

Dermal denticles as a tool to reconstruct shark communities

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Reference collection data and ANOVA tables

Table S1. Raw measurement data for all denticles in the reference collection. A total of 215 denticles spanning 37 species of elasmobranch were measured and assigned a functional morphotype following the designations in Reif 1985a. The characters are enumerated in Table 2, and sampling positions and abbreviations are described in Fig. 3.

Family	Species	Sample location	Functional morphotype	Crown shape					Crown size	Crown thickness	Micro-structures	>1 peaks	Peak type				Ridges		Ridge length		Spine	Orientation		Ridge spacing (µm)
				1	2	3	4	5					1	2	3	4	≥1	No.	1	2		1	2	
Alopiidae	<i>Alopias vulpinus</i>	B2	Drag reduction	0	0	1	0	0	181	14.5	1	1	0	1	0	0	1	3	0	1	0	1	0	50
		B3	Drag reduction	1	0	0	0	0	198	7.9	0	1	0	1	0	0	1	3	0	1	0	1	0	63
		C2	Drag reduction	1	0	0	0	0	158	2.5	0	1	0	1	0	0	1	3	0	1	0	1	0	44
		D2	Drag reduction	0	0	1	0	0	99	2.6	0	1	0	1	0	0	1	3	0	1	0	1	0	25
		P2	Drag reduction	1	0	0	0	0	106	4.2	0	0	1	0	0	0	1	3	1	0	0	1	0	31
Carcharhinidae	<i>Carcharhinus acronotus</i>	B2	Drag reduction	1	0	0	0	0	444	5.9	0	1	0	0	1	0	1	5	0	1	0	1	0	106
		C2	Drag reduction	0	0	1	0	0	384	7.7	0	1	0	0	1	0	1	5	0	1	0	1	0	75
		D2	Drag reduction	1	0	0	0	0	384	6.1	0	1	0	0	1	0	1	7	0	1	0	1	0	63
		P2	Drag reduction	0	0	1	0	0	387	6.2	0	0	1	0	0	0	1	6	0	1	0	0	1	69
		P2	Drag reduction	0	0	1	0	0	387	6.2	0	0	1	0	0	0	1	6	0	1	0	0	1	69
	<i>Carcharhinus albimarginatus</i>	B2	Drag reduction	1	0	0	0	0	300	6	1	1	0	1	0	0	1	3	0	1	0	1	0	81
		C2	Drag reduction	1	0	0	0	0	236	4.7	1	1	0	0	1	0	1	3	0	1	0	1	0	63
		D2	Drag reduction	1	0	0	0	0	238	4.8	0	1	0	0	1	0	1	5	0	1	0	1	0	44
		P2	Drag reduction	0	0	1	0	0	256	6.8	1	1	0	0	1	0	1	5	0	1	0	1	0	56
	<i>Carcharhinus falciformis</i>	B1	Drag reduction	1	0	0	0	0	269	7.2	1	1	0	1	0	0	1	5	0	1	0	1	0	81
		B2	Drag reduction	0	0	1	0	0	244	3.9	1	1	0	1	0	0	1	5	0	1	0	1	0	69
		B2	Drag reduction	1	0	0	0	0	244	3.9	1	1	0	1	0	0	1	5	0	1	0	1	0	69
		B2	Drag reduction	0	0	1	0	0	250	4	1	1	0	1	0	0	1	5	0	1	0	1	0	69
		C1	Drag reduction	1	0	0	0	0	194	3.1	1	1	0	0	1	0	1	5	0	1	0	1	0	50
C1		Drag reduction	0	0	1	0	0	204	4.1	1	1	0	1	0	0	1	5	0	1	0	1	0	44	
C1		Abrasion strength	1	0	0	0	0	211	3.4	1	0	1	0	0	0	0	0	0	0	0	0	0	0	-
C1	Generalized functions	1	0	0	0	0	180	4.8	1	0	1	0	0	0	1	3	1	0	0	1	0	38		

Family	Species	Sample location	Functional morphotype	Crown shape					Crown size	Crown thickness	Micro-structures	>1 peaks	Peak type				Ridges		Ridge length		Spine	Orientation		Ridge spacing (µm)
				1	2	3	4	5					1	2	3	4	≥1	No.	1	2		1	2	
