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ANEXOS

Anexo I. Matrizes de correlação das análises estatísticas feitas para elementos-traço em bÍlis e fÍgado. (Correlações em vermelho são significativas, embora só tenhamos considerado correlações acima de 0,5).

Variable	Spearman Rank Order Correlations (All data for article separated by site.sta) MD pairwise deleted Marked correlations are significant at $p < .05000$						
	Cr ipiranga liver	Mn ipiranga liver	Ni ipiranga liver	Cu ipiranga liver	Cd ipiranga liver	Pb ipiranga liver	Zn ipiranga liver
Cr ipiranga liver	1,000000	0,329644	0,276360	0,108255	0,142964	0,129644	-0,225328
Mn ipiranga liver	0,329644	1,000000	0,224578	0,354972	0,175235	0,310319	-0,104878
Ni ipiranga liver	0,276360	0,224578	1,000000	-0,066041	0,314634	0,009193	0,086679
Cu ipiranga liver	0,108255	0,354972	-0,066041	1,000000	0,314634	0,328518	0,100375
Cd ipiranga liver	0,142964	0,175235	0,314634	0,314634	1,000000	0,439587	0,307317
Pb ipiranga liver	0,129644	0,310319	0,009193	0,328518	0,439587	1,000000	0,415197
Zn ipiranga liver	-0,225328	-0,104878	0,086679	0,100375	0,307317	0,415197	1,000000
Cr Ipiranga bile	0,168016	0,124089	0,211741	0,224899	0,077935	0,039676	-0,187449
Mn Ipiranga bile	-0,031682	0,538792	-0,027127	0,160939	-0,199302	0,099904	0,137962
Ni Ipiranga bile	-0,168623	0,076721	0,274696	0,047571	0,110121	0,030567	0,096154
Cu Ipiranga bile	0,005668	0,452632	-0,089879	0,510324	-0,168219	0,295547	0,176316
Cd Ipiranga bile	0,025260	-0,077141	-0,098468	-0,225070	-0,046133	-0,045831	0,126602
Pb Ipiranga bile	-0,227328	0,154656	-0,034211	0,293320	-0,119433	0,137247	0,225304
Zn Ipiranga bile	0,104464	0,338293	0,032594	0,123191	-0,195769	0,372609	0,224011

Variable	Spearman Rank Order Correlations (All data for article separated by site.sta) MD pairwise deleted Marked correlations are significant at $p < .05000$						
	Cr Ipiranga bile	Mn Ipiranga bile	Ni Ipiranga bile	Cu Ipiranga bile	Cd Ipiranga bile	Pb Ipiranga bile	Zn Ipiranga bile
Cr ipiranga liver	0,168016	-0,031682	-0,168623	0,005668	0,025260	-0,227328	0,104464
Mn ipiranga liver	0,124089	0,538792	0,076721	0,452632	-0,077141	0,154656	0,338293
Ni ipiranga liver	0,211741	-0,027127	0,274696	-0,089879	-0,098468	-0,034211	0,032594
Cu ipiranga liver	0,224899	0,160939	0,047571	0,510324	-0,225070	0,293320	0,123191
Cd ipiranga liver	0,077935	-0,199302	0,110121	-0,168219	-0,046133	-0,119433	-0,195769
Pb ipiranga liver	0,039676	0,099904	0,030567	0,295547	-0,045831	0,137247	0,372609
Zn ipiranga liver	-0,187449	0,137962	0,096154	0,176316	0,126602	0,225304	0,224011
Cr Ipiranga bile	1,000000	0,085834	0,646356	0,244939	-0,262127	0,493725	0,251240
Mn Ipiranga bile	0,085834	1,000000	0,145655	0,633129	-0,072002	0,242016	0,588551
Ni Ipiranga bile	0,646356	0,145655	1,000000	0,215385	-0,308866	0,637854	0,318959
Cu Ipiranga bile	0,244939	0,633129	0,215385	1,000000	-0,383435	0,443117	0,617067
Cd Ipiranga bile	-0,262127	-0,072002	-0,308866	-0,383435	1,000000	-0,231725	-0,269415
Pb Ipiranga bile	0,493725	0,242016	0,637854	0,443117	-0,231725	1,000000	0,399737
Zn Ipiranga bile	0,251240	0,588551	0,318959	0,617067	-0,269415	0,399737	1,000000

Anexo II. Biometria dos peixes utilizados neste estudo (alguns peixes foram utilizados apenas para testar alguns dos protocolos descritos neste estudo, e não entraram para os resultados finais).

