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Supplementary Materials for

Ossification patterns of the carpus and tarsus in salamanders and impacts of preaxial dominance on the fin-to-limb transition

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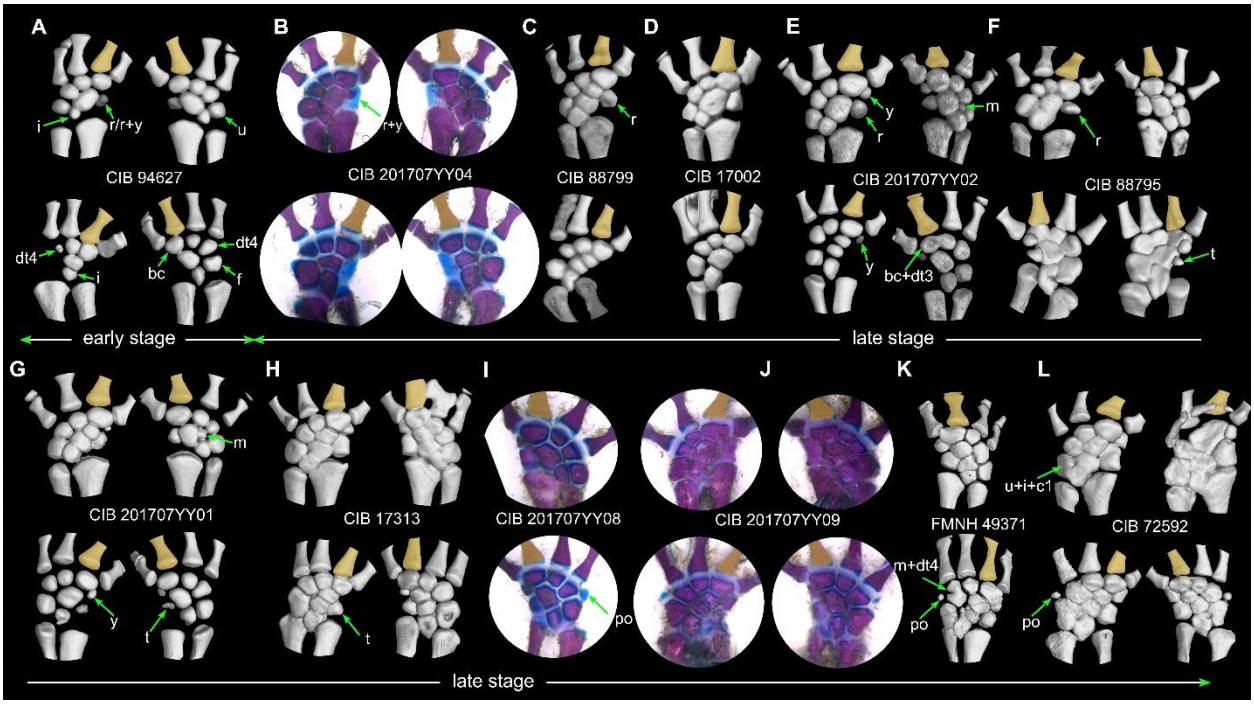

Fig. S1.

Morphology and ossification patterns of the carpals and tarsals in extant four-toed hynobiid *Batrachuperus yenyuanensis*. The manus (upper row) and pes (lower row) are arranged from left to right to show an increased ossification of the mesopodium (not to scale), and digit II is colored in gold to delineate the preaxial side. Most specimens (catalogue numbers located between carpus and tarsus) are shown in dorsal view except tarsus in CIB 88795 (**F**) and right-side carpus in CIB 72592 (**L**) are shown in ventral view to better visualize the mesopodials. Preaxial and postaxial dominance is present in the ossification of digital arch and non-digital-arch mesopodials, respectively. Proximal mesopodials ossify later than distal mesopodials in most specimens except the tibiale ossifies earlier than element y in CIB 17313 (**H**). Note the presence of an independent element m in the carpus (**E**, **G**) and an unfinished fusion (**K**) between element m and distal tarsal 4. Three specimens were cleared and double stained with cartilages stained in blue and bones in red. Carpus ossifies earlier than tarsus. See Fig. 2 for anatomical abbreviations and Data S1 for specimen details.