		C2	Drag reduction	0	0	1	0	0	194	3.1	1	1	0	1	0	0	1	3	0	1	0	1	0	56
		C2	Drag reduction	1	0	0	0	0	198	3.2	1	1	0	1	0	0	1	5	0	1	0	1	0	50
		C3	Drag reduction	1	0	0	0	0	150	4	0	1	0	0	1	0	1	5	0	1	0	1	0	38
		C3	Abrasion strength	1	0	0	0	0	240	3.8	0	0	1	0	0	0	0	0	0	0	0	0	0	-
		D1	Drag reduction	1	0	0	0	0	180	4.8	1	1	0	0	1	0	1	3	0	1	0	1	0	44
		D1	Abrasion strength	1	0	0	0	0	184	2.9	1	0	1	0	0	0	0	0	0	0	0	0	0	-
		D1	Generalized functions	0	0	1	0	0	130	10.4	1	0	1	0	0	0	1	3	1	0	0	1	0	38
		D2	Drag reduction	0	0	1	0	0	194	5.2	1	0	1	0	0	0	1	5	0	1	0	1	0	38
		D2	Abrasion strength	1	0	0	0	0	224	4.5	1	0	1	0	0	0	0	0	0	0	0	0	0	-
		D2	Generalized functions	0	0	1	0	0	179	4.8	1	0	1	0	0	0	1	5	1	0	0	1	0	38
		D2	Drag reduction	1	0	0	0	0	169	4.5	1	1	0	0	1	0	1	5	0	1	0	1	0	38
		D3	Drag reduction	1	0	0	0	0	187	5	1	1	0	1	0	0	1	3	0	1	0	1	0	44
		D3	Drag reduction	1	0	0	0	0	175	4.7	1	1	0	1	0	0	1	3	0	1	0	1	0	44
		D3	Generalized functions	1	0	0	0	0	244	4.9	1	0	1	0	0	0	0	0	0	0	0	0	0	-
		D3	Generalized functions	1	0	0	0	0	219	5.8	1	0	1	0	0	0	0	0	0	0	0	0	0	-
		E	Drag reduction	0	0	1	0	0	219	4.4	1	0	0	0	1	0	1	5	0	1	0	1	0	50
		H2	Drag reduction	1	0	0	0	0	238	4.8	1	1	0	0	1	0	1	5	0	1	0	1	0	56
		P1	Drag reduction	0	0	1	0	0	124	5	1	1	0	0	1	0	1	3	0	1	0	1	0	31
		P1	Abrasion strength	1	0	0	0	0	224	3.6	1	0	1	0	0	0	0	0	0	0	0	0	0	-
		P1	Generalized functions	1	0	0	0	0	209	8.4	1	0	1	0	0	0	0	0	0	0	0	0	0	-
		P1	Drag reduction	0	0	1	0	0	180	4.8	1	1	0	1	0	0	1	5	0	1	0	1	0	44
		P2	Drag reduction	0	0	1	0	0	188	5	1	1	0	1	0	0	1	5	0	1	0	1	0	44
		P2	Drag reduction	1	0	0	0	0	225	4.5	1	1	0	0	1	0	1	5	0	1	0	1	0	44
		P2	Generalized functions	1	0	0	0	0	225	9	1	0	1	0	0	0	0	0	0	0	0	0	0	-
	<i>Carcharhinus galapagensis</i>	B2	Drag reduction	1	0	0	0	0	299	6	1	1	0	1	0	0	1	3	0	1	0	1	0	75
		C2	Drag reduction	0	0	1	0	0	303	4.8	1	1	0	1	0	0	1	3	0	1	0	1	0	63
		D2	Drag reduction	1	0	0	0	0	238	6.3	1	0	1	0	0	0	1	3	0	1	0	1	0	63
		H1	Abrasion strength	0	0	1	0	0	263	2.6	1	0	1	0	0	0	0	0	0	0	0	0	0	-
		P2	Drag reduction	0	0	1	0	0	256	6.8	1	1	0	0	1	0	1	5	0	1	0	1	0	63
	<i>Carcharhinus leucas</i>	B2	Drag reduction	1	0	0	0	0	288	4.6	1	1	0	1	0	0	1	3	0	1	0	1	0	113
		C2	Drag reduction	1	0	0	0	0	274	4.4	1	1	0	1	0	0	1	3	0	1	0	1	0	100
		D2	Drag reduction	1	0	0	0	0	288	4.6	1	1	0	1	0	0	1	3	0	1	0	1	0	88
		H2	Drag reduction	1	0	0	0	0	312	5	1	1	0	1	0	0	1	3	0	1	0	1	0	113
		P2	Drag reduction	1	0	0	0	0	274	5.5	1	1	0	1	0	0	1	3	0	1	0	1	0	69
	<i>Carcharhinus limbatus</i>	B2	Drag reduction	1	0	0	0	0	219	4.4	0	1	0	1	0	0	1	3	0	1	0	1	0	63
		C2	Drag reduction	1	0	0	0	0	274	5.5	1	1	0	1	0	0	1	5	0	1	0	1	0	56
		D2	Drag reduction	0	1	0	0	0	237	6.3	1	1	0	0	1	0	1	5	0	1	0	1	0	38
		GS	Drag reduction	1	0	0	0	0	231	6.2	1	1	0	1	0	0	1	3	0	1	0	1	0	63
