Supplementary information 2.

Detailed description of growth curve modelling

The growth models established on pachypleurosaurs aim at a mathematical formulation on how an individual had increased its size between birth and death. We used these models, which describe growth at the macroscopic level in order to find estimates on important life-history traits for pachypleurosaur specimens (size and mass at birth, asymptotic size and mass, asymptotic age, age at which sexual maturity is reached, maximum growth rate). We are aware of the constraint that most of our pachypleurosaur specimens have preserved a comparative small number of growth marks, which is problematic in non-linear regression analysis and statistics of growth models derived. However, for many extinct taxa the growth record as preserved in bones is the only source of direct information on their growth and their paleobiology. Our results are no hard data and their interpretations are only hypotheses on extinct taxa.

From our total sample of 31 pachypleurosaur specimens (Table 1) we first identified 17 specimens having preserved at least five growth marks or having preserved at least four growth marks and the outer cortex. Only these specimens were passed to growth curve modelling (*Dactylosaurus*: MB.R. 771.5, MB.R. 801.2, MB.R. 772.3, MB.R. 776.2, MB.R. 786; *Anarosaurus*: Wijk07-50, Wijk07-70, Wijk09-472, Wijk09-58; aff. *Neusticosaurus pusillus*: SMNS 50372c, SMNS 92125; *N. pusillus*: PIMUZ T 4178, PIMUZ T 4211; *N. edwardsii*: PIMUZ phz 153, PIMUZ T 4758; *Serpianosaurus*: PIMUZ phz 119, PIMUZ T 4510). We then carried out for each of these specimens the complex model fitting procedure described below in order to find the statistical best growth model(s) for each of them. Our procedure is based on Griebeler et al. (2013) and was already improved in Klein et al. (2015) and Klein and Griebeler (2016). With our approach we aimed at the technical problem that an unknown number of growth marks could be missing from the inner part of a bone. An estimation of this number had finally to be done for three out of the 17 specimens modelled (aff. *Neusticosaurus pusillus*: PIMUZ T 4211; *Serpianosaurus*: PIMUZ phz 119, PIMUZ T 4510). For all other specimens there was no histological evidence that growth marks are missing in the inner part of the bone. Our approach also explicitly tackles the technical problem described in Myhrvold (2013), which is that the growth record has no information preserved on both growth acceleration and deceleration, i.e. the record covers only the exponential, quasi-linear or asymptotic phase of growth. This information on growth is needed for

establishing a reliable sigmoidal growth model on a specimen (Myhrvold 2013, Klein et al. 2015, Klein and Griebeler 2016). This criterion was not passed by four out of the 17 specimens modelled as their growth record clearly covered only the quasi-linear phase of growth. Thus, we were finally able to establish growth model for 13 pachypleurosaur specimens (Supplementary Table S1). All models relate humerus length (cm) to age (years). Mass estimation is difficult in Pachypleurosauria (see Supplementary information S1), and we aimed to keep our growth models most precise. For details on our method used to transform a specimen's humerus length into body mass (mass at birth, asymptotic mass, maximum growth rate) in order to make its life-history traits comparable to extant squamates (Fig. 4) please refer to Supplementary information 1.

Growth acceleration and deceleration preserved in the growth record? To assess whether the growth record of a specimen covers only the exponential, quasi-linear or asymptotic phase of growth (Myhrvold 2013) we fitted an exponential, linear, and asymptotic equation to its ontogenetic growth series on humerus length (derived from the growth record preserved in the midshaft region of the bone). We therefore used the following equations, in which L_0 is humerus length at the first growth mark (t = 0), L_{death} is humerus length preserved at the last growth mark or at the outer cortex, and g the growth parameter.

Exponential growth model: $$L(t) = L_0 \exp(gt) \quad (1)$$

Linear growth model: $$L(t) = L_0 + gt \quad (2)$$

Asymptotic growth model: $$L(t) = L_0 + (L_{death} - L_0)(1 - \exp(-gt)) \quad (3)$$

Standard growth models applied to specimens. We also considered four standard growth models (Fitzhugh 1976) for each of the specimens. These were the von Bertalanffy (vBGM), Gompertz (GGM), logistic (LGM), and Chapman-Richards (CRGM) growth model. In all standard growth models t is a real number (time axis), L_0 the initial length, L_{max} the maximum length, and g the growth parameter.