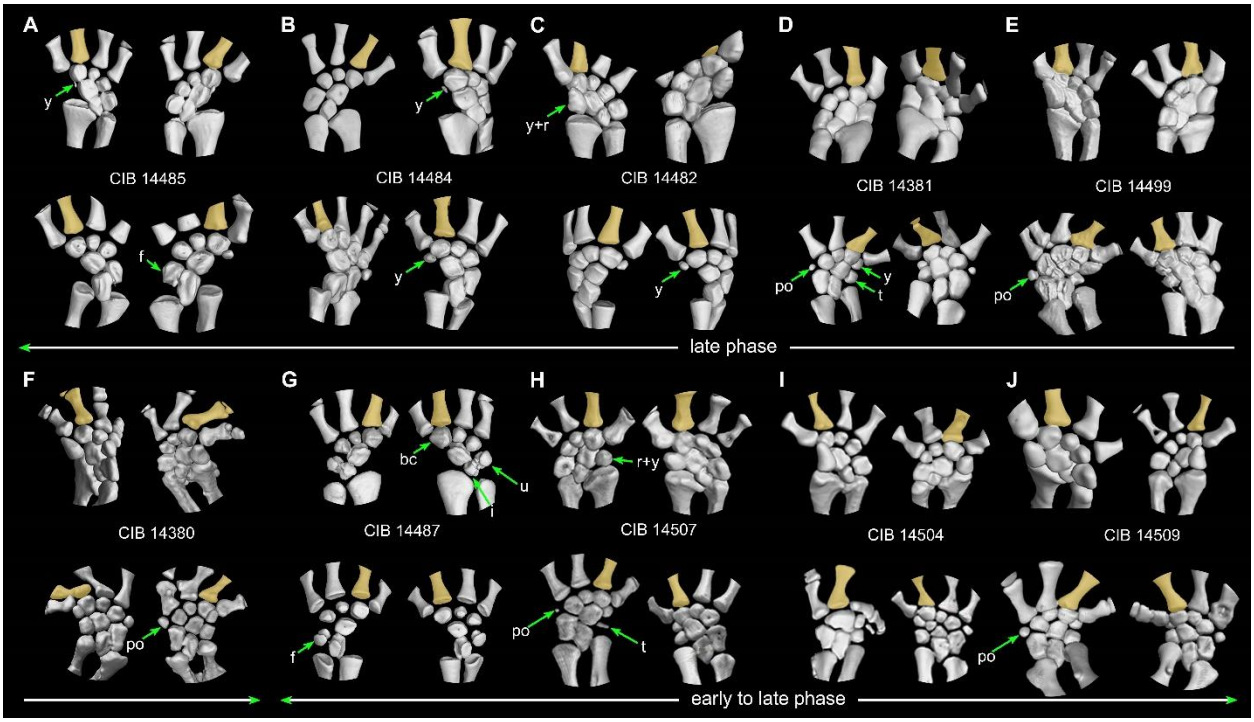

Fig. S2.

Morphology and ossification patterns of the carpals and tarsals in neotenic (A–F) and metamorphosed (G–J) four-toed hynobiid *Batrachuperus londongensis*. The manus (upper row) and pes (lower row) are arranged from left to right to show an increased ossification of the mesopodium (not to scale), with digit II colored in gold. Most specimens (catalogue numbers located between carpus and tarsus) are shown in dorsal view except carpus and tarsus in CIB 14485 (**A**) and CIB 14380 (**F**), left tarsus in CIB 14484 (**B**), and carpus of CIB 14482 (**C**), CIB 14499 (**E**), CIB 14507 (**H**), CIB 14504 (**I**), and CIB 14509 (**J**) are shown in ventral view to better visualize the mesopodials. The postminimus is the last to ossify in both neotenic and metamorphosed specimens. Ossification of non-digital-arch mesopodials is characterized by postaxial dominance. The relative weaker ossification of distal carpals/tarsals than basale commune in CIB 14487 (**G**) shows the presence of preaxial dominance in the ossification of the digital arch mesopodium. Carpus ossifies earlier than tarsus. See Fig. 2 for anatomical abbreviations and Data S1 for specimen details.

