



## Validation of the South Asian cichlid genus *Pseudetroplus* Bleeker (Pisces: Cichlidae)

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### Abstract

The South Asian Cichlidae are composed of two clades that together represent the sister group of the Madagascan genus *Paretroplus* Bleeker. *Chaetodon suratensis* Bloch and *Eetroplus canarensis* Day are retained in *Eetroplus* Cuvier, while *Chaetodon maculatus* Bloch is allocated to *Pseudetroplus* Bleeker. *Pseudetroplus* is distinguished from *Eetroplus* in having, among other characters, 11 (vs. 12–13) pleural ribs; 26–27 (vs. 28–29) vertebrae; the anterior half of the median suture between the lower pharyngeal jaw serrated (vs. smooth); the first 6 anal-fin pterygiophores arranged anterior to the first 3 (vs. 2) haemal spines; the supraoccipital-exoccipital prong extending ventrally about half-way across the foramen magnum (vs. not extending into the foramen magnum); and the anterior jaw teeth tricuspid, acuminate (vs. unicuspid, spatulate). *Microgaster* Swainson is a synonym of *Pseudetroplus* and a junior homonym of *Microgaster* Latreille in Hymenoptera.

**Key words:** *Eetroplus*, India, Sri Lanka, chromide, *Microgaster*

### Introduction

South Asian cichlids represent an interesting example of transoceanic Gondwanan vicariance (Sparks & Smith 2005; see also Friedman *et al.* 2013). Three species have hitherto been recognized: *Eetroplus suratensis* (Bloch, 1790; type species of *Eetroplus* Cuvier, in Cuvier & Valenciennes, 1830: 486), *E. maculatus* (Bloch, 1795) and *E. canarensis* Day, 1877. The former two species occur in the lowlands of Sri Lanka and southern peninsular India, whereas the third is restricted to the Netravati River in Karnataka State, India.

Recent morphological and molecular analyses (e.g., Zardoya *et al.* 1996; Farias *et al.* 1999, 2000; Stiassny *et al.* 2001; Sparks, 2004; Sparks & Smith 2004; Sparks 2008) show *Eetroplus* to be monophyletic and the sister group of the endemic Madagascan genus *Paretroplus*. *Eetroplus* s.l. differs from *Paretroplus* principally by having the lateral oral dentition tricuspid (vs. unicuspid, spatulate in *Paretroplus*), multiple rows of teeth on both jaws (vs. a single row on each jaw), infraorbital 2 not enlarged (i.e., “a single lachrymal plate” (Sparks, 2008), vs. enlarged, complementing the lachrymal); and an asymmetrical displacement of the first anal-fin pterygiophore behind, and the second anal-fin pterygiophore in front of, the haemal-spine complex.

Sparks (2008) showed also that *E. suratensis* and *E. canarensis* form a monophyletic assemblage to which *E. maculatus* is recovered as the sister group, adults of the former clade differing from those of the latter in possessing a blunt snout with a steeply sloping profile (vs. snout profile markedly acute in *E. maculatus*); seven to nine prominent dark lateral bars (vs. an absence of bars but the presence of one or more black blotches) on the side of the body; and a prominent black patch on the pectoral fin, near its base (vs. pectoral fin hyaline).

Indeed, Bleeker (1862: 125), recognizing a higher-level distinction between *E. maculatus* and *E. suratensis*, established the genus *Pseudetroplus*, with *Eetroplus coruchi* Cuvier, 1830 (a synonym of *E. maculatus*) as type species. He distinguished *Pseudetroplus* from *Eetroplus* on the basis, among other characters, of the former possessing tricuspid

jaw teeth and scaly sheaths to the dorsal and anal fins. Günther (1862: 266), however, was doubtful of the validity of *Pseudetroplus*, noting that “the characters of the new genus are, tricuspid teeth, and a scaly sheath along the base of the dorsal and anal fins. I find these characters *equally* developed in *E. suratensis* and in *E. maculatus*, and I can come to no other conclusion than that Dr. v. Bleeker either has a third species, different from both, or that he has taken the characters for *Eetroplus* from a very old specimen of *E. suratensis*, in which the incisions on the front teeth have become obsolete.” *Pseudetroplus* has since been regarded as a synonym of *Eetroplus*.

