

Exceptional preservation of a Cretaceous intestine provides a glimpse of the early ecological diversity of spiny-rayed fishes (Acanthomorpha, Teleostei)

-

Supplementary Information

Authors: Donald Davesne^{1,2,*}, Pierre Gueriau^{2,3,4,*}, Didier B. Dutheil² and Loïc Bertrand^{3,4}

¹ Department of Earth Sciences, University of Oxford, OX1 3AN Oxford, United Kingdom.

² Centre de Recherche sur la Paléobiodiversité et les Paléoenvironnements, UMR7207 (CNRS-MNHN-UPMC), Muséum national d'Histoire naturelle, 75005 Paris, France.

³ IPANEMA, CNRS, ministère de la Culture, UVSQ, USR3461, Université Paris-Saclay, 91192 Gif-sur-Yvette, France.

⁴ Synchrotron SOLEIL, 91192 Gif-sur-Yvette, France.

*These authors contributed equally to this work. Correspondence should be addressed to D.D. (email: donald.davesne@earth.ox.ac.uk) or P.G. (email: pierre.gueriau@synchrotron-soleil.fr).

Taxon-by-character matrix used in the phylogenetic analysis.

The following taxon-by-character matrix is adapted from Davesne *et al.* (2016). It adds the taxon †*Spinocaudichthys*, from the Late Cretaceous of Morocco, to the matrix.

For the full list of characters and character states, see the Supplementary Material of Davesne *et al.* (2016) at:

<https://www.frontiersin.org/articles/10.3389/fevo.2016.00129/full#supplementary-material>

Missing character states are coded as '?'. Inapplicable character states are coded as '-'.

References:

