REGIONALIZATION IN THE LIZARD AXIAL COLUMN

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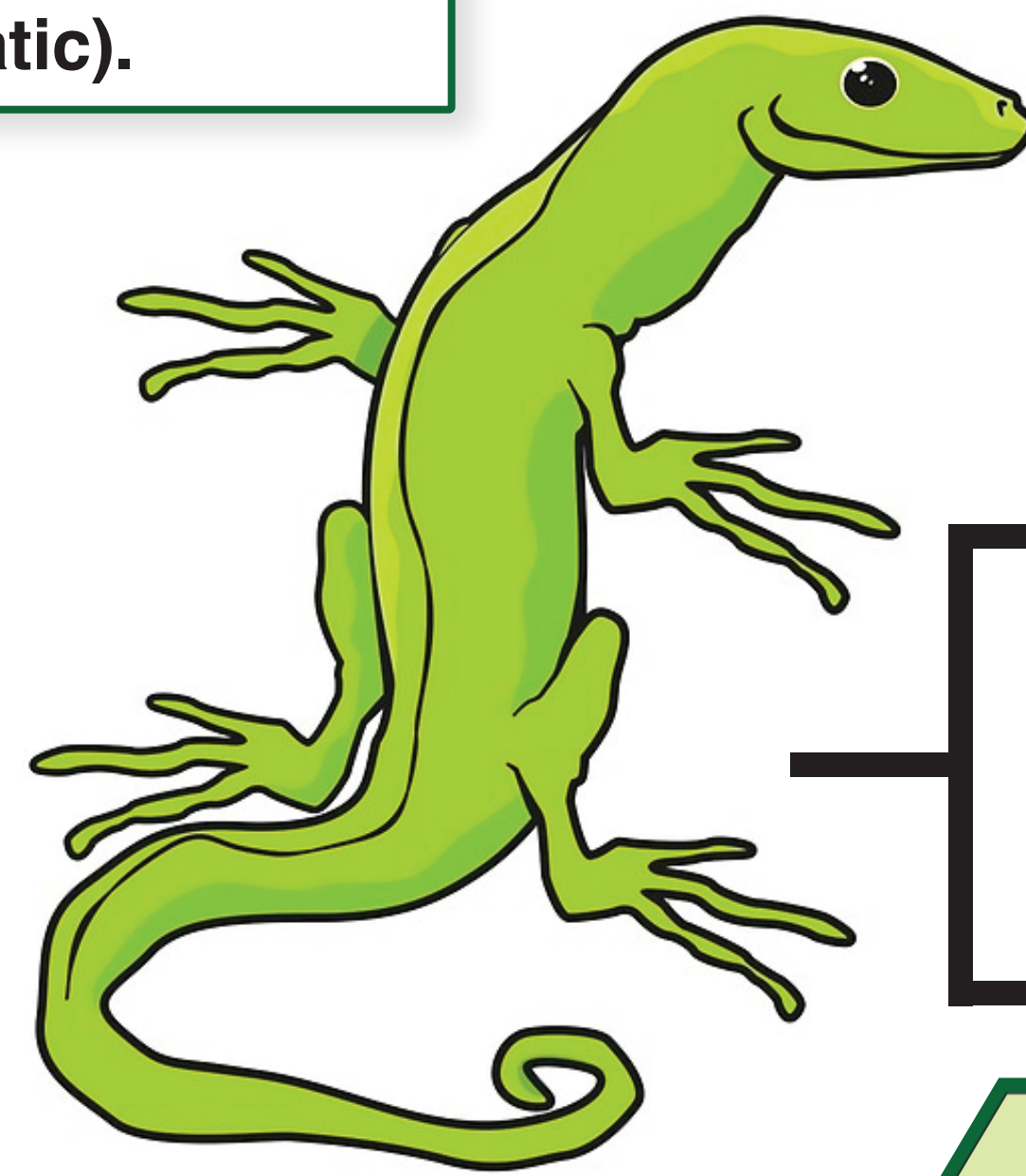[1]Stony Brook University, Stony