*Eetroplus suratensis* and *E. canarensis*, however, possess numerous characters that support their close relationship, as distinct from *E. maculatus*. Here, in order to distinguish these two clades taxonomically and also recognize the diversity that exists within the South Asian Cichlidae, we propose that *Pseudetroplus* Bleeker be recognized as a valid genus.

## Material and methods

Material referred to in this paper is deposited in the Australian Museum, Sydney (AMS) and the collection of the Wildlife Heritage Trust (WHT), presently deposited in the National Museum of Sri Lanka, Colombo. Measurements were made with digital Vernier callipers and recorded to the nearest 0.1 mm. Osteological descriptions are based on cleared and alizarin-stained specimens following the single-staining method of Taylor & Van Dyke (1985).

## Results

### *Pseudetroplus* Bleeker

*Pseudetroplus* Bleeker, in Günther, 1862: 266; type species *Eetroplus maculatus* (Bloch).

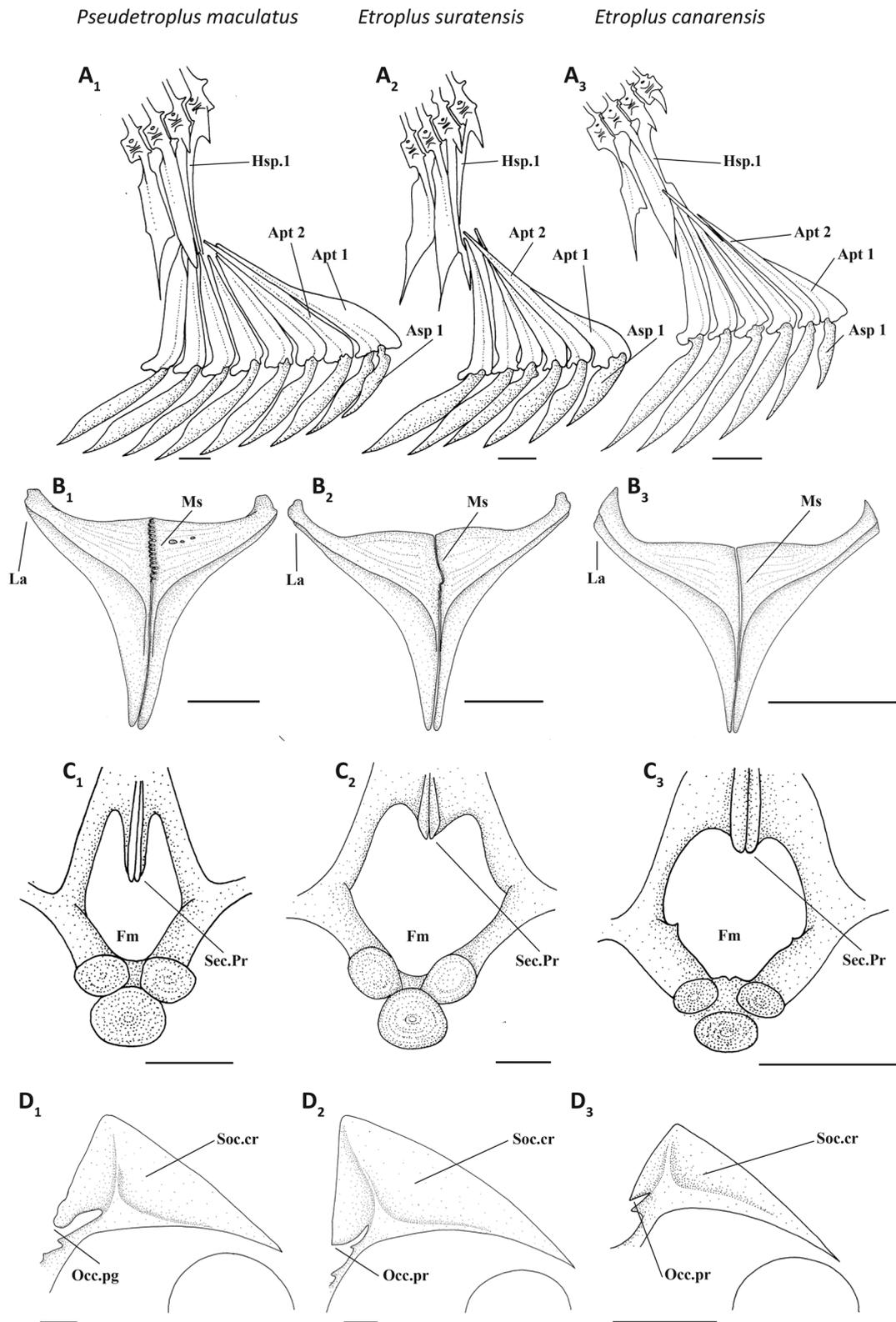
*Pseudetroplus* Bleeker, 1862: 125; type species *Eetroplus coruchi* Cuvier.