		N	Ridged abrasion strength	0	0	1	0	0	235	2.3	1	0	1	0	0	0	1	3	0	1	0	1	0	69
		P1	Abrasion strength	0	0	1	0	0	161	2.6	1	0	1	0	0	0	0	0	0	0	0	0	0	-
		P2	Drag reduction	1	0	0	0	0	267	5.3	1	1	0	0	1	0	1	5	0	1	0	1	0	50
	<i>Carcharhinus melanopterus</i>	B2	Drag reduction	0	0	1	0	0	638	10.2	0	0	0	0	1	0	1	7	0	1	0	1	0	131

Family	Species	Sample location	Functional morphotype	Crown shape					Crown size	Crown thickness	Micro-structures	>1 peaks	Peak type				Ridges		Ridge length		Spine	Orientation		Ridge spacing (µm)
				1	2	3	4	5					1	2	3	4	≥1	No.	1	2		1	2	
		C2	Drag reduction	0	0	1	0	0	586	7.8	0	0	1	0	0	0	1	7	0	1	0	1	0	100
		D2	Drag reduction	0	0	1	0	0	542	8.7	0	0	1	0	0	0	1	5	0	1	0	1	0	81
		H3	Drag reduction	0	0	1	0	0	543	4.8	0	0	1	0	0	0	1	7	0	1	0	1	0	113
		P2	Drag reduction	0	0	1	0	0	622	9.9	0	0	1	0	0	0	1	7	0	1	0	1	0	106
	<i>Carcharhinus obscurus</i>	B2	Drag reduction	1	0	0	0	0	237	3.2	1	1	0	1	0	0	1	3	0	1	0	1	0	63
		B3	Drag reduction	1	0	0	0	0	275	7.3	1	1	0	1	0	0	1	3	0	1	0	1	0	81
		C2	Drag reduction	0	0	1	0	0	250	3.3	1	1	0	1	0	0	1	3	0	1	0	1	0	63
		D1	Abrasion strength	0	0	1	0	0	269	2.4	1	0	0	0	0	1	0	0	0	0	0	0	0	-
		D2	Drag reduction	1	0	0	0	0	256	4.1	1	1	0	1	0	0	1	3	0	1	0	1	0	63
		GS	Drag reduction	1	0	0	0	0	294	7.8	1	1	0	1	0	0	1	5	0	1	0	1	0	75
		P2	Drag reduction	1	0	0	0	0	247	4	1	1	0	1	0	0	1	3	0	1	0	1	0	63
		P3	Drag reduction	0	0	1	0	0	206	8.2	1	1	0	1	0	0	1	4	0	1	0	0	1	44
	<i>Carcharhinus perezi</i>	B2	Drag reduction	1	0	0	0	0	181	3.6	1	1	0	1	0	0	1	3	0	1	0	1	0	75
		C2	Drag reduction	0	0	1	0	0	268	5.4	1	1	0	1	0	0	1	3	0	1	0	1	0	63
		D2	Drag reduction	0	0	1	0	0	184	4.9	1	1	0	1	0	0	1	3	0	1	0	1	0	50
		P2	Drag reduction	0	0	1	0	0	173	4.6	1	1	0	1	0	0	1	3	0	1	0	1	0	44
	<i>Galeocerdo cuvier</i>	B2	Defense	0	0	0	1	0	188	1.5	0	0	1	0	0	0	1	4	0	1	1	0	1	75
		C1	Defense	0	0	0	1	0	276	3.7	1	0	0	0	0	1	4	1	0	1	0	1	0	63
		C2	Defense	0	0	0	1	0	209	2.4	0	0	1	0	0	0	1	4	0	1	1	0	1	75
		D2	Defense	0	0	0	1	0	173	2	0	0	1	0	0	0	1	4	0	1	1	0	1	63
		D3	Defense	0	0	0	1	0	173	1.5	0	0	1	0	0	0	1	4	0	1	1	0	1	63
		H3	Defense	0	0	0	1	0	171	2	0	0	1	0	0	0	1	4	0	1	1	0	1	75
		P2	Defense	0	0	0	1	0	166	2.2	0	0	1	0	0	0	1	4	0	1	1	0	1	50
	<i>Negaprion acutidens</i>	B2	Drag reduction	1	0	0	0	0	356	4.7	0	1	0	1	0	0	1	3	0	1	0	1	0	131
		C2	Drag reduction	1	0	0	0	0	294	4.7	1	1	0	1	0	0	1	3	0	1	0	1	0	88
		D2	Drag reduction	1	0	0	0	0	311	8.3	1	1	0	0	1	0	1	3	0	1	0	1	0	69
		P2	Drag reduction	1	0	0	0	0	334	6.7	1	1	0	0	1	0	1	3	0	1	0	1	0	81
	<i>Negaprion brevirostris</i>	B2	Drag reduction	1	0	0	0	0	387	6.2	0	1	0	1	0	0	1	3	0	1	0	1	0	125
		B3	Drag reduction	1	0	0	0	0	306	8.2	1	1	0	1	0	0	1	3	0	1	0	1	0	75
		C2	Drag reduction	1	0	0	0	0	306	6.1	1	1	0	1	0	0	1	3	0	1	0	1	0	81