Davesne, D., Gallut, C. Barriol, V., Janvier, P., Lecointre, G., Otero, O. (2016) The phylogenetic intrarelationships of spiny-rayed fishes (Acanthomorpha, Teleostei, Actinopterygii): fossil taxa increase the congruence of morphology with molecular data. *Frontiers in Ecology and Evolution* 4: 129.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	
<i>Synodus</i>	0	0	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
<i>Gymnoscopelus</i>	0	0	-	1	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	
† <i>Ctenothrissa</i>	0	0	-	0	0	0	0	0	0	0	0	0	?	0	0	0	1	0	0	0	0	0	0	1	?	?	0	?	0	0	0	0	1	
† <i>Pycnoasteroides</i>	0	?	?	0	0	1	1	?	0	0	0	?	?	0	0	?	1	0	?	0	?	0	0	1	?	1	0	?	0	?	1	0	2/3	
† <i>Aipichthys</i> '	0	0	-	1	0	1	1	?	0	0	0	0	1	0	0	?	1	0	0	0	?	0	0	1	?	0	0	?	0	?	0	1	2	
† <i>Aipichthyoides</i>	0	0	-	0	0	1	1	?	1	0	0	?	1	1	0	?	1	0	?	?	?	0	0	1	?	?	0	?	0	?	0	1	2	
<i>Velifer</i>	1	0	-	1	1	1	1	1	1	0	0	0	1	1	1	0	1	0	1	1	0	1	0	1	3	0	1	1	0	0	1	1	3	
<i>Lampris</i>	1	0	-	1	1	1	1	1	1	0	0	0	1	1	1	0	1	0	1	1	0	1	0	1	0	2	1	1	0	0	2	1	3	
<i>Regalecus</i>	1	0	-	1	1	1	1	1	1	0	0	-	1	-	1	0	1	0	1	1	0	1	0	1	?	?	?	?	1	0	1	3	-	3
<i>Stylephorus</i>	1	0	-	1	1	1	1	?	1	1	1	-	1	-	0	1	1	1	-	1	0	0	0	1	?	?	?	-	1	1	3	-	0	
<i>Polymixia</i>	0	1	0	0	0	1	0	1	0	0	0	0	1	0	0	1	0	0	0	0	0	0	1	1	0	1	0	1	0	0	0	0	0	
† <i>Omosomopsis</i>	0	1	0	1	0	1	1	?	?	0	1	?	1	0	0	?	1	0	?	0	?	?	1	1	?	1	0	?	0	?	0	0	1	
† <i>Sphenocephalus</i>	0	1	1	1	0	1	0	?	?	?	?	?	1	0	0	1	1	0	?	0	0	0	0	1	?	?	?	?	1	0	0	2	0	0/1
<i>Aphredoderus</i>	0	0	-	1	1	1	1	0	0	1	1	1	1	0	0	1	0	0	0	0	1	0	0	1	0	2	1	1	0	0	2	0	1	
<i>Percopsis</i>	0	0	-	1	1	1	0	0	0	1	1	1	1	0	0	1	0	0	0	0	1	0	0	1	0	2	1	1	0	0	2	0	0	
<i>Bregmaceros</i>	0	1	1	1	1	1	1	1	0	1	1	1	1	0	0	1	1	0	?	1	0	0	0	1	?	?	?	?	1	1	3	-	1/2	
<i>Merluccius</i>	0	1	1	1	1	1	1	1	0	1	1	1	1	0	0	1	1	0	0	1	1	0	0	1	0	2	1	1	1	1	3	-	1	
<i>Halobatrachus</i>	1	1	0	1	1	1	1	1	-	1	1	0	1	0	0	1	0	0	0	0	1	0	0	1	1	2	1	1	1	0	3	-	1	
<i>Brotula</i>	0	1	1	1	0	1	1	1	0	1	0	0	1	0	0	1	0	0	0	0	1	0	0	1	1	2	1	1	0	1	3	0	1	
<i>Cytus</i>	1	1	1	1	1	1	1	0	0	1	0	0	2	0	0	1	1	1	0	1	0	0	0	1	0	?	1	?	1	1	2	-	2	
<i>Zeus</i>	1	1	1	1	1	1	1	0	0	1	1	0	2	0	0	1	1	1	0	1	0	0	0	1	2	2	1	1	1	1	3	-	2	
<i>Hoplostethus</i>	0	1	1	0	0	1	0	1	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	1	1	?	1	1	0	0	1	0	1	
<i>Sargocentron</i>	0	1	0	0	0	1	0	1	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	1	1	2	1	1	0	0	0	0	2	
† <i>Stichocentrus</i>	0	1	?	0	0	1	0	?	0	0	0	?	0	0	0	?	0	0	?	0	?	0	0	1	?	?	?	?	0	?	1	0	2	
<i>Dicentrarchus</i>	0	1	0	1	0	1	1	1	0	1	0	0	1	0	0	1	0	0	0	0	1	0	0	1	1	2	1	1	0	0	0	0	1	
<i>Lates</i>	0	1	0	1	0	1	1	1	0	1	0	0	1	0	0	1	0	0	0	0	1	0	0	1	1	?	?	1	0	0	0	0	1	
† <i>Spinocaudichthys</i>	?	?	?	?	?	?	?	?	?	?	?	?	?	0	?	?	?	?	?	?	?	?	?	?	?	0/1	0	?	0	?	3	-	0	

