

## Supplementary Materials

### **Positional and ontogenetic variation in vertebral centra morphology in five batoid species**

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**Table S1. Generalised additive model results for 10 different models to best describe centrum morphology along the vertebral column for five batoid species**

k is the number of knots used in each model

Species	Model		Dorso-ventral Diameter				Lateral Diameter				Rostro-caudal Length						
			Deviance	k	Adjusted $r^2$	AIC	$\Delta$ AIC	Deviance	k	Adjusted $r^2$	AIC	$\Delta$ AIC	Deviance	k	Adjusted $r^2$	AIC	$\Delta$ AIC
Little Skate	Pooled		3277.71	15	0.84	-25275.12	4449.48	3273.56	18	0.88	-23443.01	4433.9	3088.55	15	0.45	-23522.05	2241.74
	By Sex	Different Smoother	3265.75	18	0.84	-25263.06	4461.54	3261.56	18	0.88	-23453.14	4423.8	3072.59	18	0.47	-23590.06	2173.73
		Different Intercept	3275.28	18	0.84	-25276.17	4448.43	3272.56	18	0.88	-23443.65	4433.3	3085.32	18	0.46	-23576.90	2186.89
		Different Smoother & Intercept	3264.76	18	0.84	-25261.29	4463.31	3260.57	18	0.88	-23454.93	4422	3071.55	18	0.48	-23637.57	2126.22
	By Size	Different Smoother	3256.68	18	0.85	-25330.62	4393.98	3250.89	18	0.89	-23733.30	4143.6	3060.25	18	0.52	-23877.46	1886.33
		Different Intercept	3274.29	18	0.84	-25278.37	4446.23	3271.6	18	0.88	-23440.82	4436.1	3084.36	18	0.47	-23575.90	2187.89
		Different Smoother & Intercept	3254.69	18	0.85	-25329.92	4394.68	3248.95	18	0.89	-23734.11	4142.8	3058.12	18	0.53	-23926.75	1837.04
	By Individual	Different Smoother	3034.36	18	0.9	-26446.93	3277.67	2963.43	18	0.93	-24876.66	3000.3	2756.94	18	0.65	-24496.00	1267.79
		Different Intercept	3234.89	18	0.9	-26696.52	3028.08	3232.78	18	0.92	-24667.08	3209.9	3045.69	18	0.58	-24288.32	1475.47
		Different Smoother & Intercept	2901.33	18	0.96	-29724.60	0	2813.94	18	0.97	-27876.94	0	2644.62	18	0.78	-25763.79	0
Winter Skate	Pooled		462.05	15	0.86	-3614.77	926.251	462.03	16	0.86	-3451.75	691.53	454.63	13	0.52	-3589.57	414.821
	By Sex	Different Smoother	452.01	18	0.87	-3650.95	890.077	451.25	18	0.88	-3489.35	653.93	449.49	10	0.54	-3602.86	401.532
		Different Intercept	459.59	20	0.87	-3663.15	877.869	460.36	18	0.86	-3449.98	693.3	450.41	18	0.86	-3372.12	632.271
		Different Smoother & Intercept	450.31	18	0.89	-3708.53	832.493	450.26	18	0.88	-3487.91	655.37	440.36	18	0.88	-3408.80	595.59
	By Size	Different Smoother	443.47	15	0.93	-3896.50	644.521	439.29	17	0.92	-3677.35	465.93	441.87	10	0.58	-3633.88	370.514
		Different Intercept	459.99	16	0.87	-3638.81	902.213	459.56	17	0.88	-3481.86	661.42	451.96	14	0.6	-3677.31	327.083
		Different Smoother & Intercept	442.44	14	0.93	-3925.36	615.662	434.22	20	0.93	-3724.76	418.52	439.14	10	0.66	-3735.08	269.31
	By Individual	Different Smoother	412.76	17	0.95	-4084.52	456.506	397.4	20	0.96	-3999.54	143.74	426.11	12	0.65	-3696.49	307.90

