# Determinate growth is ancestral in Squamate reptiles

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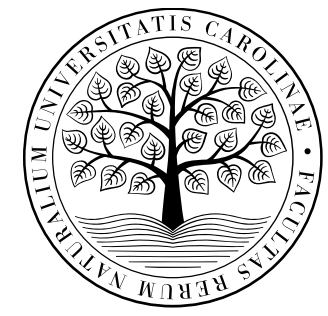
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Introduction

- Endothermic tetrapods are traditionally described as determinate growers, whereas ectothermic vertebrates as indeterminate. This paradigm is commonly mentioned in textbooks and scientific papers, although exceptions abound.
- Our recent observations of a complete **growth plate cartilage** (**GPC**) resorption, a reliable indicator of arrested growth, in many species from two advanced clades of lizards (Iguania and Anguimorpha), clearly reject the ubiquity of indeterminate growth in reptiles and raise the question about the ancestral state of the growth pattern.
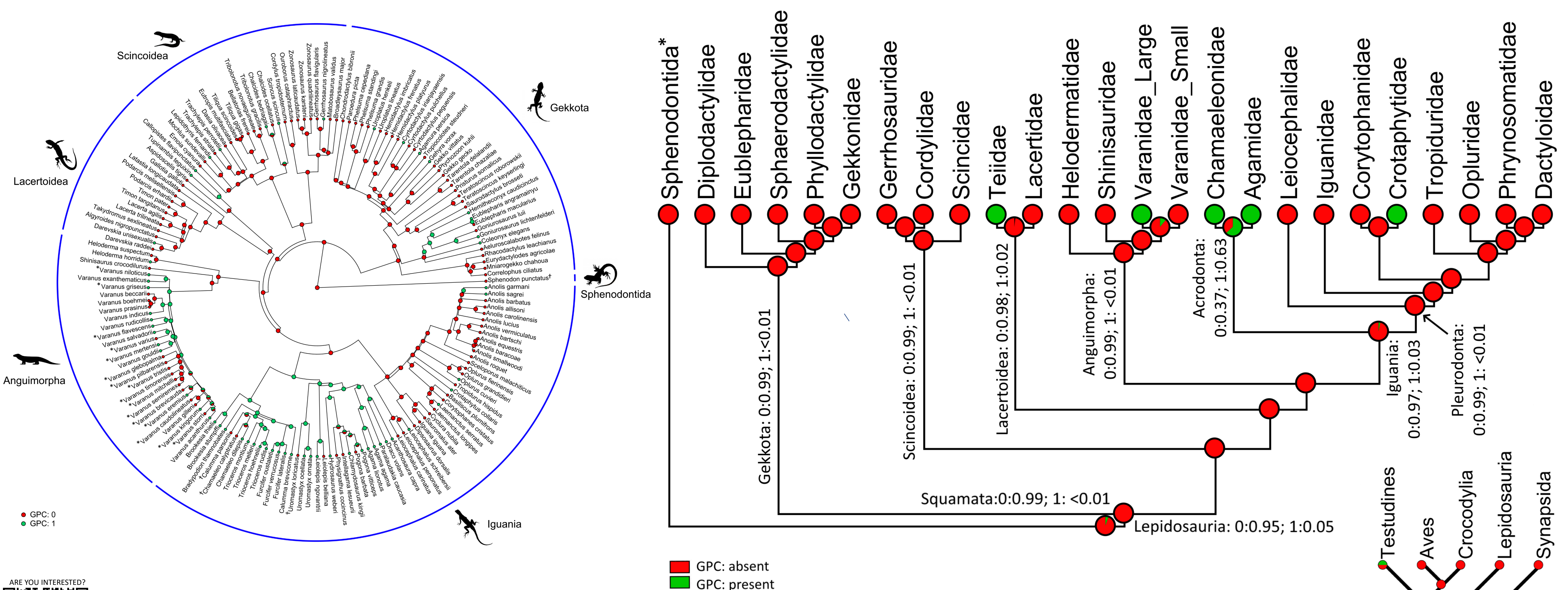
Material & Methods

- dataset of 164 species of squamate lizards
- X-ray micro-computed tomography (µCT) of femoral bones, visualization of epiphyseal growth plate cartilage (GPC)
- Categorization of species according to the GPC state as determinate or indeterminate growers
- Ancestral state reconstruction of growth type for families and higher clades