*Microgaster* Swainson, 1839: 171 (non Latreille, 1804).

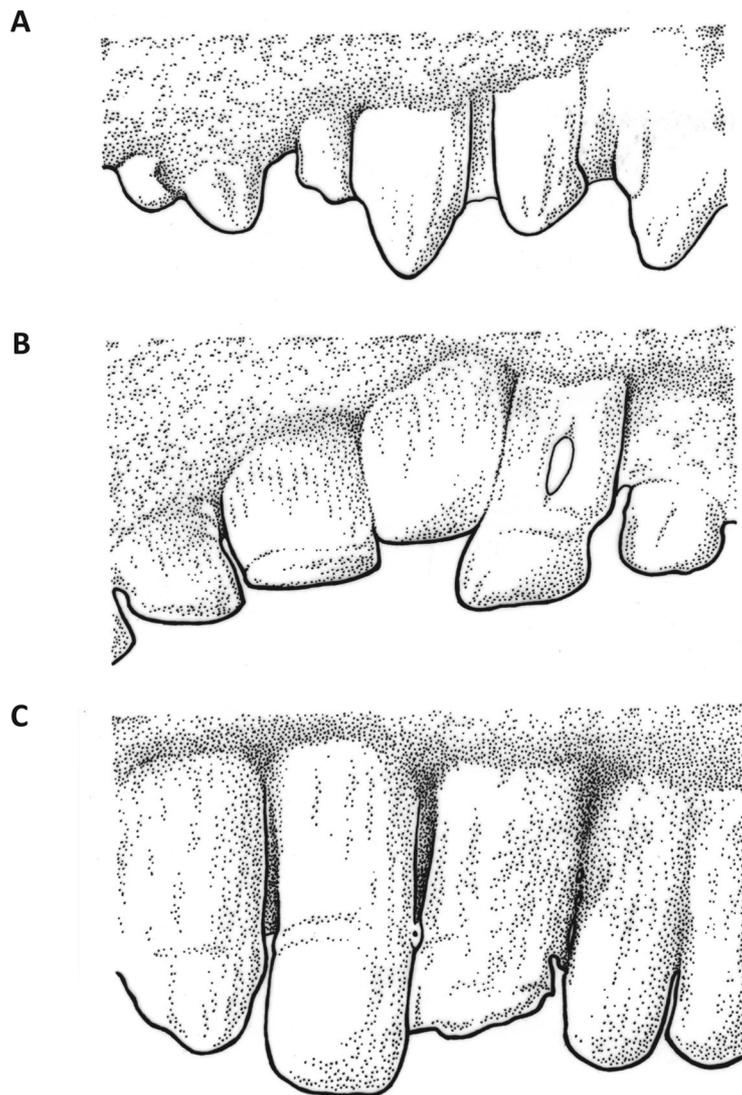
**Diagnosis.** *Pseudetroplus* is distinguished from *Eetroplus* by having 11 (vs. 12–13) pleural ribs; 26–27 (vs. 28–29) total vertebrae; lateral line incomplete (vs. interrupted), with 1–7 (vs. 13–24) pored scales; possessing an occipital prong (vs. possessing an occipital process; Fig. 1D); postero-dorsal outline of operculum curved, with a well-developed process (postero-dorsal outline of operculum straight, lacking a well-developed process); anterior half of median suture of lower pharyngeal jaw serrated (vs. smooth; Fig. 1B); base of the lateral arm of lower pharyngeal jaw broad (vs. narrow; Fig. 1B); first 6 anal-fin pterygiophores arranged anterior to the first 3 (vs. 2) haemal spines (Fig. 1A); supraoccipital-exoccipital prong well developed, extending ventrally over half-way across foramen magnum (vs. less-well developed, not extending into foramen magnum; Fig. 1C). Further, the anterior jaw teeth in *Pseudetroplus* are acuminate (vs. spatulate in *Eetroplus*; Fig. 2). *Pseudetroplus* also differs from *Eetroplus* in pigmentation, possessing one or more black blotches on the side of the body (vs. 7–9 prominent dark lateral bars in *Eetroplus*); possessing two brown stripes on the dorsal fin (vs. lacking stripes on the dorsal fin); and lacking a black patch on the pectoral fin, near its base (vs. black blotch present on base of pectoral fin).

