COMPARISON OF BODY SIZE DEVELOPMENT IN CAPTIVE AND FREE-RANGING LEOPARD TORTOISES (*GEOCHELONE PARDALIS*)

RITZ J[1], HAMMER C[2], CLAUSS M[1]

[1]Clinic for Zoo Animals, Exotic Pets and Wildlife, Vetsuisse Faculty, University of Zurich, Winterthurerstrasse 260, CH-8057 Zurich, SWITZERLAND, julia.ritz@access.uzh.ch
[2]Al Wabra Wildlife Preservation, Doha, STATE OF QATAR

Although the leopard tortoise, *Geochelone pardalis* (BELL, 1827), is one of the largest mainland tortoise worldwide and is common in a wide range in Eastern and Southern Africa (IVERSON, 1992), the knowledge about this species, particularly its growth development, is limited. Especially literature on the body mass development – the most essential parameter in tortoise husbandry and breeding – is mostly lacking. A growth rate exceeding that of natural populations is suspected to occur in many captive and pet tortoises with potential pathological consequences such as obesity, high mortality, gastrointestinal illnesses, renal diseases, 'pyramiding', fibrous osteodystrophy or metabolic bone disease (HÄFELI and SCHILDGER, 1995; MCARTHUR, 2004; MCARTHUR and BARROWS, 2004; DONOGHUE, 2006; HATT, 2008). Despite these misgivings, empirical studies providing this suggestion or comparisons of age-related growth in captive and free-ranging herbivorous tortoises are rare. To our knowledge, published data on this topic contains only one paper on Galapagos giant tortoises (*Geochleone nigra*) by FURRER et al. (2004) and one on spur-thighed tortoises (*Testudo graeca*) by LAPID et al. (2005). We intended to check whether more comparisons could be derived from combining literature data, and whether the body size development of Leopard tortoises kept at the Al Wabra Wildlife Preservation (AWWP), Doha, State of Qatar, was similar in this respect when compared to data from specimens living in the wild. The juvenile leopard tortoises hatched between May and October 2002 to 2006 at AWWP, were kept in enclosures with a natural vegetation of grasses and small shrubs with a regular supplement of a variety of vegetables, fruits, fresh lucerne (*Medicago sativa*), fresh grasses, different browse, flowers and grass hay ad libitum. The animals were weighed and measured several times per year between 2002 and 2008 and faecal samples were taken regularly. In most of the cases no parasites were found. Otherwise the tortoises were treated with Fenbendazole or Praziquantel. The total length (straight carapace length) and the plastron height were measured with callipers (straight measurements) and the carapace length and the plastron length were taken with a soft tape (curved measurements). Data was recorded to the nearest millimetre or the nearest gram, respectively. All leopard tortoises raised at AWWP showed a regular allometric body form development similar to previously published patterns in the same species on not artificially fed or free-living individuals (WILSON, 1968; RALL, 1988; LAMBERT, 1995; LAMBERT et al., 1998), whereas the comparison of growth development shows different results: The intensively kept tortoises at AWWP showed a dramatically faster growth pattern than conspecifics from the wild (HAILEY and COULSON, 1999; HAILEY and LAMBERT, 2002) or kept in natural enclosures with hardly any food supplementation (WILSON, 1968). The same pattern – free-ranging or extensively kept tortoises growing much slower than intensively kept individuals – is evident in studies on other tortoise species as in Galapagos giant tortoises (*Geochelone nigra*) by FURRER et al. (2004), in spur-thighed tortoises (*Testudo graeca*) by LAPID et al. (2005) or when combining different publications on desert tortoises (*Gopherus agassizi*), (MILLER, 1932 and 1955; GERMANO, 1992 and 1994; PATTERSON and BRATTSTROM, 1972). It seems obvious that the different living conditions of the populations – particularly the food offered to them – influences the growth considerably. To our knowledge, the only study that provided controlled evidence for an influence of the diet on growth in tortoises is the one by FLEDELIUS et al. (2005) on the influence of calcium supplements on leopard tortoises' growth. Additionally, a similar effect was

reported in soft-shelled turtles (HUANG et al., 2003) and in other reptiles the influence of different diets on the growth rate has been repeatedly described as well, documenting a considerable potential to accelerate or decelerate growth in reaction to the supply of food; we can only presume that this plasticity is more pronounced than in the case of the endothermic mammals or birds in which growth rates are probably less flexible. As a keeper of ectothermic animals, it is necessary to be aware of this difference in metabolism for it makes an oversupplementation of food in tortoises likely whenever no special attention is paid to restrict this amount. Whether faster growth rates are actually linked to health problems can, so far, only be speculated upon. Although there appears to be a consensus in this respect in the reptile literature, experimental evidence is lacking. In order to reduce the growth rate of hatchings at AWWP, and presumably contribute to a higher health standard of the following hatchling cohorts, vegetables and fruits were excluded as a result of this study at AWWP, so that the current diet only includes the natural enclosure vegetation of grasses and shrubs, and additionally offered grass and lucerne hay. Future years will show whether this change in diet regime will reduce the growth rate of AWWP leopard tortoises to levels reported in free-ranging specimens.