Acarás

Código	Wg (g)	Lt (cm)	Sexo	Cor da bÍlis	Fígado	Gônadas
338	251,73	23,60	M	Verde claro	2,28	0,51
339	217,09	25,8	F	Amarelo	4,38	6,57
340	206,84	21,00	M	x	2,52	x
341	179,84	20,50	F	x	1,49	8,9
342	141,16	18,70	X	x	2,87	4,13

Tilápias

Código	Wg (g)	Lt (cm)	Sexo	Cor da bÍlis	Fígado (g)	Gônada
334	405,43	27,80	F	Verde claro	2,85	4,06
335	527,23	30,8	M	Verde	5,74	2,04
336	345,8	26,50	F	Verde escuro	4,49	2,59
337	403,81	28,50	M	Verde	4,83	1,63
343	88,90	27,00	M	Verde muito escuro	3,15	0,29

344	218,01	29,00	M	Verde muito escuro	1,49	0,28
345	76,59	24,50	F	Verde muito escuro	2,42	1,30
346	135,99	23,70	M	Verde muito escuro	2,03	0,12
347	103,79	23,00	M	Verde muito escuro	2,61	0,72
348	136,40	27,50	M	Verde muito escuro	2,20	0,20
349	50,31	15,50	M	Verde muito escuro	2,00	0,31
350	112,16	x	x	Verde muito escuro	1,02	0,27
351	113,37	25,10	F	Verde muito escuro	2,17	2,73
352	92,83	27,80	M	Verde muito escuro	1,65	x
353	166,45	25,00	M	Verde muito escuro	0,67	0,29
354	137,24	26,60	M	x	4,58	1,43
355	86,87	27,50	M	Verde muito escuro	5,48	x
356	148,23	25,90	M	Verde muito escuro	5,61	x
357	91,27	25,00	M	Verde muito escuro	4,32	x
358	121,96	25,80	M	Verde muito escuro	4,72	0,48
359	161,13	25,00	M	Verde amarelado	5,79	0,80
360	92,50	25,00	M	x	4,30	0,60
361	118,89	25,50	M	Verde muito escuro	3,22	1,54

362	140,26	23,50	M	x	x	x
417	145,80	20,10	F	Avermelhada	x	3,50
418	236,90	23,00	F	Avermelhada	x	1,80
419	181,20	22,10	F	Amarelo clara	2,50	2,20
420	368,80	26,00	M	Avermelhada	3,80	x
421	194,70	21,00	F	Verde claro	4,40	5,40
422	195,80	22,00	F	Verde escuro	3,20	1,30
423	185,40	21,00	F	Verde escuro	1,80	1,20
424	214,20	22,50	F	Amarelo claro	2,30	1,30
425	547,60	31,00	F	Verde escuro	x	1,80
426	297,00	25,50	F	Verde escuro	2,30	7,40
427	615,71	34,50	M	Castanho avermelhada	x	x
428	242,16	24,00	M	Verde escura	3,34	1,25
434	1339,51	49,00	M	Avermelhado	0,33	1,50
435	1679,45	42,00	M	Avermelhado		x
442	250,00	23,00	x	Verde escuro	4,64	x
443	230,00	20,00	x	Verde escuro	5,67	x
444	300,00	36,00	x	Verde escuro	12,66	x