**Discussion.** The name *Pseudetroplus* was published both by Bleeker in Günther (1862) and by Bleeker (1862). While the date of publication of the former is 8 November 1862 (Eschmeyer, 2014), the date of publication of the latter is unknown and must under ICZN (1999) art. 21.3.2 be assumed to be 31 December, 1862. Bleeker (1862) gave the type species as *Eetroplus coruchi* Cuvier, 1830 (type locality: Malabar [Kerala], India), a junior subjective synonym of *Chaetodon maculatus* Bloch, 1795 (type locality: ponds along the Coromandel coast [Tamil Nadu], India), while Bleeker in Günther (1862) specified the type species as *E. maculatus*. The statement in Eschmeyer (2014) that “if [Bleeker in Günther] was first, then *suratensis* is probably the type” is evidently an error, for Günther (1862: 266) wrote: “According to a communication from Dr. v. Bleeker, he intends to separate this species [i.e. *E. suratensis*] generically from *E. maculatus*, retaining the name of *Eetroplus* for the former, and adopting that of *Pseudetroplus* for the latter [i.e. *E. maculatus*]”. Cuvier (1830) used the spelling *Eetroplus coruchi* on p. 491 of his text, which indicated plate 136, on which he employed the name *Glyphisodon koruschi*: as first reviser we here give precedence to the spelling *Eetroplus coruchi*.

*Microgaster* Swainson, 1839 (type species *E. coruchi* Cuvier, in Cuvier & Valenciennes, 1830), while a senior synonym of *Pseudetroplus*, is a junior homonym of *Microgaster* Latreille (1804: 175) in Hymenoptera.



**FIGURE 1.** Osteology of **1**, *Pseudetroplus maculatus*, WHT 11087, 54.6 mm SL, Kerala, India; **2**, *Etroplus suratensis*, WHT 11088, 63.1 mm SL, Bellanwila, Sri Lanka; **3**, *E. canarensis*, WHT 11084, 48.3 mm SL, Natravedi River, Bengal, India. **A**, Anterior caudal vertebrae and associated structures in right lateral view; **B**, lower pharyngeal jaw; **C**, posterior view of neurocranium, showing foramen magnum; **D**, lateral view of supraoccipital crest and associated structures. Abbreviations: **Hsp.1**, first haemal spine; **Apt 1–2**, anal pterygiophore 1–2; **La**, lateral arm of lower pharyngeal jaw; **Ms**, median suture of lower pharyngeal jaw in lingual view; **Sec.pr**, supraoccipital-exoccipital prong; **Fm**, foramen magnum; **Soc.cr**, supraoccipital crest; **occ.pg**, occipital prong; **occ.pr**, occipital process. Scale bar 1 mm.



**FIGURE 2.** Anterior premaxillary dentition of A, *Pseudetroplus maculatus*, AMS B. 8099, 70.5 mm SL, Madras (Tamil Nadu), India; B, *Etroplus suratensis*, AMS I. 4478, 73.4 mm SL, Madras (Tamil Nadu), India; C, *E. canarensis*, AMS B.8148, 61.5 mm SL, Canara (Karnataka), India.

Sparks (2008) and Stiassny *et al.* (2001) distinguished the South Asian cichlids from their sister group, the Madagascan genus *Paretroplus*, by the former possessing more than a single row (vs. only a single row) of teeth in each jaw; the presence of a single lacrimal plate (lachrymal bifurcated in *Paretroplus*); and an asymmetrical displacement of the first anal-fin pterygiophore behind and the second in front of the haemal spine complex (vs. first anal-fin pterygiophore in front of and the second behind the haemal spine complex). While our results are consistent with this description, we note that the arrangement of anal-fin pterygiophores differs consistently between *Pseudetroplus* and *Etroplus*, with the former having the first 6 pterygiophores falling anterior to the first 3 haemal spines, whereas in the latter the first 6 pterygiophores fall anterior to the first 2 haemal spines: see Fig. 1A). Furthermore, whereas in both *Pseudetroplus* and *Etroplus* all lateral jaw teeth and the inner rows of the anterior teeth are tricuspid, the anterior jaw teeth are acuminate in adult *Pseudetroplus* and spatulate in adult *Etroplus*.