		D2	Generalized functions	1	0	0	0	0	308	6.2	1	0	1	0	0	0	1	6	1	0	0	0	1	81
		P2	Drag reduction	0	0	1	0	0	310	6.2	1	1	0	1	0	0	1	4	0	1	0	0	1	50
	<i>Prionace glauca</i>	B2	Drag reduction	1	0	0	0	0	344	6.9	1	1	0	1	0	0	1	3	0	1	0	1	0	113
		C2	Ridged abrasion strength	0	1	0	0	0	339	3.9	1	0	0	0	0	1	1	3	0	1	0	1	0	88
		D2	Drag reduction	0	1	0	0	0	272	4.4	1	0	0	0	0	1	1	3	0	1	0	1	0	69
		P2	Ridged abrasion strength	0	1	0	0	0	342	3	1	0	0	0	0	1	1	3	0	1	0	1	0	88
	<i>Rhizoprionodon porosus</i>	B1	Drag reduction	1	0	0	0	0	362	5.8	1	1	0	1	0	0	1	5	0	1	0	1	0	81
		B2	Drag reduction	1	0	0	0	0	362	5.8	1	1	0	1	0	0	1	5	0	1	0	1	0	81
		B3	Drag reduction	0	0	1	0	0	412	4.7	1	1	0	0	1	0	1	5	0	1	0	1	0	81
		C1	Drag reduction	0	1	0	0	0	298	4.8	1	1	0	0	1	0	1	5	0	1	0	1	0	75
		C2	Drag reduction	1	0	0	0	0	332	6.6	1	1	0	0	1	0	1	5	0	1	0	1	0	63
		C3	Drag reduction	0	1	0	0	0	237	6.3	1	1	0	0	1	0	1	5	0	1	0	1	0	38

Family	Species	Sample location	Functional morphotype	Crown shape					Crown size	Crown thickness	Micro-structures	>1 peaks	Peak type				Ridges		Ridge length		Spine	Orientation		Ridge spacing (µm)
				1	2	3	4	5					1	2	3	4	≥1	No.	1	2		1	2	
		D1	Drag reduction	0	0	1	0	0	261	10.5	1	0	1	0	0	0	1	5	0	1	0	1	0	38
		D1	Generalized functions	0	0	1	0	0	231	9.2	1	0	1	0	0	0	0	0	0	0	0	0	0	-
		D1	Generalized functions	0	0	1	0	0	237	9.5	1	0	1	0	0	0	1	5	1	0	0	0	1	38
		D2	Drag reduction	0	1	0	0	0	292	5.8	1	0	1	0	0	0	1	5	0	1	0	1	0	50
		D3	Drag reduction	0	1	0	0	0	317	25.4	1	0	0	0	0	1	1	5	0	1	0	1	0	31
		D3	Drag reduction	1	0	0	0	0	256	6.8	1	1	0	0	1	0	1	5	0	1	0	1	0	50
		D3	Drag reduction	0	0	1	0	0	235	6.3	1	0	1	0	0	0	1	5	0	1	0	1	0	38
		H2	Drag reduction	0	0	1	0	0	337	5.4	1	1	0	0	1	0	1	5	0	1	0	1	0	69
		N	Drag reduction	1	0	0	0	0	323	12.9	1	0	1	0	0	0	1	5	0	1	0	1	0	56
		N	Abrasion strength	0	0	1	0	0	356	3.6	1	0	1	0	0	0	0	0	0	0	0	0	0	-
		N	Ridged abrasion strength	0	0	1	0	0	313	6.3	1	0	1	0	0	0	1	6	1	0	0	1	0	63
		P1	Drag reduction	0	1	0	0	0	265	7.1	1	0	0	0	0	1	1	6	0	1	0	0	1	38
		P1	Generalized functions	0	0	1	0	0	211	5.6	1	0	1	0	0	0	1	5	1	0	0	1	0	31
		P2	Drag reduction	1	0	0	0	0	247	9.9	1	1	0	0	1	0	1	5	0	1	0	1	0	44
		P2	Generalized functions	1	0	0	0	0	249	9.9	0	0	1	0	0	0	0	0	0	0	0	0	0	-
		P2	Generalized functions	0	0	1	0	0	243	9.7	0	0	1	0	0	0	1	5	1	0	0	1	0	31
	<i>Rhizoprionodon terraenovae</i>	B2	Drag reduction	1	0	0	0	0	237	3.8	1	1	0	1	0	0	1	3	0	1	0	1	0	69
		B3	Drag reduction	1	0	0	0	0	229	4.6	1	1	0	1	0	0	1	3	0	1	0	1	0	69
		D2	Drag reduction	1	0	0	0	0	198	7.9	1	1	0	0	1	0	1	3	0	1	0	1	0	50
	<i>Triacodon obesus</i>	H1	Abrasion strength	1	0	0	0	0	268	3.6	0	0	1	0	0	0	0	0	0	0	0	0	0	-