The specific formulation of the vBGM that we used is based on the Pütter-von Bertalanffy equation (von Bertalanffy 1938, 1957; Pütter 1920). It has been successfully applied in this form to many extant reptile taxa (Halliday and Verrell 1988) including snakes, lizards (Shine and Charnov 1992), turtles (Frazer and Ehrhart 1985), and crocodiles (Magnusson and Sanaiotti 1995) in order to mathematically describe their ontogenetic growth in body size (i.e. snout-vent-length or total length). This asymptotic growth model formulated on gain in body length over ontogeny has no inflection point, but under a cubic transformation which is used to describe gain in body mass ($Mass(t) = L(t)^3$) the inflection point is found at about 30% (=100*8/27) of asymptotic mass.

vBGM: $$L(t) = L_{\max} - (L_{\max} - L_0)\exp(-gt) \qquad (4)$$

The GGM has been applied to describe growth in length in extant chelonians (Andrews 1982, Hailey and Coulson 1999). In this model the inflection point is located at about 38% (=100/e) of asymptotic length. The age at which it is seen is given by parameter *i* in the specific model formulation used by us. We used the following equation to implement the GGM.

GGM: $$L(t) = L_0 + L_{\max}\exp(-\exp(-g(t-i))) \qquad (5)$$

The LGM has been successfully used to describe growth in smaller extant reptiles (Magnusson and Sanaiotti 1995) including tortoises (Ritz et al. 2010). This model has the inflection point at 50% of asymptotic length. The age at which the point is seen is set by parameter *i* in the formulation used by us. The following equation describes the LGM that we used in our study.

LGM: $$L(t) = L_0 + \frac{L_{\max}}{1+\exp(-g(t-i))} \qquad (6)$$

We finally considered the CRGM for each specimen. Contrary to the vBGM, GGM and LGM this model has a parameter *m* which sets the position of the inflection point on the length axis. Parameter *i* in our formulation is again the age at which the inflection point is observed. Parameters *i* and *m* enable the CRGM to generate any sigmoidal growth curve within the two extremes, a monotonic concave increase (no inflection point, maximum growth rate at birth) and a monotonic convex increase (no inflection point, truncated exponential model). By choosing specific values for parameter *m*, the CRGM is able to mimic the vBGM (m=2/3), the GGM ($m \rightarrow 1$, equation 6 is not defined for m = 1!), and the LGM (m = 2) (Richards 1959). The formulation of the CRGM that we used is taken from Gaillard et al. (1997) and is based on Richards (1959), but contrary to the formulation used by these authors ours allows for a flexible L_0.

CRGM:

$$L(t) = L_0 + \frac{L_{\max}}{(1+(m-1)\exp(g(i-t)))^{1/(m-1)}} \qquad (7)$$

Please note that our formulation of the GGM (5), and LGM (6) also allows a flexible location of the inflection point with respect to age and mass (as the CRGM). Note also that only under the vBGM the humerus length at age 0 (birth size) is L_0 and asymptotic length equals L_{max}. By contrast, for the GGM, LGM, and CRGM humerus length at age 0 (birth size) is $L(t)$ evaluated at t = 0 (= $L(0)$) and asymptotic length is $L_0 + L_{max}$. Under the GGM, LGM, and CRGM parameter L_0 allows for a non-zero length at t = 0 and thus it moves the respective growth curve along the length axis.

The number of parameters assumed by our equation on the vBGM (4) is three, four for the GGM (5) and LGM (6), and five for the CRGM (7). These high model parameter numbers can become problematic in non-linear regression analysis when the number of growth marks preserved in a bone is comparatively small. This is the case for the pachypleurosaurs studied herein (Table 1). We therefore additionally considered for each of these four standard growth models simpler equations, in which we fixed different parameters to specific values (and did not fit them). Thus, a total of 6 equations derived from the general equation (4) implementing von Bertalanffy growth were applied to each specimen, 11 equations

implementing Gompertz growth (equation 5), 11 equations implementing logistic growth (equation 6), and 12 equations implementing Chapman-Richards growth (equation 7). Thus, for each of the specimens under study we overall considered 40 equations on standard growth models (listed below) and also three equations enabling us to test whether not only one growth phase is preserved in its growth record (1 through 3).