Species	Model		Deviance	Dorso-ventral Diameter				Deviance	k	Lateral Diameter				Deviance	k	Rostro-caudal Length			
				k	Adjusted $r^2$	AIC	$\Delta$ AIC			Adjusted $r^2$	AIC	$\Delta$ AIC	Adjusted $r^2$			AIC	$\Delta$ AIC		
		Different Intercept	456.29	17	0.89	-3701.02	840.003	456.59	17	0.88	-3479.35	663.93	451.37	10	0.64	-3717.61	286.781		
		Different Smoother & Intercept	378.1	23	0.98	-4541.02	0	385	20	0.97	-4143.28	0	394.28	17	0.83	-4004.39	0		
Barndoor Skate	Pooled		459.00	10	0.79	-5574.04	1085.87	462.9	15	0.83	-5725.93	670.57	442.45	10	0.32	-5212.10	561.733		
	By Sex	Different Smoother	453.69	18	0.79	-5574.10	1085.81	458.24	10	0.83	-5731.21	665.29	437.25	10	0.33	-5209.29	564.541		
		Different Intercept	457.93	10	0.8	-5594.87	1065.04	462.8	10	0.83	-5723.23	673.28	441.47	10	0.32	-5211.42	562.41		
		Different Smoother & Intercept	453.24	10	0.8	-5596.25	1063.66	457.26	10	0.83	-5730.57	665.94	436.28	10	0.33	-5208.82	565.017		
	By Size	Different Smoother	448.64	10	0.87	-5799.38	860.529	452.42	10	0.87	-5840.35	556.15	432.06	10	0.47	-5319.94	453.889		
		Different Intercept	457.05	10	0.82	-5632.87	1027.04	461.75	15	0.86	-5808.95	587.56	440.27	10	0.4	-5263.24	510.597		
		Different Smoother & Intercept	446.04	10	0.89	-5852.63	807.275	449.73	10	0.89	-5922.32	474.19	429.11	10	0.55	-5389.19	384.644		
	By Individual	Different Smoother	433.82	10	0.92	-5955.65	704.26	434.07	10	0.93	-6090.14	306.37	418.69	10	0.52	-5348.10	425.73		
		Different Intercept	453.72	10	0.89	-5807.76	852.147	457.46	10	0.89	-5875.56	520.94	437	10	0.57	-5417.61	356.227		
		Different Smoother & Intercept	406.41	18	0.98	-6659.91	0	416.74	15	0.96	-6396.50	0	388.06	18	0.82	-5773.83	0		
Atlantic Stingray	Pooled		695.09	10	0.59	-4384.39	950.027	694.26	15	0.69	-4296.73	606.96	676.88	10	0.29	-4428.66	255.101		
	By Sex	Different Smoother	691.18	15	0.61	-4420.81	913.605	690.54	10	0.69	-4295.07	608.62	673.52	10	0.69	-4193.63	490.136		
		Different Intercept	693.28	15	0.59	-4382.33	952.085	694.03	10	0.69	-4307.25	596.44	677.05	10	0.69	-4206.18	477.585		
		Different Smoother & Intercept	690.2	15	0.61	-4418.96	915.457	689.51	10	0.69	-4307.12	596.57	672.5	10	0.69	-4206.19	477.577		
	By Size	Different Smoother	681.98	15	0.64	-4465.12	869.296	683.35	10	0.72	-4375.49	528.2	666.12	15	0.3	-4414.27	269.488		
		Different Intercept	691.94	15	0.68	-4538.10	796.308	692.29	10	0.69	-4304.36	599.33	670.6	18	0.47	-4620.88	62.883		
		Different Smoother & Intercept	678.48	15	0.72	-4634.37	700.044	681.32	10	0.73	-4379.01	524.68	660.07	15	0.46	-4587.61	96.157		
	By Individual	Different Smoother	658.12	10	0.66	-4487.95	846.458	654.97	10	0.74	-4386.82	516.87	648.52	10	0.28	-4378.91	304.85		

