Amphibians

1. The Appendicular Skeleton, By Kat Pawley
There has been much **debate** over the last two decades involving temnospondyls, concerning the origin of terrestrial vertebrates (summarized in Clack, 2002), the phylogenetic relationships of early tetrapods, and the origin of modern liss amphibians and amniotes. Page 561

2. Origin And Early Evolution Of The Amniotes, By David S Berman
Cladistic analyses of Paleozoic tetrapod relationships have yielded dramatically contradictory results (Gauthier et al., 1988; Carroll, 1995; Laurin and Reisz, 1995, 1997; Laurin, 1998), despite the use of similar computerized algorithms and extremely large data sets. Major sources of this problem, according to Carroll (1995), can be attributed to: 1) the lack of at least some data from all known taxa and 2) the lack of more information of more plesiomorphic members of recognized clades that are not known from their presumably earlier fossil record. Thus, if any of the recent cladistic analyses of late Paleozoic tetrapod relationships are used to construct a morphological series that traces the early evolutionary changes of a particular region of the tetrapod skeleton to its culmination in the amniote condition, the result is often, predictably, questionable. Page 938

Potentially important to the controversy of the phylogenetic position of the baphetids is the recent description by Lombard and Bolt (1995) of the Lower Carboniferous amphibian *Whatcheeria*, which in their phylogenetic scheme was placed tentatively as the first outgroup of the anthracosaurs. Page 952

With the additional consideration of the diadectomorphs, his phylogeny encountered further problems, and he was unable to resolve the relationships between the three taxa. The final solution was an unresolved trichotomy. Page 953

3. The Origin Of Terrestrial Vertebrates, By Robert L. Carroll
These events serve as informative models for the study of other major transitions and large scale radiations, but they also point to the problems of the incomplete nature of the fossil record and the difficulties of establishing relationships. It is especially difficult to classify early tetrapods because their origin and early radiation occurred within several distinct environments, having different likelihoods of preservation in the sedimentary record. Page 1202

Most Paleozoic labyrinthodonts belong to the Temnospondyli (Holmes, 2000). They appear to be monophyletic in origin, but their specific relationships to Upper Devonian or other Carboniferous labyrinthodonts remain uncertain. Page 1207

4. Phylogeny of Rhacophoridae, By Guohua Yu
The phylogenetic relationships among rhacophorid frogs are under dispute. Page 571

Although many studies of phylogeny based on morphological or molecular datasets have been reported for this rich and diverse group, and previous molecular studies have provided compelling evidence in support of the Buergeriinae–Rhacophorinae dichotomy among Rhacophoridae, the phylogenetic placement and taxonomy of some genera and species of Rhacophoridae are still under **debate**. Page 571

Additionally, these differences in the phylogenetic placement and validity of Feihyla make the phylogenetic placement of Chiromantis ambiguous. Page 571

Controversies on the phylogenetic placement of Aquixalus odontotarsus and the validity of genus Aquixalus are ongoing. Page 571

5. Australian Frog Genera Crinia, By Kathryn Read
This group has been the subject of a number of long-standing taxonomic and phylogenetic **debates. Page 294**
The biogeographic and taxonomic **debate**s have been so protracted largely due to the lack of a robust phylogeny covering all species able to test alternative taxonomic scenarios. Page 295

6. Origin of extant amphibians, By Diego San Mauro
One of the most hotly **debate**d topics in vertebrate evolution is the origin of extant amphibians (Lissamphibia). The recent contribution of molecular data is shedding new light on this **debate**, but many important questions still remain unresolved. Page 554

There are over 6500 species of extant amphibians distributed in all continents except Antarctica (AmphibiaWeb, 2010; Frost, 2009), and their origin and phylogenetic relationships (particularly those among the three orders) have long been hotly **debate**d (Carroll, 2009; Schoch and Milner, 2004). Page 554

Much has been written recently about the origin and possible ancestry of extant amphibians (Anderson et al., 2008; Carroll, 2007, 2009; Marjanovic´ and Laurin, 2008a, 2009; Ruta and Coates, 2007; Schoch and Milner, 2004; Vallin and Laurin, 2004), and this is still an ongoing **debate**. Page 558

All this may simply reflect the ongoing **debate** on the performance of relaxed clock molecular dating methods (Welch and Bromham, 2005), and how their estimates are affected by the different assumptions they make about rate change. Page 558

The Temnospondyli hypothesis has received the wider acceptance so far, but support for each of the three hypotheses differs greatly from study to study, and the issue is still hotly **debate**d. Page 559

Three main competing hypotheses have been proposed regarding the most plausible ‘candidate’ ancestor group of the extant amphibians. The first hypothesis suggests that the Temnospondyli are the closest relatives of the extant amphibians (Benton, 1990; Bolt, 1991; Milner, 1988; Panchen and Smithson, 1987; Ruta et al., 2003; Trueb and Cloutier, 1991a). A second hypothesis suggests instead that the Lepospondyli are the closest relatives of extant amphibians (Laurin, 1998; Laurin and Reisz, 1997; Marjanovic and Laurin, 2008a, 2009; Vallin and Laurin, 2004). The third hypothesis proposes a polyphyletic nature of extant amphibians (with respect to major Paleozoic amphibian lineages), with frogs and salamanders arising among temnospondyls and caecilians among lepospondyls (Anderson, 2008; Anderson et al., 2008; Carroll, 2001, 2007; Carroll et al., 2004). The Temnospondyli hypothesis has received the wider acceptance so far, but support for each of the three hypotheses differs greatly from study to study, and the issue is still hotly **debate**d. Page 559

