Title: MEGA-BITES: Extreme jaw forces of living and extinct piranhas (Serrasalmidae)

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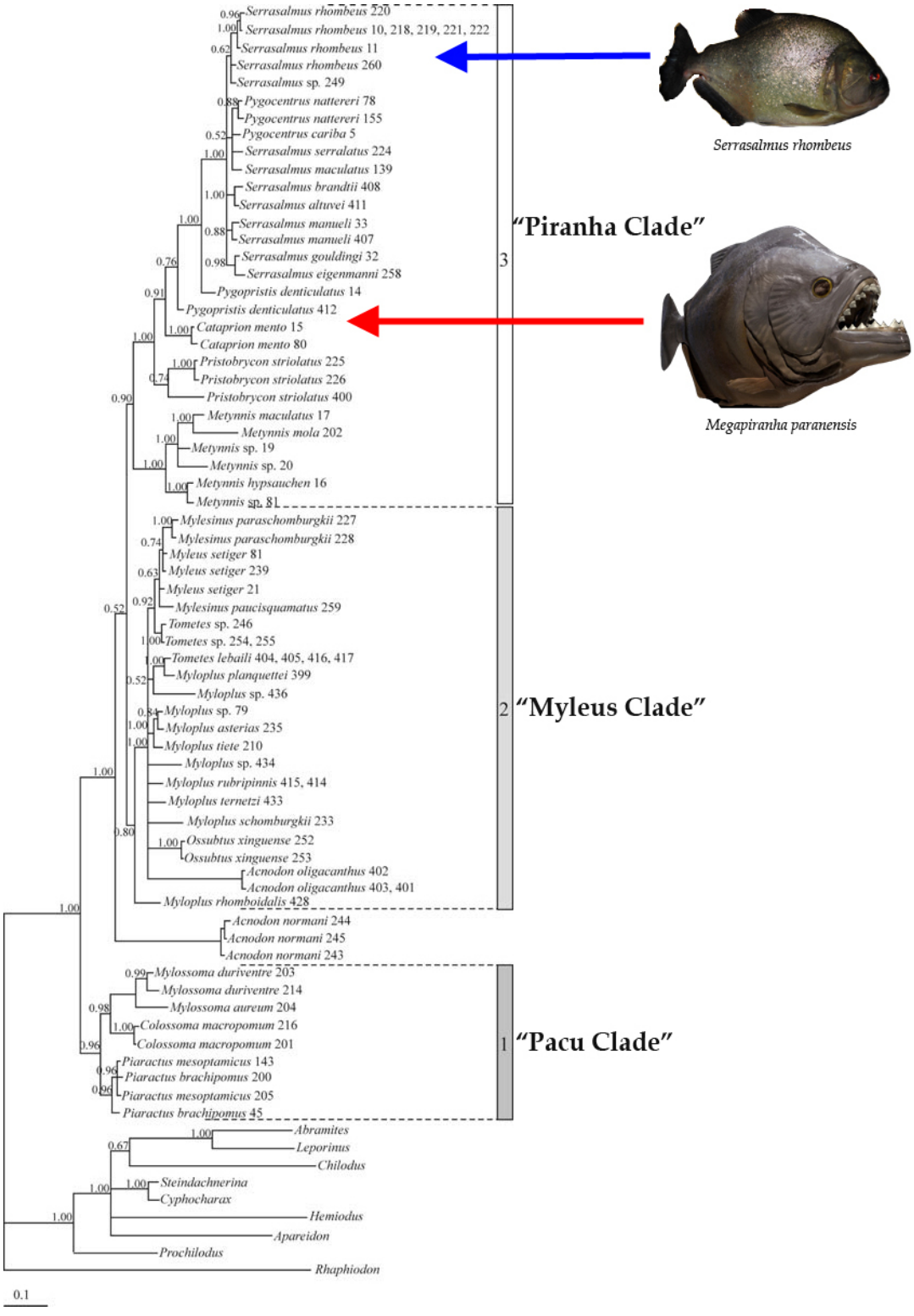
Supplementary Information:

SI Figure 1: Molecular phylogeny of the Serrasalmidae showing the three sub-clades: 1) carnivorous piranha clade, 2) omnivorous *Myleus* clade, 3) herbivorous pacu clade (reprinted from *Orti et al*. 2008). Red arrow indicates the relative position of *M. paranensis* and shows its close phylogenetic relatedness to *S. rhombeus* (blue arrow) as derived from the parsimony analysis of morphological characters for the fossil premaxilla and teeth by Cione et al. (2009).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Chilodus
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Hemiodus
Apareidon
Prochilodus
Rhaphiodon
0.1
3
"Piranha Clade"
2
"Myleus Clade"
1
"Pacu Clade"
Serrasalmus rhombeus
Megapiranha paranensis

SI Movie 1. Megapiranha Bite Simulations: This video shows the indentation results of a metal replica of the *M. paranensis* fossil jaw and teeth while impacting the bony tissues of an armored catfish, *Hoplosternum littorale*. (http://www.youtube.com/watch?v=_5aHb0h2bvs)

SI Table 1. *In-vivo* bite forces of wild black piranha, *Serrasalmus rhombeus.*

Individual	TL (mm)	# of Bites	Peak Bite (N)	Mean Bite (N)	Std Dev Bite (N)
1	365	3	306.93	280.24	24.77
2	215	1	75.62	na	na
3	205	1	66.72	na	na
4	300	4	93.41	74.51	22.21
5	250	1	142.34	na	na
6	220	1	88.96	na	na
7	368	2	320.27	306.9	18.86
8	295	9	235.76	212.53	20.36
9	322	5	155.69	137.89	27.60
10	210	3	84.51	71.17	13.34
11	220	3	88.96	84.51	7.70
12	215	1	80.07	na	na
13	260	3	142.34	136.42	6.79
14	245	2	71.17	60.05	15.74
15	240	4	97.86	90.08	6.67

SI Table 2. Maximum anterior bite forces (ABF) and bite force quotients (BFQ) for apex predatory fishes.

Species Name	Body Mass (Kg)	Max ABF (N)	Residuals	BFQ
Living Taxa:				
Sphyraena barracuda [3,33]	11.9	93	-0.578	26.45
Carcharhinus limbatus [20,34]	22.1	423	-0.077	83.71
Serrasalmus rhombeus	**0.2**	**85**	**0.399**	**250.80**
Serrasalmus rhombeus	**1.1**	**320**	**0.561**	**363.69**
Carcharhinus leucus [34]	140.3	1023	-0.164	68.49
Sphyrna mokarra [34]	580.6	2432	-0.150	70.83
Carcharodon carcharias [5]	240.0	1602	-0.106	78.31
Carcharodon carcharias [5]	3324.0	9320	-0.011	97.60
Extinct Taxa:				
Carcharodon megalodon [5]	47690.0	55522	0.086	122.01
Carcharodon megalodon [5]	103197.0	93127	0.115	130.17
Dunkleosteus terrelli [2]	1000.0	6170	0.116	130.65
Megapiranha paranensis	**10.6**	**1240**	**0.576**	**376.91**
Megapiranha paranensis	**73.5**	**4749**	**0.667**	**464.44**

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34. Huber, D.R., Claes, J.M., Mallefet, J., Herrel, A. Is extreme bite performance associated with extreme morphologies in sharks. *Physio. & Biochem. Zool*. 82(1): 20-28 (2009).