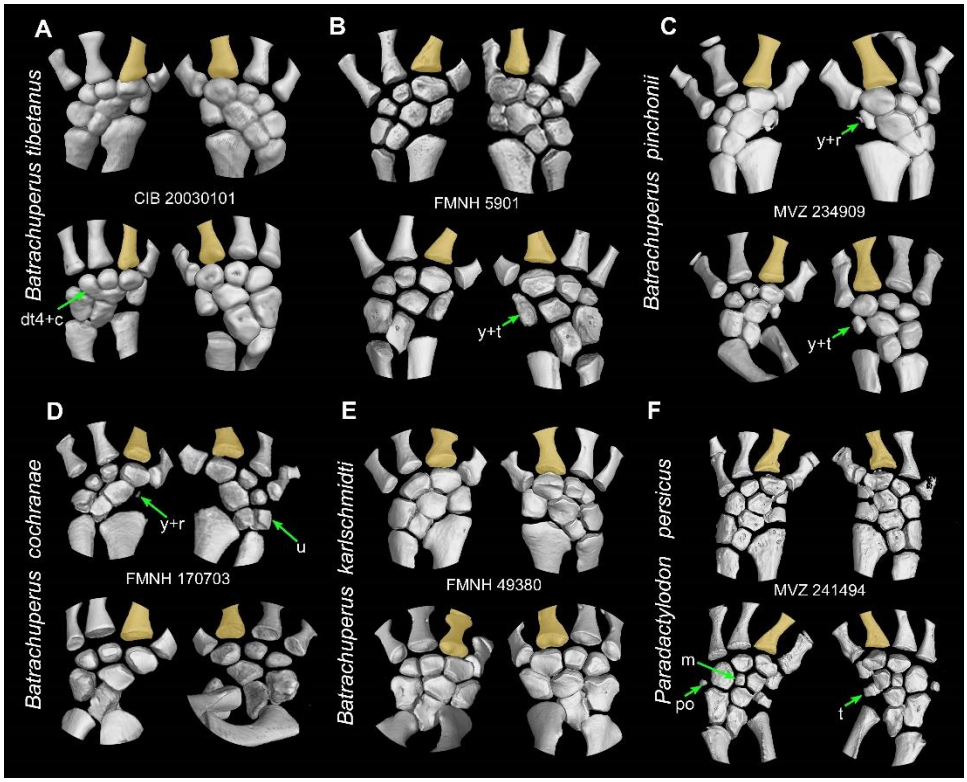

Fig. S3.

Morphology and ossification patterns of the carpals and tarsals in five species of the four-toed hynobiid genera *Batrachuperus* and *Paradactylodon*. (**A**, **B**) *Batrachuperus tibetanus*; (**C**) *Batrachuperus pinchonii*; (**D**) *Batrachuperus cochranae*; (**E**) *Batrachuperus karlschmidti*; (**F**) *Paradactylodon persicus*. Digit II is colored in gold to represent the preaxial side. The manus (upper row) and pes (lower row) in most specimens have a weak ossification in the preaxial column and demonstrate the presence of postaxial dominance in non-digital-arch mesopodium. The supernumerary element m is present in the tarsus of *Paradactylodon persicus* (**F**). All specimens are shown in dorsal view. Not to scale. See Fig. 2 for anatomical abbreviations and Data S1 for specimen details.