		B2	Ridged abrasion strength	0	0	1	0	0	455	4.6	1	0	1	0	0	0	1	5	0	1	0	1	0	125
		C2	Drag reduction	0	0	1	0	0	430	5.7	0	0	1	0	0	0	1	5	0	1	0	1	0	94
		C2	Ridged abrasion strength	0	0	1	0	0	456	3	0	0	1	0	0	0	1	6	0	1	0	0	1	88
		D1	Abrasion strength	0	0	0	0	0	477	2.1	1	0	1	0	0	0	0	0	0	0	0	0	0	-
		D2	Ridged abrasion strength	0	0	1	0	0	369	3.7	1	0	1	0	0	0	1	6	1	0	0	1	0	81
		E	Abrasion strength	0	0	1	0	0	550	3.7	0	0	1	0	0	0	1	10	1	0	0	1	0	88
		P2	Ridged abrasion strength	0	0	1	0	0	400	5.3	0	0	1	0	0	0	1	6	1	0	0	0	1	88
Centrophoridae	<i>Centrophorus granulosus</i>	B2	Ridged abrasion strength	0	1	0	0	0	976	5.6	0	0	0	0	0	1	1	6	1	0	0	0	1	131
		B3	Ridged abrasion strength	0	0	1	0	0	806	5.4	0	0	0	0	0	1	1	5	1	0	0	0	1	238
		C2	Ridged abrasion strength	0	1	0	0	0	915	7.3	0	0	0	0	0	1	1	6	1	0	0	0	1	125
		D2	Ridged abrasion strength	0	1	0	0	0	600	6.9	0	0	0	0	0	1	1	4	0	1	0	0	1	100
		P2	Ridged abrasion strength	0	1	0	0	0	627	6.3	0	0	0	0	0	1	1	5	0	1	0	0	1	125
Dalatiidae	<i>Isistius brasiliensis</i>	B2	Luminescence	0	0	1	0	0	131	5.2	0	0	1	0	0	0	0	0	0	0	0	0	0	-
Etmopteridae	<i>Etmopterus pusillus</i>	B2	Luminescence	0	0	0	0	0	194	5.2	0	0	1	0	0	0	0	0	0	0	0	0	0	-
Ginglymostomatidae	<i>Ginglymostoma cirratum</i>	B1	Ridged abrasion strength	0	0	1	0	0	824	3.3	0	0	1	0	0	0	1	3	1	0	0	0	1	281
		B2	Ridged abrasion strength	0	0	1	0	0	924	3	0	0	1	0	0	0	1	3	1	0	0	1	0	288
		B3	Abrasion strength	0	0	1	0	0	474	3.4	0	0	1	0	0	0	0	0	0	0	0	0	0	-
		B3	Generalized functions	0	0	1	0	0	316	5.1	0	0	1	0	0	0	0	0	0	0	0	0	0	-
		B3	Ridged abrasion strength	0	0	1	0	0	613	3.3	0	0	1	0	0	0	1	3	1	0	0	1	0	150
		C2	Abrasion strength	0	0	1	0	0	370	3	0	0	1	0	0	0	0	0	0	0	0	0	0	-
		C2	Ridged abrasion strength	0	0	1	0	0	675	4.2	0	0	1	0	0	0	1	3	1	0	0	1	0	163
		D2	Ridged abrasion strength	0	0	1	0	0	612	3.3	0	0	1	0	0	0	1	3	1	0	0	0	1	200

Family	Species	Sample location	Functional morphotype	Crown shape					Crown size	Crown thickness	Micro-structures	>1 peaks	Peak type				Ridges		Ridge length		Spine	Orientation		Ridge spacing (µm)
				1	2	3	4	5					1	2	3	4	≥1	No.	1	2		1	2	
Hexanchidae	<i>Nebrius ferrugineus</i>	D3	Abrasion strength	1	0	0	0	0	280	3.7	0	0	1	0	0	0	0	0	0	0	0	0	0	-
		H1	Abrasion strength	0	0	1	0	0	706	3.8	0	0	1	0	0	0	0	0	0	0	0	0	0	-
		H3	Ridged abrasion strength	0	0	1	0	0	706	3.3	0	0	1	0	0	0	1	5	1	0	0	1	0	175
		P1	Abrasion strength	0	0	1	0	0	718	3.8	0	0	1	0	0	0	0	0	0	0	0	0	0	-
		P2	Ridged abrasion strength	0	0	1	0	0	574	3.1	0	0	1	0	0	0	1	3	1	0	0	1	0	188
		P3	Generalized functions	0	0	1	0	0	354	5.7	0	0	1	0	0	0	0	0	0	0	0	0	0	-
		E	Abrasion strength	0	0	1	0	0	1262	3.7	0	0	1	0	0	0	0	0	0	0	0	0	0	-
		GS	Abrasion strength	0	0	1	0	0	655	5.2	0	0	1	0	0	0	0	0	0	0	0	0	0	-