(a) (b) Epi Met Dia Sut 500 µm
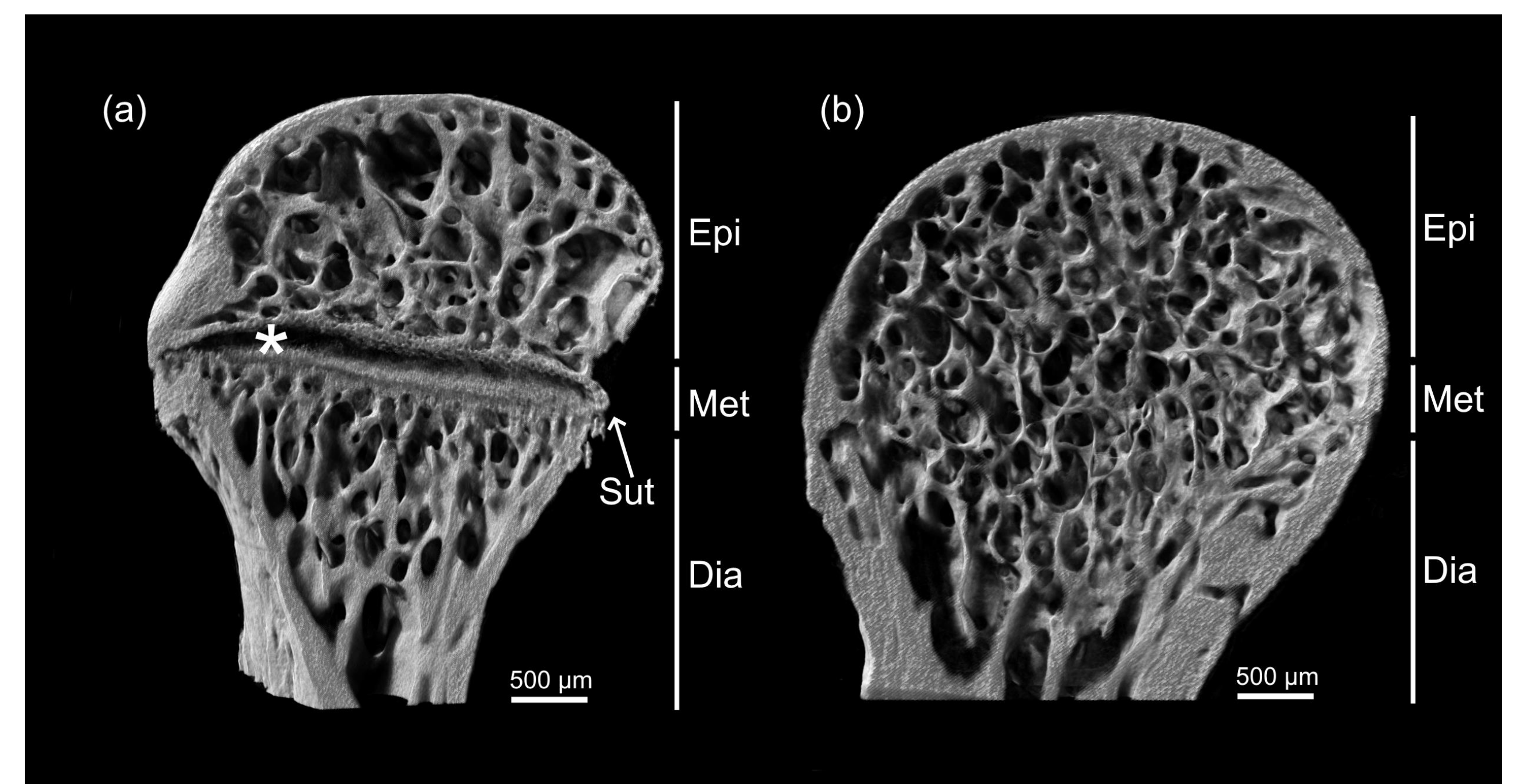
Frontal cross-section of the proximal part of the femur by µCT. The epiphyseal growth plate is present in a subadult (a) and absent in an adult of the Crested Gecko *Correlophus ciliatus* (b). Epiphysis (Epi), Metaphysis (Met), Diaphysis (Dia), Suture (Sut), Epiphyseal growth plate cartilage (asterisk).

Results

- Absence of GPC (indicating determinate body growth) was predominant pattern
- Determinate growth is ancestral for whole squamata
- Indeterminate growth is neither universal nor ancestral in lizards
- We can extend our conclusions to all lepidosauria or even diapsida
- Strong evidence that all ectothermic vertebrates are not indeterminate growers

Scincoidea
Gekkota
Lacertoidea
Sphenodontida
Anguimorpha
Iguania

GPC: 0
GPC: 1

ARE YOU INTERESTED?

Sphenodontida* · Diplodactylidae · Eublepharidae · Sphaerodactylidae · Phyllodactylidae · Gekkonidae · Gerrhosauridae · Cordylidae · Scincidae · Teiidae · Lacertidae · Helodermatidae · Shinisauridae · Varanidae_Large · Varanidae_Small · Chamaeleonidae · Agamidae · Leiocephalidae · Iguanidae · Corytophanidae · Crotaphytidae · Tropiduridae · Opluridae · Phrynosomatidae · Dactyloidae

Gekkota: 0:0.99; 1: <0.01
Scincoidea: 0:0.99; 1: <0.01
Lacertoidea: 0:0.98; 1:0.02
Anguimorpha: 0:0.99; 1: <0.01
Acrodonta: 0:0.37; 1:0.63
Iguania: 0:0.97; 1:0.03
Pleurodonta: 0:0.99; 1: <0.01
Squamata:0:0.99; 1: <0.01
Lepidosauria: 0:0.95; 1:0.05

GPC: absent
GPC: present

Testudines · Aves · Crocodylia · Lepidosauria · Synapsida

* data for tuataras and archosaurs from the literature