Brook, NY 11974; [2]University of Manchester, Manchester, M13 9PL, UK
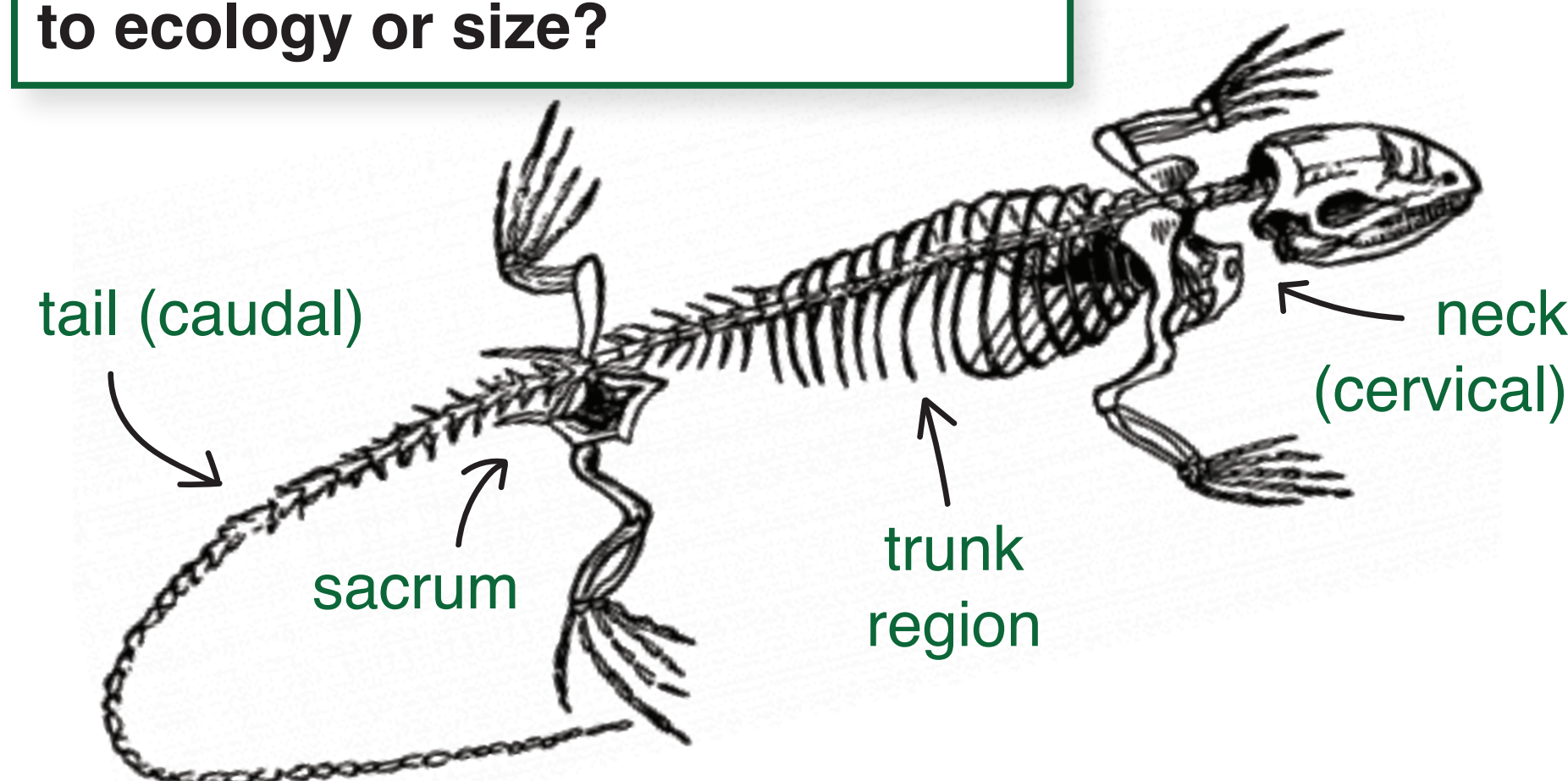
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INTRODUCTION

