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Palaeontology

From *Potanichthys* to *Wushaichthys*:
resolving the evolutionary origin
and reproductive strategy of the
Thoracopteridae: a reply to Tintori (2015)Guang-Hui Xu¹ and Li-Jun Zhao²

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Our recent studies on *Potanichthys* [1] and *Wushaichthys* [2] from China shed new light on the evolutionary origin and reproductive strategy of the Thoracopteridae. Tintori commented on our taxonomic assignment of *Wushaichthys* and on our hypotheses of gradual evolution of over-water gliding adaption and internal fertilization of thoracopterids [3–5]. Moreover, he questioned the provenance and age of *Potanichthys* [1] and *Wushaichthys* [2], and claimed that *Potanichthys xingyiensis* was a younger synonym of *Thoracopterus wushaensis* [5]. However, we do not agree with him on these points because Tintori's commentary is not based on a phylogenetic analysis and lacks supportive evidence.

The taxonomy should be based on the results of phylogenetic analysis, not the reverse. Our phylogenetic studies [2] indicate that the traditional, poorly defined family Peltopleuridae is paraphyletic; the previously alleged 'peltopleurid' *Peripeltopleurus* [6] and the recently described *Wushaichthys* [2] are more closely related to four-winged thoracopterids than to *Peltopleurus* because they possess ambiguous features of Thoracopteridae. We have summarized five synapomorphies of Thoracopteridae in our recent contribution [2], and *Wushaichthys* is recovered as the most basal member of this family (figure 1a). The diagnosis of *Wushaichthys* starts from 'a basal thoracopterid distinguished from others of this family' [2, p. 2]. That means the genus should first possess five synapomorphies of Thoracopteridae. The additional features listed in the diagnosis are enough to distinguish *Wushaichthys* from others of this family. Additionally, our phylogenetic studies suggest that *Potanichthys* [1] and *Gigantopterus* [3] are more derived than *Thoracopterus* [3] in having an almost naked body, median and fused premaxillae, and more than one supraorbitals. Thus, *Potanichthys* and *Gigantopterus* are not synonyms of *Thoracopterus*.

Uniformitarianism, the concept that the present is the key to the past, has been recognized as a principle of geology and virtually all fields of science [7]. Under this concept, the differentiation of phenotypic traits in thoracopterids and peltopleurids has been interpreted as sexual dimorphism; those individuals with hooklets (claws) on the anal fin are supposed males and those without hooklets females [2,6]. Analogous to that in modern viviparous teleosts [8], the specialized anal fin in supposed males of thoracopterids and peltopleurids might function as a gonopodium and play an important role in sperm transfer, and consequently indicate a reproductive strategy of internal fertilization in these extinct taxa. Tintori's interpretation [5] of those thoracopterid individuals with hooklets on anal fin as females contrasts the condition observed in living fishes and, therefore, violates the concept of uniformitarianism, and his comment on our hypothesis of internal fertilization in thoracopterids lacks the support of evidence.