		GS	Generalized functions	0	1	0	0	0	308	6.2	0	0	0	0	0	1	0	0	0	0	0	0	0	-
		GS	Generalized functions	0	0	1	0	0	529	14.1	0	0	1	0	0	0	1	3	1	0	0	1	0	150
		N	Abrasion strength	0	0	0	0	0	1188	4.5	0	0	1	0	0	0	0	0	0	0	0	0	0	-
		B2	Generalized functions	0	0	1	0	0	406	6.5	0	1	0	1	0	0	1	3	0	1	0	0	1	119
		C2	Generalized functions	0	1	0	0	0	498	5	0	1	0	0	1	0	1	3	0	1	0	1	0	125
P2	Generalized functions	0	1	0	0	0	364	7.3	0	0	0	0	0	1	1	3	0	1	0	1	0	106		
H2	Generalized functions	0	1	0	0	0	347	5.5	0	1	0	1	0	0	1	3	0	1	0	0	1	113		
Lamnidae	<i>Isurus oxyrinchus</i>	B2	Drag reduction	1	0	0	0	0	211	16.9	0	1	0	1	0	0	1	3	0	1	0	0	1	50
		C2	Drag reduction	1	0	0	0	0	148	5.9	0	1	0	1	0	0	1	3	0	1	0	1	0	31
		D2	Drag reduction	1	0	0	0	0	131	5.2	0	1	0	1	0	0	1	3	0	1	0	1	0	31
		P2	Drag reduction	1	0	0	0	0	161	12.8	0	0	1	0	0	0	1	3	0	1	0	1	0	38
Pristidae	<i>Pristis perotteti</i>	B2	Generalized functions	0	1	0	0	0	156	4.2	0	0	0	0	0	1	1	2	1	0	0	1	0	50
		D2	Generalized functions	0	1	0	0	0	150	4	0	0	0	0	0	1	1	2	1	0	0	1	0	50
		H3	Generalized functions	0	1	0	0	0	187	3.7	0	0	0	0	0	1	1	2	1	0	0	1	0	75
		P2	Generalized functions	0	1	0	0	0	132	5.3	0	0	0	0	0	1	1	1	1	0	0	0	0	-
		P2	Generalized functions	0	1	0	0	0	132	5.3	0	0	0	0	0	1	1	2	1	0	0	1	0	50
Pseudocarchariidae	<i>Pseudocarcharias kamoharai</i>	B2	Ridged abrasion strength	0	0	1	0	0	261	7	1	0	0	0	0	1	1	3	0	1	0	1	0	88
		C2	Ridged abrasion strength	0	0	1	0	0	238	4.8	1	0	0	0	0	1	1	3	0	1	0	1	0	75
		D2	Ridged abrasion strength	0	0	1	0	0	237	3.8	1	0	0	0	0	1	1	3	0	1	0	1	0	69
		P2	Ridged abrasion strength	0	0	1	0	0	242	3.9	1	0	0	0	0	1	1	3	0	1	0	1	0	75
Rhinobatidae	<i>Rhinobatos lentiginosus</i>	B1	Abrasion strength	0	0	0	0	1	418	5.6	1	0	1	0	0	0	0	0	0	0	0	0	0	-
Scyliorhinidae	<i>Scyliorhinus retifer</i>	B2	Generalized functions	0	1	0	0	0	366	4.2	1	0	0	0	0	1	1	3	0	1	0	0	1	81
		C2	Generalized functions	0	1	0	0	0	491	7.8	1	0	0	0	0	1	1	5	0	1	0	0	1	100
		D2	Generalized functions	0	1	0	0	0	472	6.3	1	1	0	0	0	1	1	3	0	1	0	0	1	94
		P2	Generalized functions	0	1	0	0	0	298	8	1	1	0	0	0	1	1	5	0	1	0	1	0	63
Sphyrnidae	<i>Sphyrna couardi</i>	E	Ridged abrasion strength	0	0	1	0	0	262	2.3	1	0	1	0	0	0	1	5	0	1	0	1	0	50
		N	Ridged abrasion strength	0	0	1	0	0	229	1.8	1	0	1	0	0	0	1	5	0	1	0	1	0	50
	<i>Sphyrna lewini</i>	B2	Drag reduction	0	0	1	0	0	205	16.4	1	1	0	1	0	0	1	3	0	1	0	1	0	50
		C2	Drag reduction	1	0	0	0	0	168	3.4	1	1	0	1	0	0	1	3	0	1	0	1	0	50
		D2	Drag reduction	1	0	0	0	0	175	7	1	1	0	1	0	0	1	3	0	1	0	1	0	50
		H1	Ridged abrasion strength	0	0	1	0	0	175	2.8	1	0	1	0	0	0	1	3	0	1	0	1	0	50
	<i>Sphyrna mokarran</i>	P2	Drag reduction	1	0	0	0	0	149	6	1	1	0	0	1	0	1	3	0	1	0	1	0	38
		B2	Drag reduction	1	0	0	0	0	194	15.5	1	1	0	1	0	0	1	3	0	1	0	1	0	50
