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

1Key Laboratory of Vertebrate Evolution and Human Origins of Chinese Academy of Sciences, Institute of Vertebrate Paleontology and Paleoanthropology, Chinese Academy of Sciences, Beijing 100044, People's Republic of China
2Zhejiang Museum of Natural History, Hangzhou, Zhejiang 310014, People's Republic of China

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 supraorbital. 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.

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Author for correspondence:
Guang-Hui Xu
e-mail: xuguanghui@ivpp.ac.cn

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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 Guizhouniscus (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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### References

5. Tintori A et al. 2012 A new ‘flying’ fish from the late Ladinian (Middle Triassic) of Wusha (Guizhou Province, southern China). *Gortania* 33, 39 – 50.