445	210,00	19,00	x	Verde escuro	2,96	x
446	220,00	21,00	x	Verde escuro	3,30	x
447	255,00	23,00	x	Verde escuro	4,15	x
448	245,00	22,00	x	Verde escuro	3,55	x
449	255,00	23,00	x	Verde escuro	6,09	x
450	240,00	22,00	x	Verde escuro	5,81	x
451	240,00	22,00	x	Verde escuro	?	x
452	190,38	21,50	x	Verde escura	4,18	x
453	332,81	26,00	x	Verde escura	4,33	x
454	196,03	22,00	x	Verde escura	1,91	x
455	337,40	26,00	x	Amarela	5,20	x
456	308,24	26,00	x	Amarela	3,84	x
457	168,72	21,00	x	Verde escura	1,92	x
458	167,43	21,50	x	Verde escura	2,93	x
459	285,46	25,50	x	Verde escura	5,06	x
460	308,89	25,50	x	Verde escura	6,39	x
461	213,98	23,00	x	Verde escura	5,98	x

Tainhas

Código	Wg (g)	Lt (cm)	Sexo	Cor da bÍlis	FÍgado	Gônadas
292	1298,01	52	F	Marrom escura	12,06	122,46
293	1174,01	56	M	Marrom escura	14,98	18,17
294	1098,23	52,7	M	Marrom escura	20	9,25
295	1182,75	51,8	M	-	16,88	32,95
296	1321,37	54,5	M	Marrom escura	22,69	31,05
297	751,95	43,7	M	Marrom escura	9,05	3,2
298	850,5	46,6	M	Marrom escura	12,5	10,36
299	880,27	46,4	M	Verde escura	19,2	20,26
300	1066,71	48,5	M	Marrom	16	51,16
301	4528,2	52	M	Marrom escura	22,73	40,08
302	1334,87	52,6	M	Marrom escura	25,91	22,6
303	654,75	40,05	F	Amarelo	13,9	34,6
304	717,56	45,5	M	Marrom escura	9,24	0,36
305	879,92	46,9	M	Marrom escura	12,3	9,62
306	1039,23	49,9	M	Marrom	13,96	21,07
307	1285,72	52,4	F	Verde escura	16,76	184,77

308	1162,49	54,8	M	Verde escura	16,6	24,79
309	1682,54	55,5	F	Marrom	30,66	241,97
310	1091,26	48,2	M	Castanho claro	15,96	15,57
311	1159,61	51,9	F	Castanho claro	21,47	16,06
312	1156,18	49,4	M	Verde escura	18,14	17,98
313	1203,7	50	F	Marrom escura	14,73	156,4
314	809,01	44,9	M	Marrom	13,15	16,06
315	982,5	52,5	F	Verde	16,18	2,96
316	1249,65	52	F	Castanho	41,64	1,42
317	1268,66	53,2	Ind	Amarelo	20,79	x
318	355,21	34,30	x	Castanho Avermelhada	5,68	x
319	171,44	28,4	x	Amarelo	1,67	x
320	360,52	35,10	M	Amarelo esverdeada	7,32	x
321	404,61	36,60	M	Amarelo esverdeada	4,9	0,47
322	422,24	30,50	F	Marrom	9,99	1,33
323	160,9	25,10	x	x	2,05	x
324	209,39	29,60	x	x	2,31	x
325	197,26	29,10	x	x	2,28	x

326	133	27,00	x	x	1,19	x
327	196,77	28,10	M	x	2,26	x
328	177,7	28,00	x	x	2,14	x
329	206,34	29,20	x	x	2,39	x
330	147,65	26,1	x	Verde muito escura	2,64	x
331	155,76	26,8	x	x	1,59	x
332	125,79	25,5	x	x	1,45	x
333	152,21	25	x	x	1,34	x
363	581,80	42,50	M	Marrom	8,48	0,86
364	575,30	41,50	M	Verde escura	9,80	0,88
365	533,75	41,20	M	Verde escura	8,69	3,62
366	1539,05	56,50	F	Marrom	29,37	x
367	602,58	43,00	M	Castanho	9,60	0,35
368	601,57	42,70	M	Marrom	8,64	x
369	1274,80	54,50	M	Verde escura	27,09	0,09
370	1438,47	56,20	F	Verde escura	27,75	4,11
371	1274,50	53,20	F	Marrom escura	19,49	2,65
372	1112,50	53,60	M	Castanho	18,52	1,14