		B3	Drag reduction	1	0	0	0	0	229	18.3	1	1	0	1	0	0	1	3	0	1	0	1	0	50

Family	Species	Sample location	Functional morphotype	Crown shape					Crown size	Crown thickness	Micro-structures	>1 peaks	Peak type				Ridges		Ridge length		Spine	Orientation		Ridge spacing (µm)	
				1	2	3	4	5					1	2	3	4	≥1	No.	1	2		1	2		
Squalidae	<i>Sphyrna tiburo</i>	C1	Drag reduction	1	0	0	0	0	198	7.9	1	1	0	1	0	0	1	5	0	1	0	1	0	50	
		C3	Drag reduction	1	0	0	0	0	194	15.5	1	1	0	1	0	0	1	3	0	1	0	1	0	38	
		D2	Drag reduction	1	0	0	0	0	193	15.4	1	1	0	1	0	0	1	3	0	1	0	1	0	38	
		P2	Drag reduction	1	0	0	0	0	168	13.4	1	1	0	1	0	0	1	3	0	1	0	1	0	38	
		B2	Drag reduction	1	0	0	0	0	281	11.2	1	1	0	1	0	0	1	5	0	1	0	1	0	63	
		C2	Drag reduction	1	0	0	0	0	310	5	0	1	0	1	0	0	1	5	0	1	0	1	0	63	
		D1	Abrasion strength	0	0	1	0	0	311	2.1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	-
		D1	Ridged abrasion strength	0	0	1	0	0	224	3.6	1	0	1	0	0	0	1	5	0	1	0	1	0	50	
		D2	Drag reduction	0	0	1	0	0	212	4.2	1	1	0	1	0	0	1	5	0	1	0	1	0	50	
	<i>Sphyrna zygaena</i>	P2	Drag reduction	0	0	1	0	0	219	4.4	1	1	0	1	0	0	1	5	0	1	0	1	0	44	
		B2	Drag reduction	1	0	0	0	0	224	8.9	1	1	0	1	0	0	1	3	0	1	0	1	0	50	
		C2	Drag reduction	1	0	0	0	0	212	5.7	1	1	0	1	0	0	1	3	0	1	0	1	0	56	
		D2	Drag reduction	1	0	0	0	0	161	12.8	1	1	0	1	0	0	1	3	0	1	0	1	0	50	
		H2	Drag reduction	0	0	1	0	0	250	5	0	1	0	1	0	0	1	7	0	1	0	1	0	50	
		P2	Drag reduction	1	0	0	0	0	155	6.2	1	1	0	1	0	0	1	3	0	1	0	1	0	44	
		<i>Squalus acanthias</i>	B2	Defense	0	0	0	1	0	150	1.2	0	0	0	0	0	1	1	1	0	1	1	0	0	-
			<i>Squalus cubensis</i>	B2	Defense	0	0	0	1	0	208	1.5	0	0	0	0	1	1	2	0	1	1	0	1	73
				C2	Generalized functions	0	1	0	0	0	288	5.8	0	1	0	1	0	0	1	6	0	1	1	0	1
Squatinae	<i>Squatina dumeril</i>	D2	Defense	0	0	0	1	0	198	2.6	0	0	0	0	1	1	4	0	1	1	0	1	69		
		P2	Defense	0	0	0	1	0	219	1.9	0	0	0	0	1	1	2	0	1	1	0	1	63		
Squatinae	<i>Squatina dumeril</i>	B2	Defense	0	1	0	0	0	390	6.2	1	0	0	0	0	1	1	2	0	1	1	1	0	113	
Triakidae	<i>Mustelus canis</i>	B2	Generalized functions	0	1	0	0	0	256	5.1	0	0	0	0	0	1	1	2	0	1	0	1	0	50	
B3		Generalized functions	1	0	0	0	0	306	8.2	1	1	0	1	0	0	1	5	0	1	0	1	0	56		
C2		Generalized functions	0	1	0	0	0	355	9.5	1	0	0	0	0	1	1	4	0	1	0	1	0	63		
D3		Generalized functions	0	1	0	0	0	235	9.4	1	0	0	0	0	1	1	3	1	0	0	1	0	50		
P2		Generalized functions	0	1	0	0	0	222	8.9	1	0	0	0	0	1	1	3	1	0	0	1	0	31		

Table S2. Distribution of functional morphotypes across shark species and families. Numbers correspond to boxes in Fig. 2A: (1) drag reduction; (2) abrasion strength; (3) defense; (4) generalized functions; and (5) ridged abrasion strength. Sampling positions and abbreviations are described in Fig. 3.