Lizard vertebral columns have four distinct regions (see below).

Living lizards exhibit a wide range of body sizes (e.g., 100 kg, 0.2 g) and ecologies (e.g., terrestrial, arboreal, aquatic).

Do lizards have more highly regionalized presacral columns than previously recognized and is pattern of regionalization related to ecology or size?

tail (caudal)
sacrum
trunk region
neck (cervical)

MATERIALS & METHODS

Varanus salvator dry-prepped skeleton (AMNH-R 49230)

microCT scanner at the American Museum of Natural History, New York, NY

Avizo (CT visualization and segmentation software)

GEOMETRIC MORPHOMETRICS

1: exported individual vertebrae from Avizo as .ply models

2: used IDAV Landmark Editor to place 24 fixed, Type I landmarks

3: landmarked .plys of all presacrals (except Atlas and Axis) for 10 lizard taxa

4: ran segmented regressions on shape data in R with "geomorph" and "regions"

IDAV visualization and graphics research group

RESULTS

BEST-FIT REGION MODELS RECOVERED FROM "REGIONS" SEGMENTED REGRESSION ANALYSES
black line indicates cervical-trunk boundary as reported in Biology of the Reptilia (Hoffstetter and Gasc, 1969)
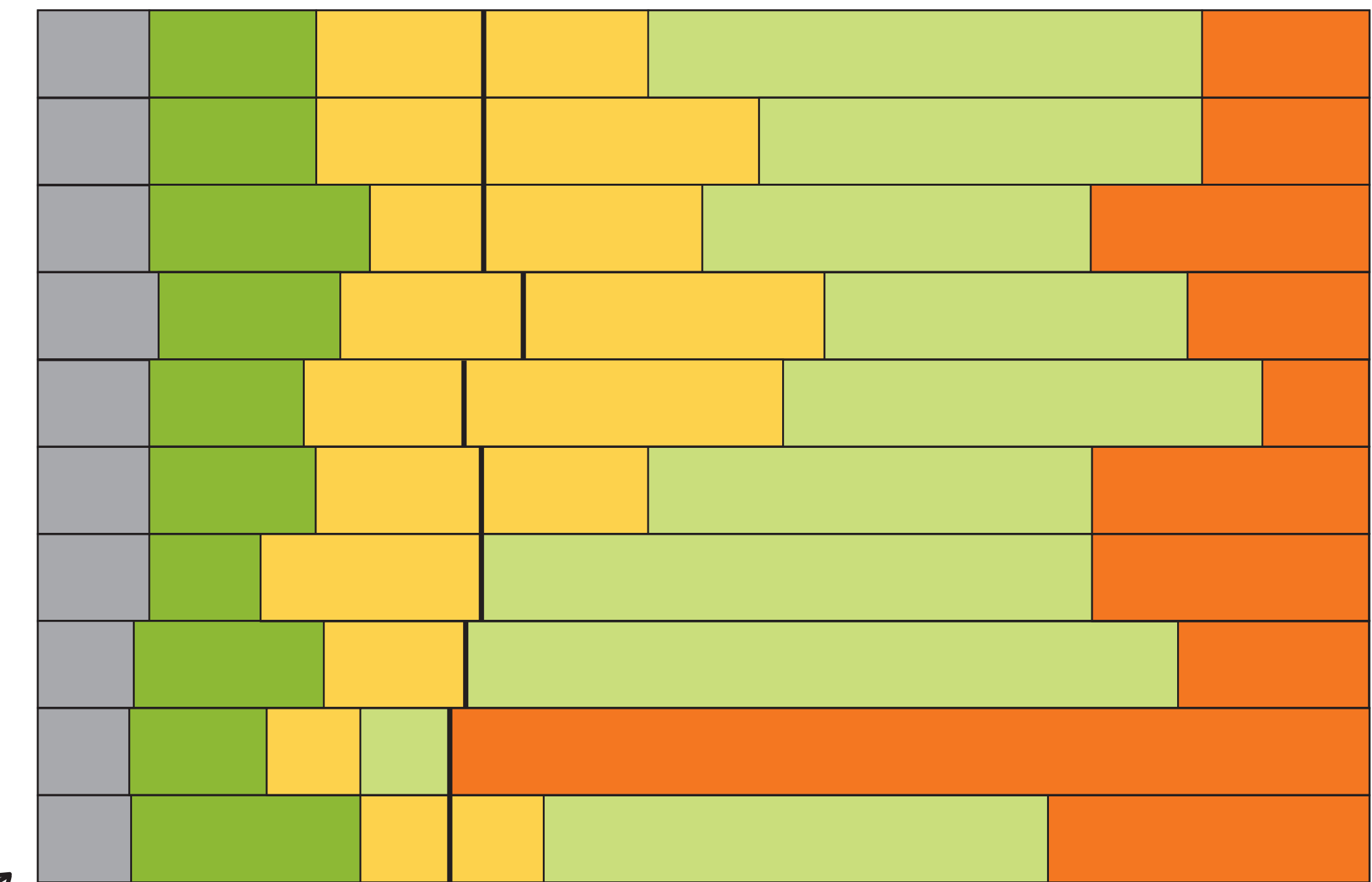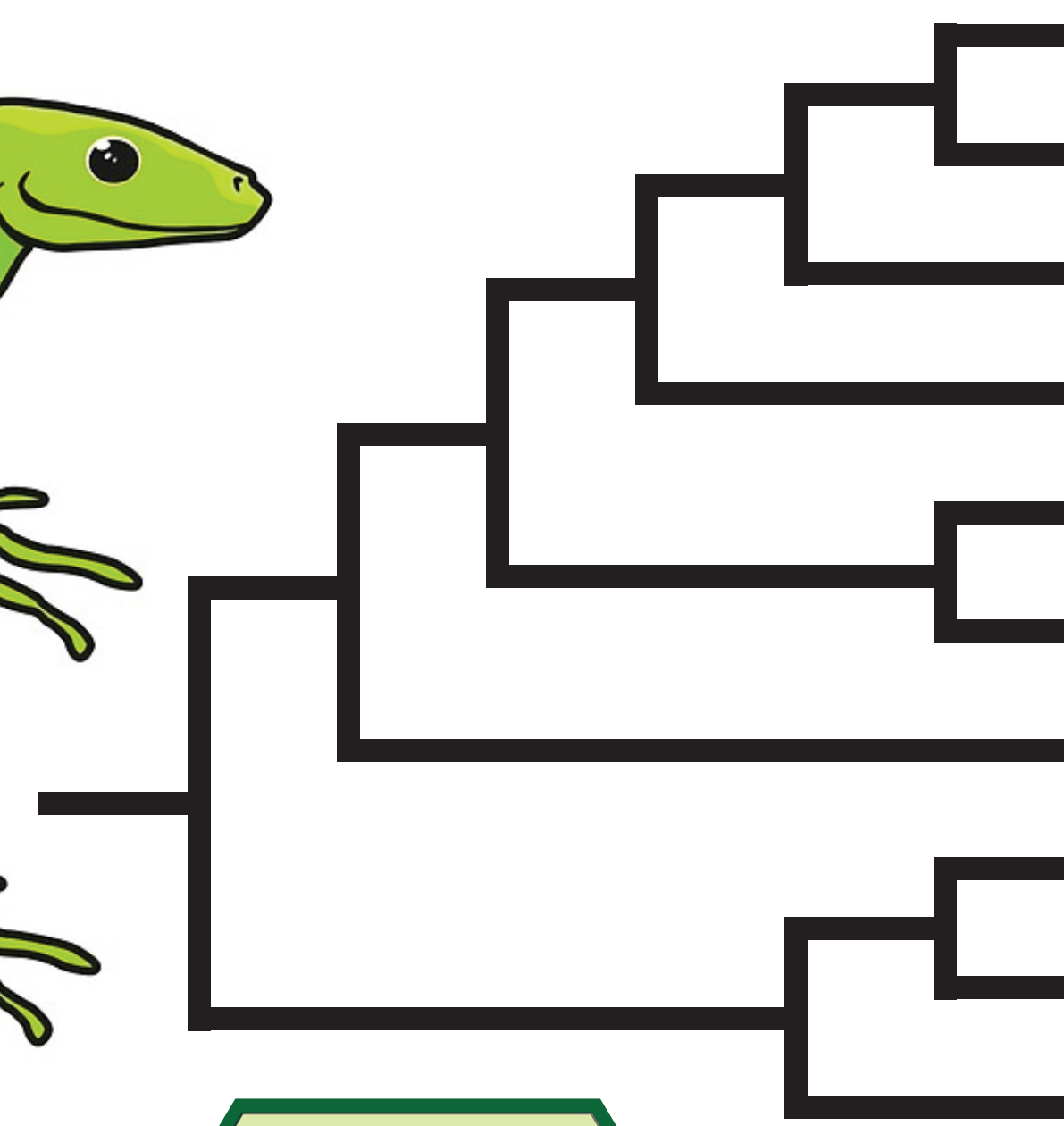