	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	
<i>Synodus</i>	0	0	-	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-	
<i>Gymnoscopelus</i>	0	0	-	0	0	0	0	0	1	1	0	?	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-	
† <i>Ctenothrissa</i>	0	0	-	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	?	?	?	?	?	0	0	-	
† <i>Pycnosteroides</i>	0	1	?	0	0	1	1	0	0	0	1	0	0	0	0	1	1	0	0	0	0	0	0	1	2	?	?	?	?	?	0	1	?	
† <i>'Aipichthys'</i>	0	1	?	0	1	1	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	2	?	?	?	0	?	0	0	-	
† <i>Aipichthyoides</i>	0	1	?	0	1	1	1	0	0	0	0	0	1	0	0	1	1	0	0	0	0	0	0	1	2	?	?	?	?	?	0	0	-	
<i>Velifer</i>	0	1	?	0	1	1	1	0	1	0	0	0	0	0	0	1	0	0	1	0	0	0	0	1	2	0	0	1	0	0	0	0	-	
<i>Lampris</i>	0	0	-	0	1	1	0	0	1	0	0	0	1	0	0	1	1	0	0	1	1	1	0	1	2	0	0	1	0	1	0	0	-	
<i>Regalecus</i>	1	0	-	0	1	1	-	1	1	0	-	-	3	0	0	1	-	2	-	1	1	1	0	1	2	0	?	1	0	1	1	0	-	
<i>Stylephorus</i>	1	0	-	0	1	1	0	1	1	0	-	-	3	0	1	1	-	2	0	1	1	0	1	1	1	0	?	?	?	1	1	0	-	
<i>Polymixia</i>	0	1	0	0	0	1	1	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	-	
† <i>Omosomopsis</i>	0	1	0	0	0	1	1	0	0	0	1	0	1	1	0	1	0	1	0	0	0	0	0	1	0	?	?	?	?	?	0	0	-	
† <i>Sphenocephalus</i>	0	1	?	0	0	0	1	0	0	0	1	0	1	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	1	?	0	1	0
<i>Aphredoderus</i>	0	1	0	0	0	1	1	0	1	0	1	0	1	0	0	1	0	1	0	0	0	0	0	1	0	0	0	0	1	0	0	0	-	
<i>Percopsis</i>	0	1	0	0	0	0	1	0	1	0	1	0	1	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	-
<i>Bregmaceros</i>	1	0	-	0	1	1	0	0	1	0	1	1	1	1	1	1	0	2	1	1	0	1	0	1	1	?	0	?	?	?	0	0	-	
<i>Merluccius</i>	0	0	-	0	0	1	0	0	1	0	1	1	1	1	1	1	0	2	1	1	0	0	0	1	1	0	?	0	0	?	0	0	-	
<i>Halobatrachus</i>	0	1	-	1	0	1	0	0	1	0	1	-	1	0	0	1	0	2	0	1	0	0	0	1	1	1	-	0	0	1	1	1	1	
<i>Brotula</i>	0	0	-	0	0	1	0	0	1	0	1	-	1	0	1	1	0	2	0	0	0	0	0	1	3	?	-	-	-	1	1	1	1	
<i>Cyttus</i>	0	1	0	1	0	1	1	1	1	1	1	1	1	0	1	1	0	2	0	1	0	0	1	1	1	0	0	1	0	1	0	1	0	
<i>Zeus</i>	0	1	0	1	0	1	1	1	1	1	1	1	2	1	1	1	0	2	0	1	0	0	1	1	1	0	0	1	0	1	0	1	0	
<i>Hoplostethus</i>	0	1	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	1	1	0	0	1	1	
<i>Sargocentron</i>	0	1	1	1	0	1	1	0	1	1	0	1	0	0	0	1	0	0	0	0	0	0	0	1	1	1	0	1	0	0	0	1	1	
† <i>Stichocentrus</i>	0	1	?	0	0	1	1	0	0	0	0	0/1	0	0	0	?	0	0	0	0	0	0	0	1	1	?	?	?	?	?	0	1	?	
<i>Dicentrarchus</i>	0	1	1	1	0	1	1	0	1	1	0	0	0	0	0	1	0	2	0	0	0	0	0	1	1	1	1	1	0	1	1	1	1	
<i>Lates</i>	0	1	1	1	0	1	1	0	1	1	0	0	1	0	0	1	0	2	0	0	0	0	0	1	1	1	1	1	0	1	1	1	1	
† <i>Spinocaudichthys</i>	0	1	?	0	0	1	1	0	0	0	1	0	1	0	?	0	0	0	?	?	?	0	0	0	0	0	?	?	?	?	0	0	-	