Family	Species	N	H1	H2	H3	E	GS	P1	P2	P3	B1	B2	B3	D1	D2	D3	C1	C2	C3	
Alopiidae	<i>Alopias vulpinus</i>								1			1	1		1				1	
Carcharhinidae	<i>Carcharhinus acronotus</i>								1			1			1				1	
	<i>Carcharhinus albimarginatus</i>								1			1			1				1	
	<i>Carcharhinus falciformis</i>					1		1,2,4	1,4		1	1	1	1,2,4	1,2,4	1,4	1,2,4	1	1,2	
	<i>Carcharhinus galapagensis</i>		2						1			1			1				1	
	<i>Carcharhinus leucas</i>			1					1			1			1				1	
	<i>Carcharhinus limbatus</i>	5					1	2	1			1			1				1	
	<i>Carcharhinus melanopterus</i>				1				1			1			1				1	
	<i>Carcharhinus obscurus</i>							1		1	1		1	1	2	1			1	
	<i>Carcharhinus perezii</i>									1			1			1			1	
	<i>Galeocerdo cuvier</i>				3					3			3			3	3	3	3	
	<i>Negaprion acutidens</i>									1			1			1			1	
	<i>Negaprion brevirostris</i>									1			1	1		4			1	
	<i>Prionace glauca</i>									5			1			1			5	
	<i>Rhizoprionodon porosus</i>					1,2,5			1,4	1,4		1	1	1	1,4	1	1	1	1	1
	<i>Rhizoprionodon terraenovae</i>		2										1	1		1				
<i>Triaenodon obesus</i>						2			5			5		2	5			1,5		
Centrophoridae	<i>Centrophorus granulosus</i>								5			5	5		5			5		
Dalatiidae	<i>Isistius brasiliensis</i>											6								
Etmopteridae	<i>Etmopterus pusillus</i>											6								
Ginglymostomatidae	<i>Ginglymostoma cirratum</i>		2		5			2	5	4	5	5	2,4,5		5	2		2,5		
	<i>Nebrius ferrugineus</i>	2					2	2,4												
Hexanchidae	<i>Heptanchias perlo</i>			4					4			4						4		
Lamnidae	<i>Isurus oxyrinchus</i>								1			1			1			1		
Pristidae	<i>Pristis perotteti</i>				4				4			4			4					
Pseudocarchariidae	<i>Pseudocarcharias kamoharai</i>								5			5			5			5		
Rhinobatidae	<i>Rhinobatos lentiginosus</i>										2	2								
Scyliorhinidae	<i>Scyliorhinus retifer</i>								4			4			4			4		
Sphyrnidae	<i>Sphyrna couardi</i>	5				5														
	<i>Sphyrna lewini</i>		5						1			1			1			1		
	<i>Sphyrna mokarran</i>								1			1	1		1		1	1		
	<i>Sphyrna tiburo</i>								1			1		2,5	1			1		
	<i>Sphyrna zygaena</i>			1					1			1			1			1		
Squalidae	<i>Squalus acanthias</i>											3								
	<i>Squalus cubensis</i>								3			3			3			4		
Squatinae	<i>Squatina dumeril</i>											3								
Triakidae	<i>Mustelus canis</i>								4			4	4			4		4		

Table S3. ANOVA table showing the sum of squares (SS), mean sum of squares (MS), degrees of freedom (df), F-statistic (F), and p-value. (I.) Elasmobranch family as a source of variation in ridge spacing along the crowns of ridged denticles. (II.) Elasmobranch family as a source of variation in denticle crown size. (III.) Functional morphotype as a source of variation in denticle crown thickness. The residuals for each test are shown directly below.

Source	SS	MS	df	F	p-value
I. Treatment: ridge spacing vs. family	13.798	3.4496	4	33.251	<0.0001
Residuals	15.043	0.1037	145		
II. Treatment: crown size vs. family	3.4949	1.16495	3	12.65	<0.0001
Residuals	14.366	0.09209	156		
III. Treatment: crown thickness vs. functional morphotype	20.071	4.0142	5	25.826	<0.0001
Residuals	32.485	0.1554	209		