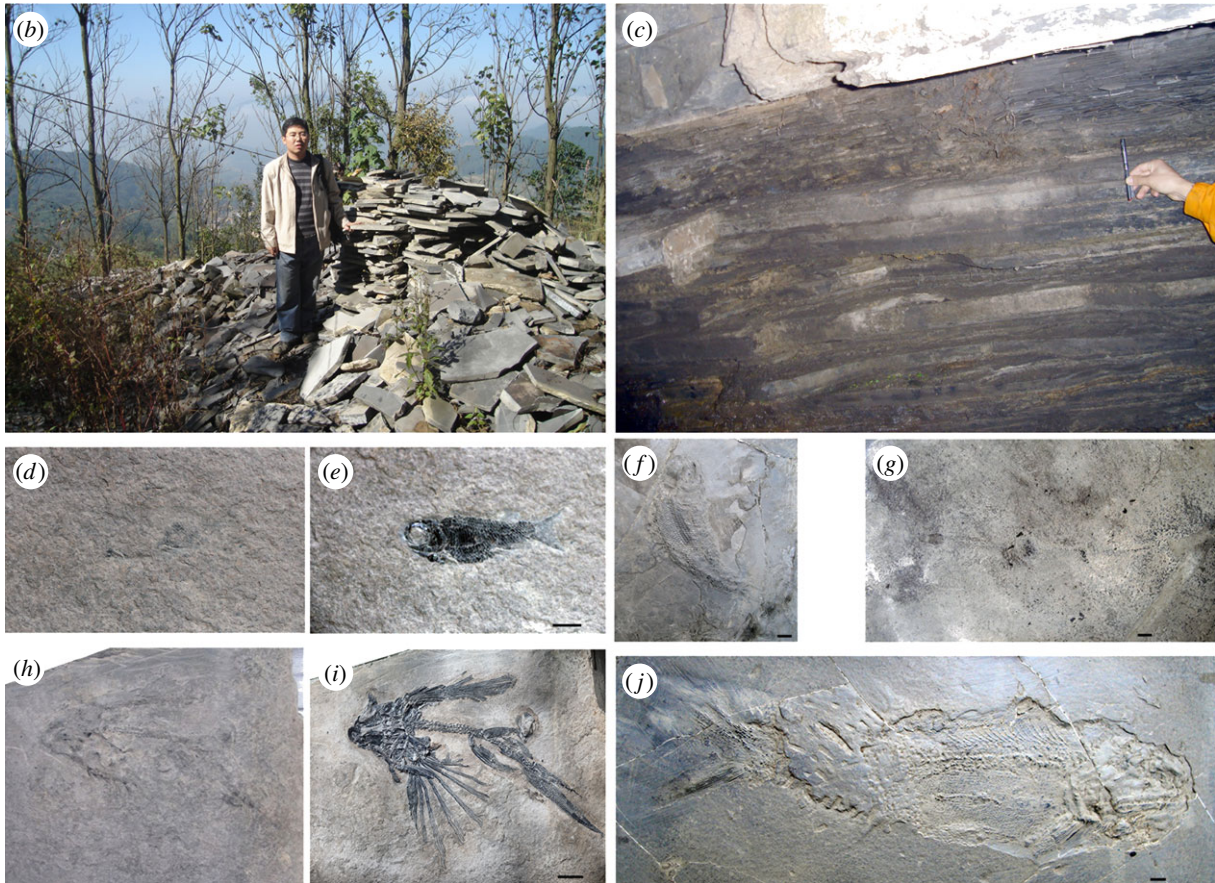
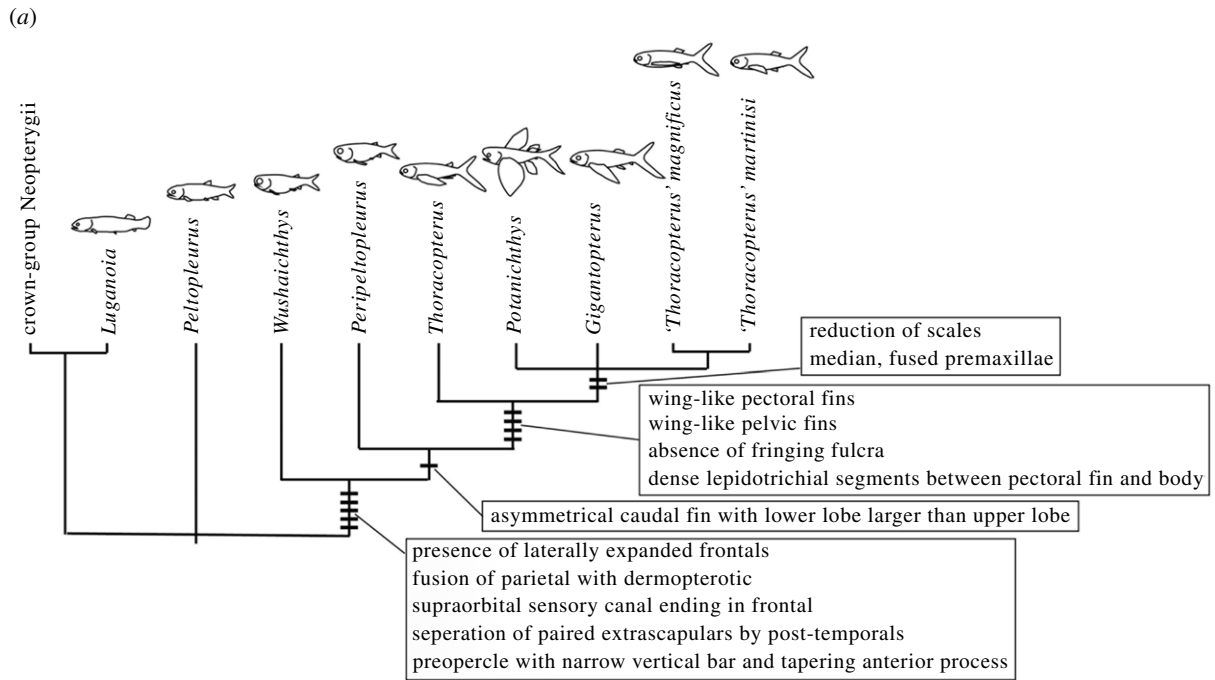


Figure 1. Cladogram showing phylogenetic relationships of Thoracopecterae and fieldwork at Xiemi locality. (a) Cladogram (adapted from Xu *et al.* [2]); (b) photo showing Xu's fieldwork at Xiemi locality; (c) fossil beds at Xiemi locality; holotype of *Wushaichthys exquisitus* before (d) and after (e) preparation; (f,g,j) unprepared specimens collected at Xiemi locality; (f) *Asialepidotus*; (g) *Keichousaurus*; (j) *Guizhoumiscus*; holotype of *Potanichthys xingyiensis* before (h) and after (i) preparation. Scale bars, 10 mm. (Online version in colour.)

The fossil beds (Zhuganpo Member of Falang Formation) of the Middle Triassic (Ladinian) Xingyi Biota are widely exposed in Wusha, Xingyi, Guizhou Province [9], and fossil collections at this area have a long history. Holotypes of *Potanichthys* and *Wushaichthys* (figure 1d,e,h,i) were collected at Xiemi locality in 2009, and were prepared at Xu's laboratory

by G-H Xu and his colleague Z Wang. Along with *Potanichthys* and *Wushaichthys*, other fossils collected at Xiemi locality at least include ray-finned fishes *Asialepidotus* (figure 1f) and *Guizhoumiscus* (figure 1j), and marine reptile *Keichousaurus* (figure 1g); all these taxa are characteristic members of the Xingyi Biota [9]. The Nimaigu locality mentioned by Tintori

is one of recently discovered localities in Xingyi area. It is about 5 km northeast of Xiemi locality, and large-scale fossil collections at this locality start from 2011.

Based on several specimens collected from Nimaigu locality, Tintori *et al.* [5] described a flying fish similar to *P. xingyiensis* (namely *T. wushaensis*) in *Gortania*. Although we note that the cited publication date of Tintori *et al.*'s article [5] is 29 October 2012 (2 days before the online publication of Xu *et al.* [1]), we also note that *Gortania* might be less accessible (as it is a print-only journal that publishes once each year

and is not indexed on common bibliographic databases) and perhaps less well known than several other journals that publish articles on palaeontology. As our paper was rapidly cited in other studies [9–11], it appears that our descriptions and naming of these fossils [1] have been generally accepted by the palaeontological community.

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