The 40 equations on standard growth models used to describe growth in pachypleurosaur specimens. The vBGM is parameterized by parameters L_0, L_{max}, and g (equation 4), the GGM (equation 5) and LGM (equation 6) are parameterized by parameters L_0, L_{max}, g and i, and the CRGM (equation 7) is parameterized by parameters L_0, L_{max}, g, i, and m. Starting with a full parameterisation of each of these four growth models (all model parameters are estimated during model fitting), we then stepwise reduced their numbers of parameters estimated (#parameters estimated) by setting specific model parameters to fixed values (they are not estimated during fitting of the equation). est. = this parameter is estimated during model fitting; from last gm = in the respective model equation L_{max} is set to the humerus length corresponding to the last growth mark preserved in the growth record or (if preserved) to the outer cortex; from first gm = in the respective model equation L_0 is set the humerus length corresponding to the first growth mark; fixed to 0 = L_0 (or i) is set to 0 in the respective model equation, when parameter i is set to 0, the inflection point is determined by 38% asymptotic length (GGM) or 50% asymptotic length (LGM), respectively.

Growth model	**#parameters estimated**	L_0	L_{max}	g	i	m
vBGM	3	est.	est.	est.		
	2	est.	from last gm	est.		
	2	from first gm	est.	est.		
	2	fixed to 0	est.	est.		
	1	from first gm	from last gm	est.		
	1	fixed to 0	from last gm	est.		
GGM and LGM	4	est.	est.	est.	est.	
	3	est.	from last gm	est.	est.	
	3	from first gm	est.	est.	est.	
	3	fixed to 0	est.	est.	est.	
	2	est.	from last gm	est.	fixed to 0	
	2	from first gm	est.	est.	fixed to 0	
	2	fixed to 0	est.	est.	fixed to 0	
	2	from first gm	from last gm	est.	est.	

	2	fixed to 0	from last gm	est.	est.	
	1	from first gm	from last gm	est.	fixed to 0	
	1	fixed to 0	from last gm	est.	fixed to 0	
CRGM	5	est.	est.	est.	est.	est.
	4	est.	from last gm	est.	est.	est.
	4	from first gm	est.	est.	est.	est.
	4	fixed to 0	est.	est.	est.	est.
	4	est.	est.	est.	fixed to 0	est.
	3	from first gm	from last gm	est.	est.	est.
	3	fixed to 0	from last gm	est.	est.	est.
	3	est.	from last gm	est.	fixed to 0	est.
	3	from first gm	est.	est.	fixed to 0	est.
	3	fixed to 0	est.	est.	fixed to 0	est.
	2	from first gm	from last gm	est.	fixed to 0	est.
	2	fixed to 0	from last gm	est.	fixed to 0	est.

Estimation of the number of missing growth marks in the inner part of the bone. Three of the 17 pachypleurosaur specimens that we finally passed to growth curve modelling (*N. pusillus*: PIMUZ T 4178; *Serpianosaurus*: PIMUZ phz 119, PIMUZ T 4510) had large marrow cavities, which could indicate that some growth marks are missing (resorbed), and thus that the first growth mark preserved in these bones does not correspond to birth. Please note that the two methods estimating the number of missing growth marks that are given in Griebeler et al. (2013) are inapplicable to these pachypleurosaurs. Both methods presented in that paper make use of a known birth size (i.e. egg mass was used as an estimate of sauropod hatchling mass in Griebeler et al. 2013) in order to estimate the number of missing growth marks. The method presented herein was already successfully applied to the sauropterygians *Simosaurus* (Klein and Griebeler 2016), and Placodontia (Klein et al. 2015). To estimate how many growth marks could be missing in the inner part of bones (#res. gms) of these three pachypleurosaur specimens, we first applied the method from Sander and Klein (2005) in order to have an educated guess. Next, we considered different birth sizes and numbers of missing growth marks for each of the 40 equations on standard growth models in order to simultaneously estimate the number of growth marks missing in the inner part of the

bone and birth size. To implement this manual grid search on the best number of missing growth marks and the best birth size for a specimen, we generated new growth series based on those preserved in the specimen's growth record. For the number of missing growth marks we assumed one up to (3 * #res. gms) growth marks and stepwise increased this value by one growth mark. The lowest birth size (humerus length at birth) considered for our manual grid search was 0.1 which corresponds to the lowest annual increase in humerus length seen across our pachypleurosaur sample and the largest was the humerus length preserved at the first growth mark in the specimen's growth record. Our increment in humerus length was ((humerus length at the first growth mark) / (3 * #res. gms)). In the following, we give an example on how our manual grid search was carried out in order to identify good estimates on the number of missing growth marks and birth sizes for pachypleurosaurs.