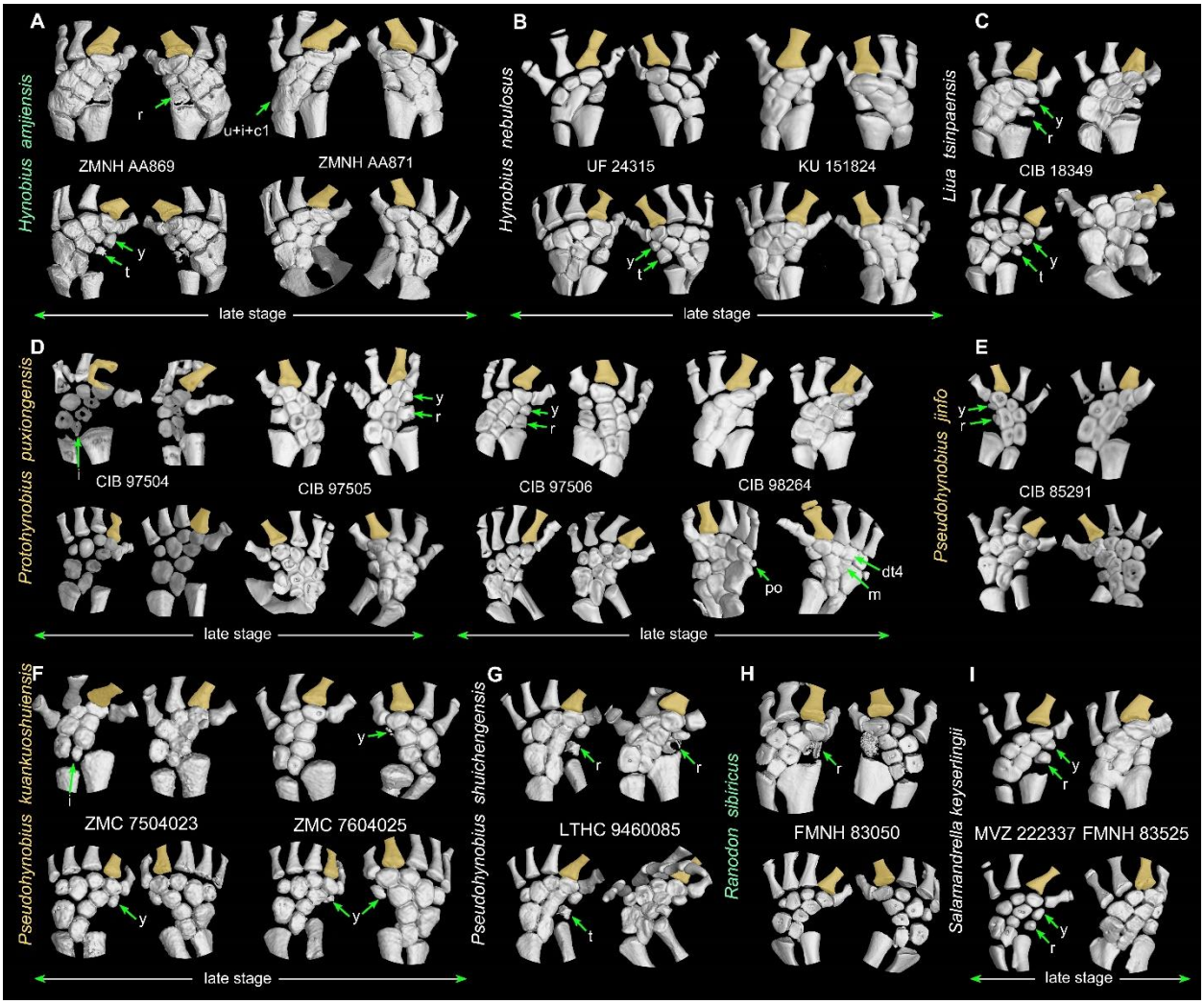

Fig. S4.

Morphology and ossification patterns of the carpals and tarsals in nine extant species of Panhynobia. Manus (upper row) and pes (lower row) are arranged from left to right for each species to reflect increased ossification of the mesopodium, and digit II is colored in gold to delineate the preaxial side. Most specimens (catalogue numbers located between carpus and tarsus) are shown in dorsal view except certain carpus and tarsus in CIB 18349 (**C**), CIB 97504-97506 (**D**), CIB 98264 (**D**), CIB 85291 (**E**), ZMC 7504023 (**F**), LTHC 9460085 (**G**) are shown in ventral view to better visualize the mesopodials. Postaxial dominance in non-digital-arch mesopodium are reflected by the weak ossifications of radiale/tibiale and element y in every species, and a distal-to-proximal ossification polarity is characterized by the earlier appearance or higher ossification extent of element y than radiale/tibiale in the preaxial column (**A**, **C**, **F**, **G**) and the weak ossification extent of intermedium in the central column (**D**, **F**). An independent element m is present in the tarsus of CIB 98264 of *Protohynobius puxiongensis* (**D**), in which distal tarsal 4 lacks a proximal extension into the central row of the tarsals. Species with names colored in green have carpus ossify earlier than tarsus, that in yellow have carpus ossify later than tarsus and that in white remains indistinguishable. Not to scale. See Fig. 2 for anatomical abbreviations and Data S1 for specimen details.