Sparks (2008) noted also that the monophyly of the “*Etroplus suratensis* + *Etroplus canarensis* clade” (i.e. *Etroplus sensu stricto*) was supported by the presence of a blunt snout with a steeply sloping profile in lateral view (particularly in specimens < about 75mm SL); the presence of seven to nine prominent dark lateral bands; and an unique, unreversed character: a prominent black patch on the pectoral fin near its base. These, together with the dental and osteological characters mentioned in the Diagnosis, above, serve to distinguish *Pseudetroplus* from *Etroplus*.

Day (1877: 415) noted that specimens of *P. maculatus* from Madras (the then presidency, now part of Tamil Nadu

State, in which the type locality, Tharangambadi, is located) possessed 17–18 dorsal-fin and 11–12 anal-fin spines, whereas those in southern Karnataka possessed 19–20 and 14–15 spines, respectively. Should the populations of *Pseudetroplus* in the eastern and western regions of the Indian peninsula prove specifically different, the name *P. coruchi* Cuvier, in Cuvier & Valenciennes, 1830, is available for the latter.

The difference in anterior jaw dentition in *Pseudetroplus* and *Eetroplus* appears related to diet, the former being piscivorous, whereas adults of the latter feed on filamentous algae, detritus, aquatic plants and diatoms (Bindu & Padmakumar, 2008).

### Material examined

*Pseudetroplus maculatus*: AMS B.8099, 70.5 mm SL, Madras [Presidency], India; F. Day (1865–1883); WHT 11087, 54.6 mm SL and WHT 11095, 54.6 mm SL, Kerala, India (c&s).

*Eetroplus suratensis*: AMS I.4478, 73.4 mm SL, Madras [Presidency], India; F. Day (1865–1883); WHT 11088, 63.1 mm SL and WHT 11082, 49.0 mm SL, Bellanwila, Sri Lanka (c&s).

*Eetroplus canarensis*: AMS B.8148, 61.5 mm SL, putative syntype, Canara [Karnataka], India; F. Day (1865–1883); WHT 11084, 48.3 mm SL, Natravedi River, Bengal, India (c&s).

### Acknowledgements

We thank John Sparks and an anonymous reviewer for comments that helped improve the manuscript; and Maurice Kottelat for his efforts to ascertain the date of publication of Bleeker (1862). Marcus Knight kindly reported on Southeast Indian specimens for us. RP thanks Mark McGrouther and Amanda Hay (AMS) for access to material and facilities for research.

### References

- Bindu, L. & Padmakumar, K.G. (2008) Food of the pearlspot *Eetroplus suratensis* (Bloch) in the Vembanad Lake, Kerala. *Journal of the Marine Biological Association of India*, 50 (2), 156–160.
- Bleeker, P. (1862) *Notices ichthyologiques (I–X). Verslagen en Mededeelingen der Koninklijke Akademie van Wetenschappen. Afdeling Natuurkunde*, 14, 123–141.
- Bloch, M.E. (1790) *Naturgeschichte der ausländischen Fische. Vol. 4*. Morino, Berlin, xii + 128 pp., pls. 217–252.
- Bloch, M.E. (1795) *Naturgeschichte der ausländischen Fische. Vol. 9*. Morino, Berlin, ii + 192 pp., pls. 397–429.
- Cuvier, G. & Valenciennes, A. (1830) *Histoire naturelle des poissons*, tome cinquième. Levrault, Paris, xxviii + 4 + 499 pp., pls. 100–140.
- Day, F. (1877) *The fishes of India: being a natural history of the fishes known to inhabit the seas and fresh waters of India, Burma, and Ceylon, part 3*. William Dawson & Sons, London, pp. 369–552, pls. 79–138.
- Eschmeyer, W.N. (Ed.) (2014) *Catalog of fishes*. Electronic version. Available from: <http://research.calacademy.org/research/ichthyology/catalog/fishcatmain.asp> (accessed 22 June 2014)
- Farias, I.P., Orti, G., Sampaio, I., Schneider, H. & Meyer, A. (1999) Mitochondrial DNA phylogeny of the family Cichlidae: monophyly and fast molecular evolution of the Neotropical assemblage. *Journal of Molecular Evolution*, 48, 703–711.  
<http://dx.doi.org/10.1007/pl00006514>
- Farias, L.P., Orti, G. & Meyer, A. (2000) Total evidence: molecules, morphology, and the phylogenetics of cichlid fishes. *Journal of Experimental Zoology*, 288 (1), 76–92.  
[http://dx.doi.org/10.1002/\(sici\)1097-010x\(20000415\)288:1<76::aid-jez8>3.3.co;2-g](http://dx.doi.org/10.1002/(sici)1097-010x(20000415)288:1<76::aid-jez8>3.3.co;2-g)
- Friedman, M., Keck, B.P., Dornburg, A., Eytan, R.I., Martin, C.H., Hulsey, C.D., Wainwright, P.C. & Near, T.J. (2013) Molecular and fossil evidence place the origin of cichlid fishes long after Gondwanan rifting. *Proceedings of the Royal Society, B (Biol. Sci.)*, 280, 20131733.  
<http://dx.doi.org/10.1098/rspb.2013.1733>
- Günther, A. (1862) *Catalogue of the fishes in the British Museum: catalogue of the Acanthopterygii, Pharyngognathi and Anacanthini in the collection of the British Museum. Vol. 4*. British Museum, London, xxi + 534 pp.
- ICZN [International Commission of Zoological Nomenclature] (1999) *International Code of Zoological Nomenclature. 4<sup>th</sup> Edition*. International Trust for Zoological Nomenclature, London, 306 pp.