373	1104,71	62,80	F	Verde escura	14,50	1,59
374	1268,20	54,80	F	Verde escura	29,02	2,40
375	1774,62	62,00	F	Marrom	23,07	x
376	952,50	48,60	F	Verde escura	13,28	1,68
377	1314,77	54,50	F	Marrom escura	16,60	3,01
378	1861,30	63,00	F	Verde escura	49,12	6,88
379	1102,42	51,50	M	Verde escura	29,97	x
380	593,55	42,50	X	Castanho	8,61	x
381	759,66	46,50	F	Marrom	12,73	1,35
382	747,33	47,40	M	Castanho avermelhada	10,10	0,11
383	949,32	51,00	M	Verde escura	12,03	0,30
384	619,90	43,10	M	Castanho	7,22	x
385	730,87	44,90	M	Marrom escura	12,73	x
386	708,00	44,80	F	Castanho	7,23	1,16
387	354,72	44,00	M	Castanho escura	12,21	x
388	684,20	44,00	F	Castanho	9,70	1,42
389	721,79	45,00	X	Castanho escura	8,82	x
390	559,15	41,20	F	Verde escura	9,99	x

391	1105,29	53,40	M	Verde escura	18,99	0,78
392	662,33	43,00	X	Castanho	8,92	0,58
393	644,37	43,20	M	Marrom escura	8,90	x
394	809,47	46,00	M	x	14,98	x
395	1074,26	51,00	M	Verde escura	21,73	x
396	1012,68	50,40	F	Marrom	12,43	0,59
397	1700,80	57,00	F	Marrom escura	28,99	3,81
398	872,84	48,00	X	Verde escura	17,84	0,44
399	932,45	47,00	X	Castanho	15,07	x
400	1099,91	54,00	M	Verde escura	13,43	0,15
401	1012,48	49,50	F	Verde escura	13,82	2,70
402	707,46	43,40	F	Castanho	10,47	0,59
403	1017,68	49,00	M	Castanho clara	22,6500	0,8400
404	678,00	47,00	x	Amarelo	12,4400	x
405	1132,12	51,50	F	Marrom	26,2800	3,6000
406	811,47	46,50	x	Verde	11,9700	x
407	900,00	46,90	x	Marrom	9,1766	x
408	543,05	39,50	x	Verde	9,4790	2,8534

409	803,31	47,60	x	Castanho	16,2790	x
410	432,65	36,00	M	Verde	6,4805	x
411	1284,50	54,00	M	x	28,7654	x
412	1170,89	51,00	F	Castanho	30,0570	2,0908
413	935,47	46,50	X	Castanho	21,7516	x
414	851,75	46,00	x	x	17,0818	x
415	625,84	43,00	x	Castanho	10,6740	x
416	373,29	34,00	M	Verde	4,1477	4,3407
427	1950,00	59,00	F	x	22,13	274,00
428	1738,82	58,50	M	Castanho avermelhada	40,07	40,50
429	1726,15	56,00	M	x	29,62	85,33
430	1666,79	56,00	F	x	30,39	17,86
431	1130,40	49,50	M	Verde escura	12,73	x
432	1118,54	49,00	M	Marrom escura	x	x
433	1279,61	56,50	M	Marrom	10,02	1,35
438	1108,56	51,50	M	Marrom escura	2,62	x
439	972,06	49,50	M	Marrom escura	x	2,03
440	815,61	46,00	M	Marrom escura	x	1,39

441	722,80	47,00	M	Marrom escura	x	2,05
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Anexo II. Papers publicados e/ou submetidos relacionados à tese

1. First-time report of metalloproteinases in fish bile and their potential as bioindicators regarding environmental contamination. Hauser-Davis, R.A.; Lima, A. A.; Ziolli, R. L.; de Campos, R. C. ***Aquatic Toxicology*. V. 110-111, p. 99-106, 2012. Fator de impacto: 3,333. Nível A2 (Capes).**
2. Fish Metalloproteins as Biomarkers of Environmental Contamination. Hauser-Davis, R.A.; Ziolli, R. L.; de Campos, R. C. ***Reviews of Environmental Contamination and Toxicology*. 2012. No prelo. Fator de impacto: 2,477. Nível B1/B2 (Capes).**
3. A novel report of metallothioneins in fish bile: SDS-PAGE analysis, spectrophotometry quantification and metal speciation characterization by liquid chromatography coupled to ICP-MS – Hauser-Davis, R.A.; Araújo, R.A.; Ziolli, R. L.; de Campos, R. C. ***Aquatic Toxicology*. 2012. No prelo. Fator de impacto: 3,333. Nível A2 (Capes).**
4. Fish bile as a biomarker for metal exposure – Hauser-Davis, R.A.; Araújo, R.A.; Oliveira, T.F.; Ziolli, R. L.; de Campos, R. C. ***Submetido, Marine Pollution Bulletin*. Fator de impacto: 2,359. Nível B1 (Capes).**