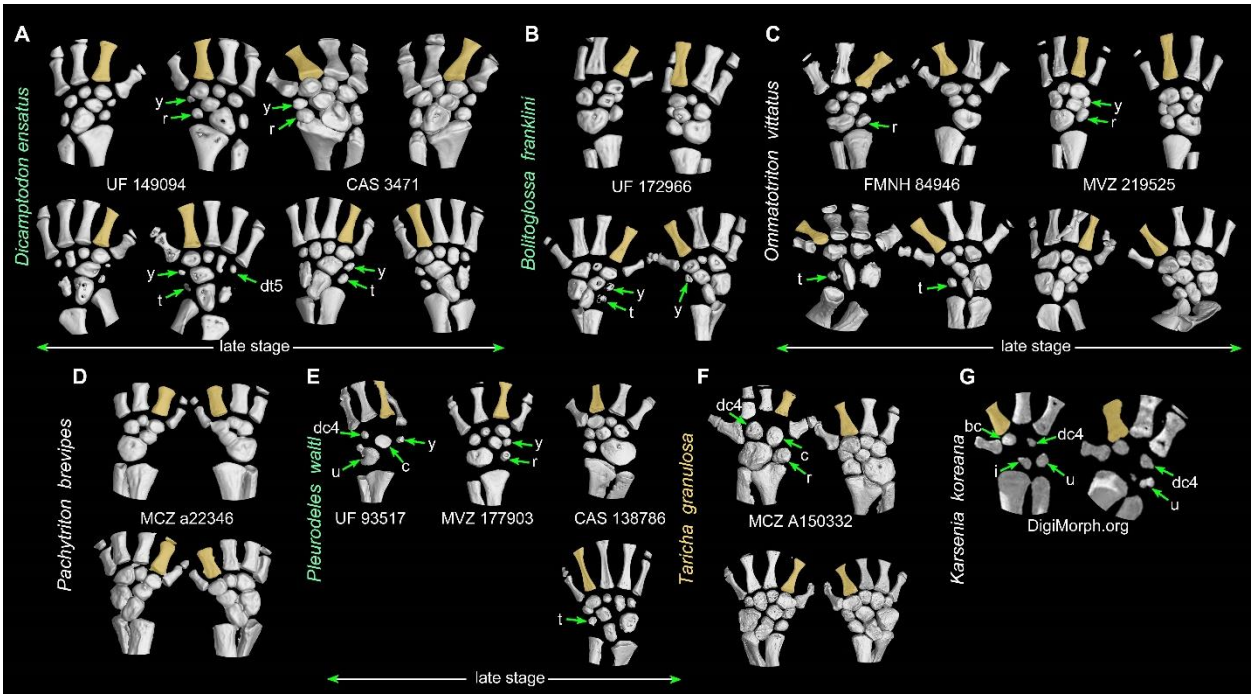

Fig. S5.

Morphology and ossification patterns of the carpals (upper row) and tarsals (lower row) in seven extant species in Dicamptodontidae (A), Plethodontidae (B, G), and Salamandridae (C–F). Digit II is colored in gold to represent the preaxial side of the limb. Most specimens (catalogue numbers located between carpus and tarsus) are shown in dorsal view except the left- and right-side carpus in CAS 3471 (**A**) and the left tarsus in FMNH 84946 (**C**) are shown in ventral view to better visualize the mesopodials. Postaxial dominance is present in the ossification of non-digital-arch mesopodials of all species, where element y and radiale/tibiale are weakly ossified or absent; and also exists in the ossification of digital arch mesopodium of *Bolitoglossa* (**B**), *Pleurodeles* (**E**) and *Taricha* (**F**) and *Karsenia* (**G**), in which distal carpal/tarsal 4 is the first to ossify (**E**, **F**) or has ossification extents higher than (**B**) or similar to (**G**) that of basale commune. Ossifications in the preaxial (**C**, **F**) and central (**E**, **G**) columns proceed from proximally to distally, and is reversed in the preaxial column of *Bolitoglossa* (**B**) and *Pleurodeles* (**E**). Species with names colored in green have carpus ossify earlier than tarsus, that in yellow have carpus ossify later than tarsus and that in white remains indistinguishable. Not to scale. See Fig. 2 for anatomical abbreviations and Data S1 for specimen details.

Data S1. (separate file)

Snout-pelvic length, life history strategy, ossification patterns of the mesopodium and CT scan parameters for specimens investigated in this study.

Data S2. (separate file)

Species investigated in this study and their taxonomy, life history strategy, larval type and ecological preference at adult stage out of breeding season.

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