- Latreille, P.A. (1804) Tableau méthodique des insectes. Classe huitième. Insectes, Insecta. In: Latreille, P.A. (Ed.), *Nouveau dictionnaire d'histoire naturelle, appliquée aux arts, principalement à l'agriculture et à l'économie rurale et domestique: par une société de naturalistes et d'agriculteurs: avec des figures tirées des trois règnes de la nature. Vol. 24.* Déterville, Paris, pp. 129–200
- Sparks, J.S. (2008) Phylogeny of the cichlid subfamily Ectoplineae and taxonomic revision of the Malagasy cichlid genus *Paretroplus* (Teleostei: Cichlidae). *Bulletin of the American Museum of Natural History*, 314, 1–151.
- Sparks, J.S. (2004) Molecular phylogeny and biogeography of the Malagasy and South Asian cichlids (Teleostei: Perciformes: Cichlidae). *Molecular Phylogenetics and Evolution*, 30, 599–614.  
[http://dx.doi.org/10.1016/s1055-7903\(03\)00225-2](http://dx.doi.org/10.1016/s1055-7903(03)00225-2)
- Sparks, J.S. & Smith, W.L. (2004) Phylogeny and biogeography of cichlid fishes (Teleostei: Perciformes: Cichlidae). *Cladistics*, 20, 501–517.  
<http://dx.doi.org/10.1111/j.1096-0031.2004.00038.x>
- Sparks, J.S. & Smith, W.L. (2005) Freshwater fishes, dispersal ability, and nonevidence: “Gondwana Life Rafts” to the rescue. *Systematic Biology*, 54 (1), 158–165.  
<http://dx.doi.org/10.1080/10635150590906019>
- Stiassny, M.L.J., Chakrabarty, P. & Loiselle, P.V. (2001) Relationships of the Madagascan cichlid genus *Paretroplus* Bleeker 1868, with description of a new species from the Betsiboka River drainage of northwestern Madagascar. *Ichthyological Exploration of Freshwaters*, 12, 29–40.
- Swainson, W. (1839) *On the natural history and classification of fishes, amphibians, and reptiles, or monocardian animals. Vol. 2.* Spottiswoode & Co., London, vi + 448 pp.
- Taylor, W.R. & Van Dyke, G.C. (1985) Revised procedures for staining and clearing small fishes and other vertebrates for bone and cartilage study. *Cybium*, 9, 107–119.
- Zardoya, R., Vollmer, D.M., Craddock, C., Streelman, J.T., Karl, S. & Meyer, A. (1996) Evolutionary conservation of microsatellite flanking regions and their use in resolving the phylogeny of cichlid fishes (Pisces: Perciformes). *Proceedings of the Royal Society of London, Series B*, 263, 1589–1598.  
<http://dx.doi.org/10.1098/rspb.1996.0233>