7. A mitogenomic perspective, By Peng Zhang
For example, the largest family of caecilians, the Caeciliidae, which includes 101 of the 176 currently recognized species (AmphibiaWeb, 2009), is probably paraphyletic with respect to the Typhlonectidae and possibly the Scolecomorphidae and the interrelationships of its constituent genera are still under **debate** (Wilkinson et al., 2003; Wake et al., 2005; Frost et al., 2006; Roelants et al., 2007; Loader et al., 2007, and see below). More uncertain is the position of the Scolecomorphidae, which might be either the sister group of Caeciliidae plus Typhlonectidae (Wilkinson and Nussbaum, 1996; Roelants et al., 2007) or within Caeciliidae (Wilkinson et al., 2003; Frost et al., 2006). Page 480

8. Gene and species trees, By Tuliana O. Brunes
Mitochondrial and nuclear DNA phylogenies were not completely concordant. Page 1125

Phylogenetic analyses of mtDNA ND2 showed five main clades with high support but with their relationships unresolved. Page 1126

This would also explain the lack of resolution to infer phylogenetic relationships among these three species. Page 1128

9. Higher-level salamander relationships, By Peng Zhang
Phylogenetic relationships among the salamander families have been difficult to resolve, largely because the window of time in which major lineages diverged was very short relative to the subsequently long evolutionary history of each family. Page 492

There is a lack of consensus regarding family-level phylogenetic relationships for living salamanders. Page 492

10. DNA markers in midwife toads, By H. Goncalves
One case that exemplifies this problem is the long-standing **debate** on the phylogeny of midwife toads. Page 494

11. Phylogenetic relationships of Pelobatoidea, By Mario Garcıa-Parıs
Elucidating the phylogenetic relationships of basal anurans has proved difficult using either morphological or molecular data sets (Ford and Cannatella, 1993; Hay et al., 1995). The most recent morphological (Ford and

Cannatella, 1993; Gao and Wang, 2001) and molecular (Hay et al., 1995; Ruvinsky and Maxon, 1996) hypotheses of relationships for the Anura deeply disagree in the position of Pelobatidae. Page 12

Both rooting strategies allowed the positions of the other outgroup species, particularly Xenopus, to remain free with respect to the ingroup, since the interrelationships among Pelobatoidea and Pipoidea are subject of **debate** (Ford and Cannatella, 1993; Gao and Wang, 2001; Hay et al., 1995; Ro_cek, 1980). Page 13

Relationships among species of Pelobates have been extensively **debate**d (Barbadillo et al., 1997; Busack et al., 1985; Cannatella, 1985; Estes, 1970; Gislen, 1936; Lathrop, 1997).None of these hypotheses was fully resolved, except that of Barbadillo et al.(1997), which used osteological characters and genetic data. Page 19

12. Malagasy poison frog, By Atsushi Kurabayashi

The phylogenetic relationships within the family Mantellidae have been a subject of **debate** for the past few decades with all genera recently allocated to this family often considered members of the family Ranidae (true frogs) or Rhacophoridae (Asian tree frogs) (reviewed by Vences and Glaw, 2001). The phylogenetic affinity of the genera Mantella and Mantidactylus with ranids or rhacophorids is also controversial due to their unique combination of morphological characters; for example, the femoral gland in Mantella and Mantidactylus is also sometimes found in some ranids, while some features of the tarsal elements are also found in both ranids and rhacophorids (e.g., Wilkinson et al., 2002). Page 230

13. Molecular clocks, By Michael S. Y. Lee

However, the more precise affinities of lissamphibians remain contentious. The three hypotheses with most current support (reviewed in detail by Schoch and Milner, 2004) are discussed below, along with their implications for divergence dates. Page 635

14. Stream-dwelling frog, By Ivan C. Phillipsen

The ability of NCPA to uncover true evolutionary patterns has been **debate**d recently (Knowles, 2008; Templeton, 2009). The main argument against NCPA is that in simulation studies a high proportion of NCPA inferences are actually “false positives” (Knowles, 2008). Page 157

Given the ongoing **debate** over NCPA, we include it here not as a stand-alone analysis, but to provide additional support for inferences made using phylogenetic and population genetic analyses. Page 157

15. High Andean tree frog, By Carlos E. Guarnizo

It still under **debate**, however, exactly when most of the tremendous diversification of the Northern Andes occurred (Roy et al., 1997; García-Moreno et al., 1999; Chesser, 2000; Koscinski et al., 2008; Rull, 2006). Page 89

16. Amazonian poison frogs, By R. Symula

The Refuge Hypothesis has been investigated by a number of researchers and has been the focus of considerable **debate** (Brown, 1982; Froehlich et al., 1991; Nores, 1999; Prance, 1982; Prance, 1973; Rasanen et al., 1991; Vanzolini, 1970). Pager 455

17. Evolution of bell frogs, By Emma L. Burns

The time of divergence of the eastern and western bell frog groups has been a matter for **debate**. Page 577

18. Hox genes in amphibians, By An Mannaert

At present, the origin of these clusters, either by whole-genome duplications or by cluster duplications, is still the subject of **debate** (reviewed by Wolfe, 2001). Page 449, 450

19. Peruvian poison frogs, By Jennifer L. Roberts

The Amazon basin is a region of unparalleled biodiversity, the origin of which has been a subject of continuing **debate**. Page 149

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