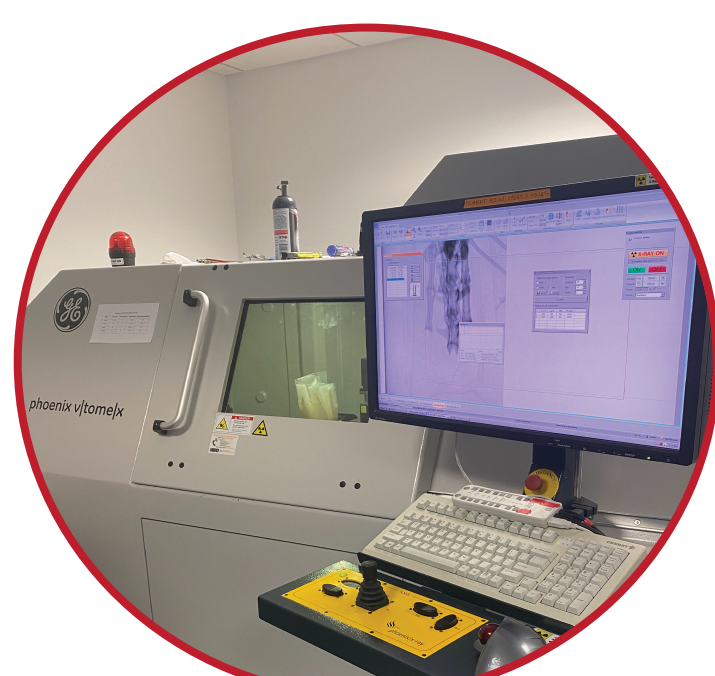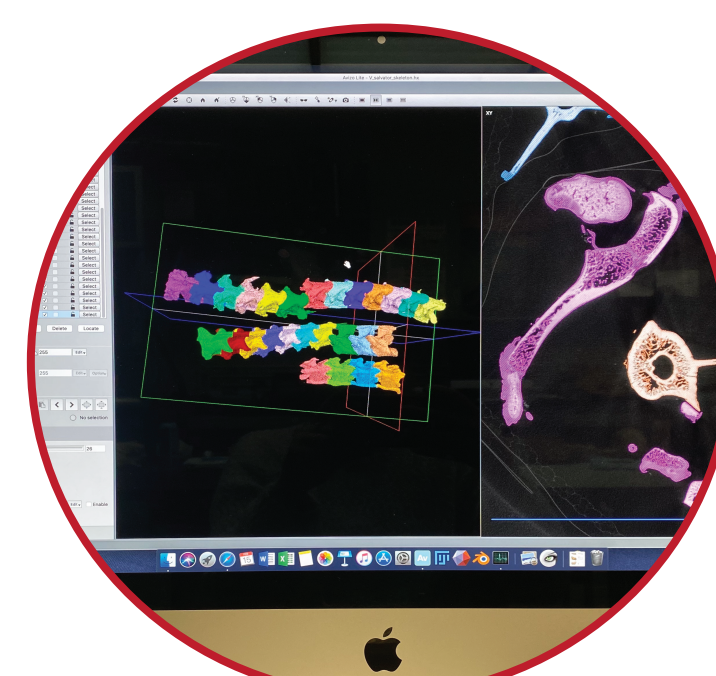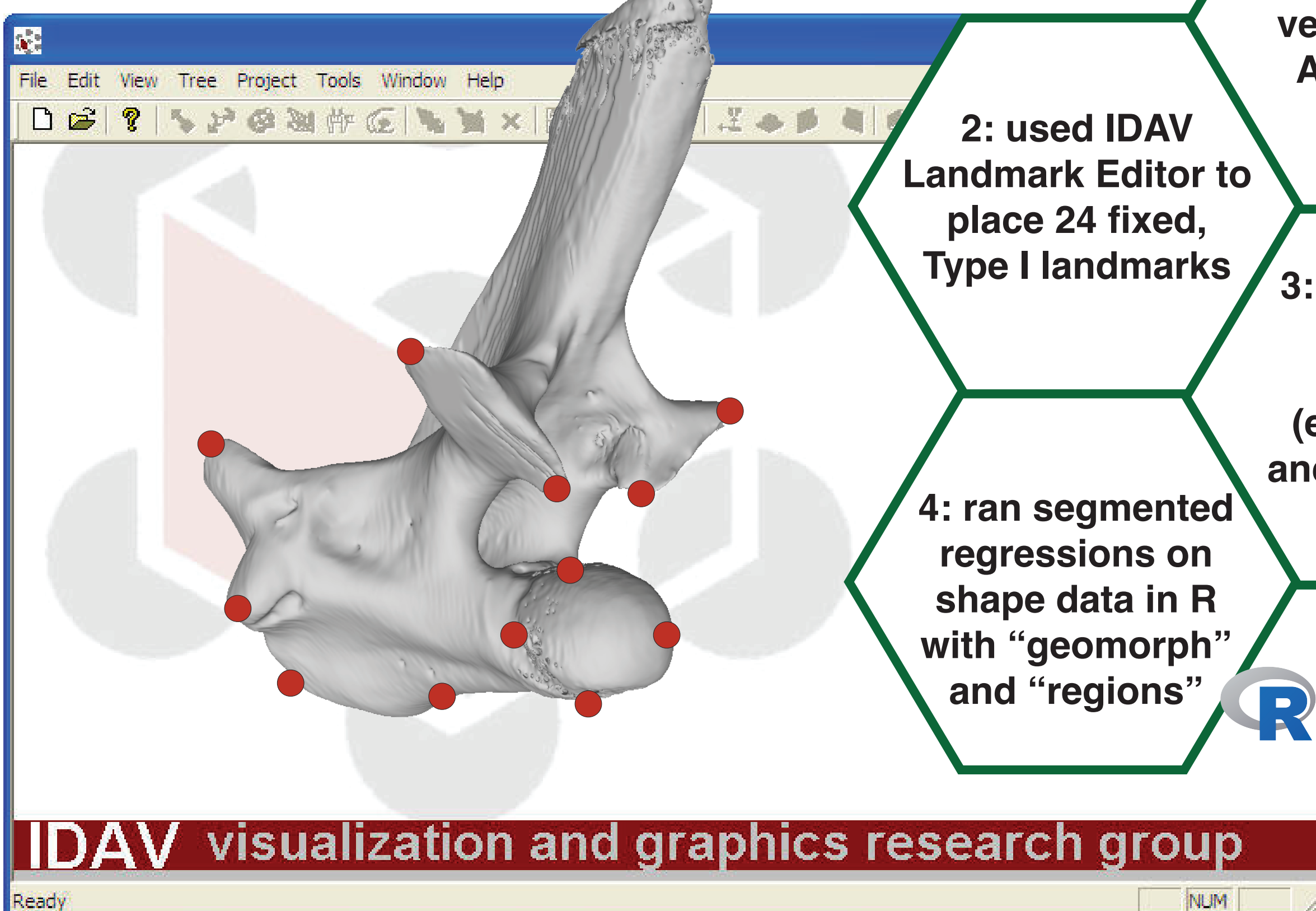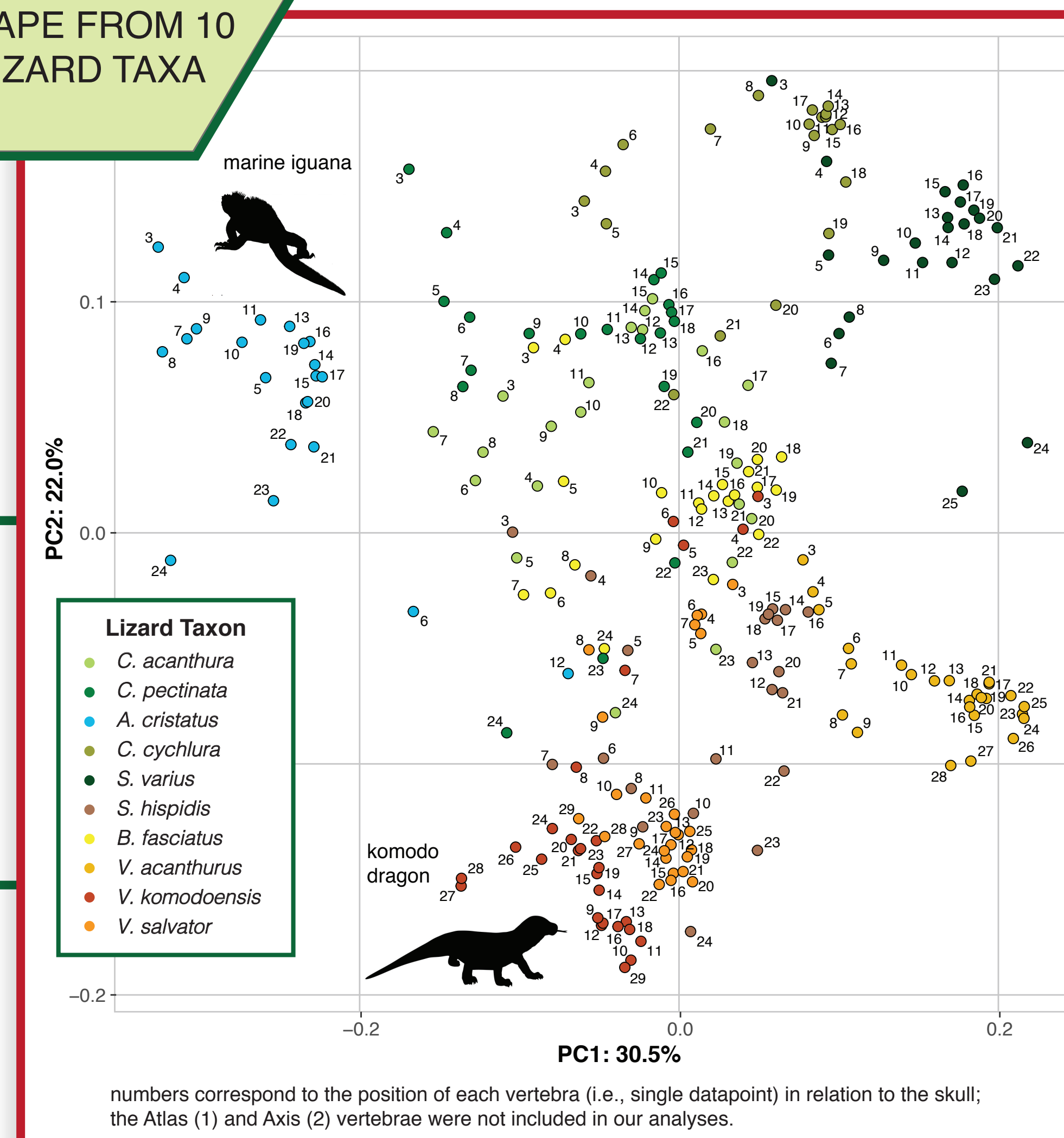
Region Score	PS count	Ecol.[+]	Taxon
3.99	24	Sx	C. acanthura
4.00	24	Sx	C. pectinata
3.99	24	Aq	A. cristatus
3.94	22	T	C. cychlura
3.99	25	Sx	S. varius
4.00	24	Sx	S. hispidis
3.99	24	Ab	B. fasciatus
4.00	28	Sx	V. acanthurus
3.99	29	T	V. komodoensis
4.00	29	Sa	V. salvator