Growth series preserved in the growth record of a hypothetical pachypleurosaur specimen

number of the growth mark	1	2	3	4	5
midshaft width (in mm)	0.6	1.0	2.3	3.0	3.2

#res. gm = 1 (here arbitrary set to one, for fossils this educated guess is derived from the method of Sander and Klein 2005)

Tested numbers of missing growth marks = {0, 1, 2, 3} (3 = 3*1 = 3 * #res. gm)

Humerus length at the first growth mark = 0.6 (humerus length observed at gm no. 1)

Tested birth sizes = {0.1, 0.2, 0.4, 0.6} (0.2 = 0.6 / 3*1 = (humerus length observed at gm no. 1) / 3 * #res. gm)

All growth series examined in our manual grid search in order to find the best number of missing growth marks and birth size for our hypothetical specimen.

age	no gm missing	1 gm missing				2 gm missing				3 gm missing			
0	0.6	0.1	0.2	0.4	0.6	0.1	0.2	0.4	0.6	0.1	0.2	0.4	0.6
1	1.0	0.6	0.6	0.6	0.6								
2	2.3	1.0	1.0	1.0	1.0	0.6	0.6	0.6	0.6				

3	3.0	1.3	1.3	1.3	1.3	1.0	1.0	1.0	1.0	0.6	0.6	0.6	0.6
4	3.2	3.0	3.0	3.0	3.0	1.3	1.3	1.3	1.3	1.0	1.0	1.0	1.0
5		3.2	3.2	3.2	3.2	3.0	3.0	3.0	3.0	1.3	1.3	1.3	1.3
6						3.2	3.2	3.2	3.2	3.0	3.0	3.0	3.0
7										3.2	3.2	3.2	3.2

For this hypothetical specimen, we would have finally done 520 fits on standard growth models (= 13 growth series considering different numbers of missing growth marks and birth sizes * 40 different equations on standard growth models).

Numerical model solving. All regression analyses were carried out in the free software R statistics (version 3.0.2). We applied the function "nls" from the *nls* package for model fitting. As each of our standard growth models (equation 4 through 7) has a conditional linear parameter (Ritz and Streibig 2008) we used the fitting algorithm "plinear" provided in the *nls* package to minimise residuals. This algorithm is very robust in terms of choosing starting values on model parameters as it is classical linear regression analysis (Ritz and Streibig 2008). Starting values must not be that precise as e.g. for the Gauss-Newton algorithm that the *nls* package provides as an alternative method (Ritz and Streibig 2008). Nevertheless, when the fitting algorithm on a specific model equation did not converge for a given growth series, we additionally tried some further guesses on starting values for model parameters to be estimated. We aimed to find more support that this equation is indeed not applicable to this growth series. Please note that when using the fitting algorithm "plinear" the conditional linear parameter ".lin" is additionally estimated (Ritz and Streibig 2008). Thus, the humerus length at the specimen's birth (L_{birth}) equals L_0*.lin for the vBGM and $L(0)$*.lin for the GGM and LGM. Analogously, only for the vBGM the asymptotic humerus of the specimen (AL) equals L_{max}*.lin, whereas under the GGM, LGM, and CRGM it is ($L_0 + L_{max}$)*.lin.

Identification of candidate standard models. To identify biological reliable growth models from the total of equations and growth series considered for a specimen (e.g. the 520 equations considered for our hypothetical pachypleurosaur growth series), we first discarded those for which the fitting algorithm did not converge. Next, we excluded those for which model parameter estimates (including the conditional parameter .lin) did not

significantly differ from zero and then subsequently those estimating negative birth sizes (L_{birth}) or negative asymptotic sizes (AA), having an inflection point seen at a negative age of the individual or a negative growth parameter or a larger birth size than asymptotic size (humerus length shrinks with increasing age). Fortunately, for all pachypleurosaurs studied the remaining number of models was very small compared to the total number of standard growth model equations and growth series on numbers of missing growth marks initially tested. For these, we finally tested whether they also passed the statistical assumptions of a non-linear regression analysis. For testing the assumption of equal variances of residuals we used Levene's test and for a test whether the residuals were normally distributed we applied the Shapiro-Wilk test (Ritz and Streibig 2008). Models passing all these filters were our candidate standard growth models for a given pachypleurosaur specimen. Passing statistical tests on statistical assumptions of non-linear regression analysis did not kick out any model for pachypleurosaurs, presumable as the respective null hypotheses are conservative and sample sizes were small.