Anexo III. Outras produções publicadas e/ou submetidas

1. Associations between serum selenium levels and the conversion of bacteriological tests during anti-tuberculosis treatment. Milena Moraes; Daniela M Ramalho; Karina N Delogo; Pryscila F Miranda; Eliene D Mesquita; Hedi M Oliveira; Antônio Ruffino-Netto; Paulo C Almeida; Rachel A Hauser-Davis; Reinaldo C Campos; Afrânio L Kritski; Martha M Oliveira. ***Submetido, Journal of Trace Elements in Medicine and Biology. Fator de impacto: 2,176. Nível B1 (Capes).***
2. Elevated CO₂ effects on growth and nutrient allocation in a pasture plague plant, *Senna reticulata*. Saraiva, A.C.F.; Mesquita, A.; Hauser-Davis, R.A.; Oliveira, T.F. ***Submetido, Biomass and Bioenergy. Fator de impacto: 3,840. Nível B1 (Capes).***
3. The effects of environmental contamination on enzyme GST levels and overall health in mullets from contaminated Brazilian lagoons. Bastos F. F; Hauser-Davis, R.A.; Ziolli, R.L.; Campos, R.C.; Cunha Bastos V. L. F; Cunha Bastos J. ***Submetido, Marine Pollution Bulletin. Fator de impacto: 2,359. Nível B1 (Capes).***
4. Logistic regression and fuzzy logic as a classification method for feral fish sampling sites. Hauser-Davis, R.A.; Oliveira, T.F.; Silveira, A.M.; Protazio, J.M.B.; Ziolli, R.L. ***Submetido, Environmental and ecological statistics. (Pendente para aceite com pequenas revisões). Fator de impacto: 1,645. Nível B1 (Capes).***
5. Mercury and methyl Mercury ratios in caimans (*Caiman crocodilus yacare*) from the Pantanal area, Brazil. Vieira, L.M.; Nunes, V. da S.; Amaral, M. C. do A.; Oliveira, A.C.; Hauser-Davis, R.A. and Campos, R.C. ***Journal of Environmental Monitoring. V. 13, p. 280-287, 2011. Fator de impacto: 1,989. Nível B1 (Capes).***

6. Guiana Dolphins (*Sotalia guianensis*, Van Benédén 1864) as Indicators of the Bioaccumulation of Total Mercury along the Coast of Rio de Janeiro State, Southeastern Brazil. Moura, J.F.; Hacon, S. de S.; Veja, C.M.; Hauser-Davis, R.A.; Campos, R.C.; Siciliano, S. **Bulletin of Environmental Contamination and Toxicology**, v. 88 (1), p. 54-59, 2011. **Fator de impacto: 0,609. Nível B4 (Capes).**
7. Cleaner red mud residue production at an alumina plant by applying experimental design techniques in the filtration stage. Borges, A.J.P.; Hauser-Davis, R. A.; Oliveira, T.F. **Journal of Cleaner Production**, v. 19, p. 1763-1769, 2011. **Fator de impacto: 2,425. Nível B1 (Capes).**
8. Case study: Comparing the use of nonlinear discriminating analysis and Artificial Neural Networks in the classification of three fish species: acaras (*Geophagus brasiliensis*), tilapias (*Tilapia rendalli*) and mullets (*Mugil liza*). Hauser-Davis, R.A.; Oliveira, T.F.; Silveira, A.M.; Silva, T.B.; Ziolli, R.L.. **Ecological Informatics**, v. 5, p. 474-478, 2010. **Fator de impacto: 1,351. Nível B3 (Capes).**