post-natal growth rates – Developmental constraints

Recent evidence suggests that many primate populations are food-limited, as evidenced by the fact that if the animals receive better nutrition, either through natural increases in food supply or through human-supplied nutritional enrichment, age of first reproduction declines and fertility rates and population size increase (Sade et al. 1977; Mori 1979; Southwick et al. 1980; Strum and Western 1982; Sugiyama and Oshawa 1982). The effects on reproductive rates probably are mediated at least partially through changes in rates of body growth and in the ratio of body mass to skeletal measures (Mori 1979; Sugiyama and Oshawa 1982). This suggests that measurement of developmental changes in body mass and assessment of factors that are related to differences in growth rates will ultimately be essential for understanding the dynamics of these populations and differential reproductive success within them.

In previous studies of individually identified yellow baboons, (Papio cynocephalus) of known age in Amboseli National Park, Kenya, we obtained maturational data over a number of years entirely through regular assessment of developmental markers that are visible in the field: animals were never fed, trapped or otherwise handled. Age at attainment of developmental milestones, such as menarche for females or first visible rounding of the testes for males, was found to be much greater than had been reported previously based on data from captive animals: the ratio of age at attainment of developmental milestones for animals in captivity to that for unprovisioned wild animals was approximately 3.5 to 5 (Altmann et al. 1977, 1981). These results are consistent with field data for olive baboons (P. anubis) in Tanzania (Packer 1979).

Amboseli data on these developmental milestones and on the time course of infant behavioral development, combined with reports on growth rates of captive baboons (Snow 1967; Buss and Reed 1970), led us to hypothesize that young baboons in Amboseli grow at rates between five and six grams per day during the first few years of life (Altmann 1980, 1983). In the present paper we report recent data on body mass and growth rates that we obtained as part of a series of investigations into aspects of development, parental investment and reproduction.

Material and methods

The subjects of the study were the immature members of two social groups of yellow baboons, Alto’s and Hook’s, whose home ranges include Amboseli National Park, Kenya. The individually identified members of these groups have been observed almost daily, Alto’s group since mid-1971, Hook’s Group since late 1980. The groups have been relatively stable in age-sex composition and stable or slightly increasing in size for a number of years (Altmann et al. 1985). Starting in mid-August, 1984, we repeatedly...
placed a dial-type platform scale (Avery model 3305) on the ground near the sleeping trees that were currently being used by one of the baboon groups. This was done either late in the afternoon, just before the baboons' ascent into a sleeping grove, or before descent from the trees in the morning. The scale was never baited. Our hope was that the youngsters would accommodate to this new object and climb on it as they do with most objects in their environment that are suitable for climbing or play. In Hook's Group, a few animals began to do so on the first day that the scale was presented; in Alto's Group, we still had only a few measurements by the end of the second month. By presenting the scale two or three times a week, however, we had obtained body-mass data on 56 (approximately 85%) of the immature animals by the end of July, 1985; for a few individuals, we gathered near-weekly measurements. Only one female who had attained menarche (approximately five years of age) got on the scale, only a few males who had reached subadulthood (about six years of age) did so, and only rarely did infants less than six months old do so: use of the scale was almost exclusively by older infants and by juveniles. Data for the other age ranges will probably be obtained, but slowly and for only a fraction of the individuals. For most animals, once they first used the scale, repeated measures were obtained.

Two observers were used to facilitate identification, check that all parts of a subject's body were on the scale, read the scale, and record data. They stood a few meters from the scale and read it with binoculars to the nearest 0.1 kg. The tare was checked before and after each weighing. When part of a subject's tail hung off the edge of the scale, we recorded the body mass along with an estimate of the proportion of tail that was on the scale. For all but the oldest animals the difference between full tail and no tail was 0.1 kg or less. Usually we were able to obtain measurements that included all or the major proportion of the tail. In addition to the date, time, subject, tare, tail no tail was 0.1 kg or less. Usually we were able to obtain measurements of the proportion of tail that was on the scale. For all but the oldest animals the difference between full tail and no tail was 0.1 kg or less. Usually we were able to obtain measurements that included all or the major proportion of the tail. In addition to the date, time, subject, tare, tail portion, and body-mass measurement, we made a note if there were any potential sources of error, such as urine or feces on the scale, poor damping of the scale, etc. Measurement sessions usually lasted approximately 15 minutes, from the first to last values obtained, as the animals progressed past the scale and continued their ongoing activities. Between measurement sessions, we periodically checked the readings with known masses and performed routine adjustments and maintenance as needed.

Before the original data were entered into a computer file for analysis, we deleted a few values that were totally anomalous, were noted as being very poor, or were otherwise uncodable. These constituted less than a dozen values out of more than 500 and were primarily obtained during the first few days of weighing or were instances of several animals simultaneously on the scale. When multiple weights were obtained for the same animal during the same weighing session, these were reduced to a single record by using the record with the greatest part of tail and no problems indicated by notes. If more than one record met the criteria, then the mean of the several weighings was used. These several values for an individual during the same session differed only rarely and then almost always did so by no more than 0.1 kg. The result was a data set consisting of more than 250 usable body-mass values.

The data were then separated into cross-sectional and longitudinal components. The first measurement for each animal for which all or most of the animal's tail was on the scale and for which there were no potential problems was used for cross-sectional analyses to compare the body mass values of known-age individuals. In the longitudinal analyses, repeated measurements of the same individual were used to calculate the growth rate for each animal for which data were available. The growth rate of an individual was calculated just from its morning weighings (see discussion of diurnal effects, below) as the slope of their linear regression, but only if we obtained at least two morning values for that individual that were at least one month apart. Analyses used GLM (general linear models) procedures in SAS (SAS Institute, Inc. 1985). Group membership, sex, maternal dominance rank (Hausfater 1975; Alt- mann 1980; Hausfater et al. 1982), season, and age were considered as independent variables predicting body mass.

Results

Values obtained for body mass were approximately six percent greater in the evening, at the end of a day of feeding, than those obtained upon descent from the sleeping trees in the morning before feeding commenced. The exceptions to this were the values for infants that were still suckling and were also sleeping huddled with their mothers; as a result of these behaviors, the infants obtained nutrition overnight and reduced heat loss, and thus experienced less weight loss overnight. Because of the night/morning difference in body mass and because the values from repeated weighings were not well distributed by time of day across individuals and subclasses, we restricted our growth rate analyses to the morning values, as indicated above. On the other hand, cross-sectional data were well-distributed by subclass across morning and evening weights, and so in order to reduce seasonal effects on the analyses we used the first good value for an individual, regardless of time of day.

In Fig. 1, cross-sectional body-mass values are presented for the 56 immature animals. For animals in the first three years of life, approximately encompassing the infant and young juvenile stages, body mass is well-pre-