Selection of the best growth model(s) for a specimen from the candidate models.

Since the identification process described before often revealed more than one candidate standard growth model for a pachypleurosaur specimen studied, we identified the best model(s) out of these by an AIC based approach (Burnham and Anderson 2002). For this we used the standard threshold $\Delta AIC \leq 10$ (Burnham and Anderson 2002). First, the best model in terms of AIC (corrected for small sample sizes) was identified from the candidate models, and next ΔAIC values were calculated for all other. In the case that ΔAIC of the linear model was less than 10 compared to the best candidate model (Burnham and Anderson 2002), we assumed that the growth record only covers the quasi-stationary phase of growth (Myhrvold 2013). Please note that neither the exponential nor the asymptotic model passed our $\Delta AIC \leq 10$ threshold for any pachypleurosaur specimens. If the ΔAIC of the exponential model would have been less than 10 compared to the best candidate model (Burnham and Anderson 2002), we would have assumed that the growth record covers only the exponential phase of growth (Myhrvold 2013). If the ΔAIC of the asymptotic growth model would have been less than 10 compared to the best model (Burnham and Anderson 2002), this could either indicate the asymptotic phase of growth (Myhrvold 2013) or not. Thus, only if all other models within the $\Delta AIC \leq 10$ range are sigmoidal (GGM, LGM or CRGM), i.e. not

at least one vBGM equation was within the ΔAIC ≤ 10 range, we would conclude that the growth record covers only the asymptotic phase of growth (Myhrvold 2013). Please note that the vBGM (equation 4 has no inflection point) is no special case when applying our approach to test whether a growth record only covers the asymptotic phase of growth to mass-based growth series. In this case, the vBGM is also sigmoidal and a better fit of an asymptotic model to the growth record clearly indicates the asymptotic phase of growth.

Calculation of life-history traits from models.

We calculated for each specimen five life-history traits from its best growth curves (=vBGM, GGM, or LGM models within ΔAIC ≤ 10, Table S1): humerus length at birth (L_{birth}, equals L_0 * .lin for a vBGM and $L(t)$ * .lin with $L(t)$ evaluated at age t for the GGM and LGM), asymptotic humerus length (AL; equals L_{max} * .lin for a vBGM, and equals ($L_0 + L_{max}$) * .lin for the GGM or LGM), age at which sexual maturity is reached (ASM), humerus length of a fully-grown individual (99% AL; 99% of asymptotic humerus length), and age at which the individual is fully grown (AA; age at which 99% of AL is reached). To estimate the age at which the individual reached sexual maturity from its growth curve (ASM), we assumed that the inflection point of the curve coincides with sexual maturation. Evidence for this concept exists in reptiles and amphibians (Kupfer et al. 2004; Lee and Werning 2008; Reiss 1989; Ritz et al. 2010). Under the GGM, ASM is seen at about 38% of AL, and under the LGM at 50% of AL. As our formulation of the vBGM (equation 4) has only an inflection point when mass is plotted against age (it is seen at 30% of asymptotic mass), we assumed that ASM coincides with the age at which 30% of AL is reached (Klein et al. 2015b).

For *Anarosaurus* Wijk07-70 and *N. edwardsii* T 4758 for which a single standard growth model passed ΔAIC ≤ 10 L_{birth}, AL, ASM, 99% AL, and AA were derived from this curve. To find estimates on L_{birth}, AL, ASM, 99% AL, and AA for specimens for which more than one growth model passed ΔAIC ≤ 10 (Table S1) we did model averaging of trait values (Burnham and Anderson 2002). We therefore first estimated each of these five traits from all best growth curves on the specimen's growth record. We then averaged for each of the trait these values based on the models' respective Akaike weights (Burnham and Anderson 2002).