IGUANIDAE
VARANIDAE

gray region = Atlas-Axis complex

percent of presacral vertebral column

0%   50%   100%

[+]Ecologies: Ab, arboreal; Aq, aquatic; Sa, Semi-aquatic; Sx, saxicolous; T, terrestrial

PCA PLOT OF PRESACRAL VERTEBRAL SHAPE FROM 10 LIZARD TAXA

marine iguana

komodo dragon

PC2: 22.0%
PC1: 30.5%

Lizard Taxon
- C. acanthura
- C. pectinata
- A. cristatus
- C. cychlura
- S. varius
- S. hispidis
- B. fasciatus
- V. acanthurus
- V. komodoensis
- V. salvator

numbers correspond to the position of each vertebra (i.e., single datapoint) in relation to the skull; the Atlas (1) and Axis (2) vertebrae were not included in our analyses.

Our segmented regressions favored a 4-region model for all 10 lizard species analyzed; however, the boundaries of the presacral regions we recovered varied.

The anterior cervical region varied the least in vertebral count and regionalization did not appear to be clearly tied to ecology.

DISCUSSION

The "cervical-trunk boundary" which is discernable using anatomical landmarks (e.g., cervical ribs, brachial plexus) is only recovered by our segmented regressions for *Brachylophus fasciatus*, *Varanus acanthurus*, and *Varanus komodoensis*.

The komodo dragon (*Varanus komodoensis*) has a highly regionalized anatomical neck, with three regions in addition to the Atlas-Axis complex, but a homogeneous trunk region, which may be related to its large size (100 kg) and terrestrial ecology.

The marine iguana (*Amblyrhynchus cristatus*) plots separately from the rest of the lizard taxa in PCA morphospace, which may be related to its fully aquatic ecology and swimming locomotion.

ACKNOWLEDGEMENTS

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