References

*BELL T (1827): Descriptions of three new species of land tortoises. Zool J **3**, 419 - 421.*

DONOGHUE S (2006): Nutrition: Nutrient disorders: Obesity. In: MADER DR (Ed.), Reptile medicine and surgery. 2nd ed. St. Louis, Missouri: Saunders Elsevier, 282 - 283.

*FLEDELIUS B, JORGENSEN GW, JENSEN HE, BRIMER L (2005): Influence of the calcium content of the diet offered to leopard tortoises (Geochelone pardalis). Vet Rec **156**, 831 - 835.*

*FURRER SC, HATT JM, SNELL H, MARQUEZ C, HONEGGER RE, RÜBEL A (2004): Comparative study on the growth of juvenile galapagos giant tortoises (Geochelone nigra) at the Charles Darwin Research Station (Galapagos Islands, Ecuador) and Zoo Zurich (Zurich, Switzerland). Zoo Biol **23**, 177 - 183.*

*GERMANO DJ (1992): Longevity and age-size relationships of populations of desert tortoises. Copeia **2**, 367 - 374.*

*GERMANO DJ (1994): Growth and age maturity of North American tortoises in relation to regional climates. Can J Zool **72**, 918 - 931.*

HÄFELI W, SCHILDGER BJ (1995): Reptilien. In: GÖLTENBOTH R, KLÖS HG (Eds.), Krankheiten der Zoo- und Wildtiere. Berlin, Germany: Blackwell Wissenschafts-Verlag, 530 - 554.

*HAILEY A, COULSON IM (1999): The growth pattern of the African tortoise Geochelone pardalis and other chelonians. Can J Zool **77**, 181 - 193.*

*HAILEY A, LAMBERT MRK (2002): Comparative growth patterns in afrotropical giant tortoises (Reptilia Testudinae). Tropical Zool **15**, 121 - 139.*

HATT JM (2008): Raising giant tortoises. In: FOWLER ME, MILLER RE (Eds.), Zoo and wild animal medicine current therapy 6. St. Louis, Missouri: Saunders Elsevier, 144 - 153.

*HUANG CH, LIN WY, WU SM (2003): Effect of dietary calcium and phosphorus supplementation in fish meal-based diets on the growth of soft-shelled turtle (Pelodiscus sinensis). Aquaculture Res **34**, 843 - 848.*

IVERSON JB (1992): A revised checklist with distribution maps of the turtles of the world. Richmond, Indiana: Privately published, 363.

*LAMBERT MRK (1995): On geographical size variation, growth and sexual dimorphism of the leopard tortoise, Geochelone pardalis, in Somaliland. Chel Cons Biol **1**, 269 - 278.*

LAMBERT MRK, CAMPBELL KLI, KABIGUMILA JD (1998): On the growth and morphometrics of leopard tortoise, Geochelone pardalis, in Serengeti National Park, Tanzania, with observations on

*effects of bushfires and latitudinal variation in populations of Eastern Africa. Chel Cons Biol **3**, 46 - 57.*

*LAPID RH, NIR I, ROBINZON B (2005): Growth and body composition in captive Testudo graeca terrestris fed with a high-energy diet. Appl Herpetol **2**, 201 - 209.*

MCARTHUR S (2004): Anatomy and Physiology: Shell and Skeleton. In: MCATHUR S, WILKINSON R, MEYER J (Eds.), Medicine and surgery of tortoises and turtles. Oxford, UK: Blackwell Publishing Ltd, 35 - 36.

MCARTHUR S, BARROWS M (2004): Nutrition: Nutritional disease in captive chelonians. In: MCATHUR S, WILKINSON R, MEYER J (Eds.), Medicine and surgery of tortoises and turtles. Oxford, UK: Blackwell Publishing Ltd, 82 - 85.

*MILLER L (1932): Notes on the desert tortoise (Testudo agassizii). Trans San Diego Soc Nat Hist **7**, 187 - 208.*

*MILLER L (1955): Further observations on the desert tortoise, Gopherus agassizi, of California. Copeia **2**, 113 - 118.*

*PATTERSON R, BRATTSTROM B (1972): Growth in captive Gopherus agassizi. Herpetologica **28**, 169 - 171.*

*RALL M (1988): Observations on the growth of the leopard tortoise Geochelone pardalis in captivity. J Herpetol Assoc Afr **35**, 7 - 8.*

*WILSON VJ (1968): The leopard tortoise, Testudo pardalis babcocki, in eastern Zambia. Arnoldia (Rhodesia) **3**, 1 - 11.*