Maximum growth rate (MGR) was also obtained from model averaging, except for *Anarosaurus* Wijk07-70 and *N. edwardsii* T 4758. We therefore estimated the annual mass gain seen within the year of the inflection point (ages i, and i+1), and calculated body masses from humerus length at age i and (i+1) for each of the best models on the specimen's growth.

Estimated birth to adult size ratios (L_{birth}toAL) of specimens were derived from model averages of L_{birth} and 99% AL, again except for *Anarosaurus* Wijk07-70 and *N. edwardsii* T 4758.

References Supplementary information 2.

Anderson JF, Hall-Martin A, Russell DA (1985) Long-bone circumference and weight in mammals, birds and dinosaurs. J. Zool. Soc. Lond. A 207, 53-61.

Andrews RM (1982) Patterns of growth in reptiles. In: Gans C, Pough FH, eds. Biology of the Repilia Vol. 13, Physiology D. New York: Academic Press. 273-320.

von Bertalanffy L (1938) A quantitative theory of organic growth. Human Biology 10, 181-213.

von Bertalanffy L (1957) Quantitative laws in metabolism and growth. Q. Rev. Biol. 32, 217-231.

Burnham KP, Anderson DR (2002) Model selection and multimodal inference: a practical information-theoretic approach. New York: Springer.

Campione NE, Evans DC (2012) A universal scaling relationship between body mass and proximal limb bone dimensions in quadrupedal terrestrial tetrapods. BMC Biology 10, 60

Fitzhugh HA (1976) Analysis of growth curves and strategies for altering their shape. J. Anim. Sci. 42, 1036-1051.

Frazer NB, Ehrhard LM (1985) Preliminary growth models for Green, *Chelonia mydas*, and Loggerhead, *Caretta caretta*, turtles in the wild. Copeia 1, 73-79.

Gaillard J-M, Pontier D, Allaine D, Loison A, Herve J-C et al. (1997) Variation in growth form and precocity at birth in eutherian mammals. Proc R Soc Lond B 264, 859-868.

Griebeler EM, Klein, N, Sander PM (2013) Aging, maturation and growth of sauropodomorph dinosaurs as deduced from growth curves using long bone histological data: An assessment of methodological constraints and solutions. PLoS ONE 8, e67012.

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

Halliday TR, Verrell PA (1988) Body size and age in amphibians and reptiles. J Herpetol 22, 253-265

Klein N, Neenan JM, Scheyer TM, Griebeler EM. (2015) Growth patterns and life-history strategies in Placodontia (Diapsida: Sauropterygia) R. Soc. Open sci. 2, 140440.

Klein N, Griebeler EM (2016) Bone histology, microanatomy, and growth of the nothosaurid *Simosaurus gaillardoti* (Sauropterygia) from the Upper Muschelkalk of southern Germany/Baden-Württemberg. C. R. Palevol. 15, 147-167.

Klein, N., Sander, P. M., Krahl, A., Scheyer, T. M. & Houssaye, A. Diverse aquatic adaptations in *Nothosaurus* spp. (Sauropterygia) – Inferences from humeral histology and microanatomy. PLoS ONE 11, e0158448 (2016).

Lee AH, O'Conner PM (2013) Bone histology confirms determinate growth and small body size in the noasaurid theropod *Masiakasaurus knopfleri*. Journal of Vertebrate Paleontology 33, 865-876.

Magnusson WE, Sanaiotti TM (1995) Growth of Caiman crocodilus in Central Amazonia, Brazil. Copeia 2, 498-501.

Myhrvold NP (2013) Revisiting the estimation of dinosaur growth rates. PLoS ONE 8, e81917

Pütter A (1920) Wachstumsähnlichkeiten. Pflügers Archive für Gesamte Physiologie Menschen und Tiere 180, 298-340.

Richards FJ (1959) A flexible growth function for empirical use. J Exp Bot 10, 290-300.

Ritz C, Streibig JC (2008) Nonlinear regression with R. Springer, New York.

Ritz J, Griebeler EM, Huber R, Clauss M (2010) Body size development of captive and free-ranging African spurred tortoises (*Geochelone sulcata*): high plasticity in reptilian growth rates. Herpetological Journal 20, 213-216.

Sander PM, Klein N (2005) Developmental plasticity in the life history of a prosauropod dinosaur. Science 310, 1800-1802.

Shine R, Charnov EL (1992) Patterns of survival, growth and maturation in snakes and lizards. Am Nat 139, 1257-1269.