

Supplemental information

Table S1. Stable isotope values for $\delta^{15}\text{N}$ and $\delta^{13}\text{C}$ of white muscle taken from the four target species. ND = no data available.

Sample ID	Date	Sex	Disk Width (cm)	Total Mass (g)	$\delta^{15}\text{N}$	$\delta^{13}\text{C}$
<i>Atlantic Stingray</i>						
DS20190823-001	8/23/19	M	13	66	12.06	-15.87
DS20190627-002	6/27/19	M	21	245	12.35	-16.57
DS20190812-002	8/12/19	M	20.3	313	12.53	-16.71
DS20190627-001	6/27/19	M	17	175	12.58	-16.47
DS20190812-003	8/12/19	M	21	313	12.68	-16.41
DS20190823-002	8/23/19	M	17.5	200	12.72	-16.66
DS20190812-001	8/12/19	F	12	54	13.05	-16.43
<i>Bluntnose stingray</i>						
HS20190617-002	6/17/19	F	23.6	374	11.59	-17.75
HS20190812-001	8/12/19	M	15.2	595	11.61	-16.97
HS20190617-001	6/17/19	M	22.1	396	11.82	-17.29
HS20190624-001	6/24/19	M	25	615	12.16	-17.29
HS20190812-002	8/12/19	F	19.5	300	12.27	-17.14
HS20190624-002	6/24/19	M	25.8	565	12.42	-17.27
HS20190823-001	8/23/19	M	18.7	205	12.43	-16.78
HS20190627-002	6/27/19	F	27	595	12.70	-17.35
HS20190702-005	7/2/19	M	16.1	180	13.71	-17.31
HS20190702-002	7/2/19	F	24.2	510	13.87	-16.38
HS20190702-004	7/2/19	M	16.1	130	14.02	-16.67
HS20190702-003	7/2/19	F	18.4	220	14.71	-16.34
<i>Butterfly ray</i>						
GM20190607-001	6/7/19	F	50	1306	13.51	-16.19
GM20190823-002	8/23/19	F	36.5	385	13.94	-16.78
GM20190702-005	7/2/19	F	33.7	315	14.02	-17.28
GM20190702-001	7/2/19	M	20.5	330	14.02	-17.23
GM20190627-002	6/27/19	M	33.3	335	14.03	-15.88
GM20190812-002	8/12/19	F	38.5	505	14.11	-17.01
GM20190617-002	6/17/19	M	33	359	14.14	-16.60
GM20190702-006	7/2/19	M	31.9	305	14.21	-16.16
GM20190702-007	7/2/19	M	28.7	170	14.28	-16.84
GM20190617-003	6/17/19	M	33	359	14.31	-16.20
GM20190823-001	8/23/19	M	29.8	277	14.32	-16.05
GM20190812-001	8/12/19	M	34	370	14.37	-15.89
GM20190812-003	8/12/19	M	35	426	14.40	-16.27
GM20190624-001	6/24/19	F	24.8	75	14.41	-16.46
<i>Sharpnose</i>						
RT20190812-001	8/12/19	ND	ND	ND	14.49	-16.81

RT20190812-011	8/12/19	F	31.6	298	14.99	-16.55
RT20190812-002	8/12/19	ND	ND	ND	15.00	-16.99
RT20190617-001	6/17/19	ND	ND	ND	15.66	-16.39
RT20190617-002	6/17/19	F	29.7	203	16.38	-16.95

Table S2. Top ten keystone phyla organized alphabetically for internal and external networks by species. Betweenness centrality value is reported along with rank (1 = highest rank, 10 = lowest rank). Phyla that were shared within species between internal and external networks are shown in red.

	Internal			External		
	Phyla	Betweenness Centrality	Rank	Phyla	Betweenness Centrality	Rank
Atlantic Stingray						
	Acidobacteria	174.61811	2	Acidobacteria	403.233333	3
	Bacteroidetes	87.881746	5	AncK6	317.733333	7
	Chloroflexi	78.870491	7	Bacteroidetes	281.533333	9
	Elusimicrobia	56.728644	8	Chloroflexi	391.466667	4
	Gemmatimonadetes	80.22381	6	Elusimicrobia	388.066667	5
	Hydrogenedentes	51.514286	10	Epsilonbacteraeota	538.133333	2
	Omnitrophicaeota	109.903175	4	Gemmatimonadetes	271.533333	10
	Patescibacteria	52.192857	9	Latescibacteria	292.866667	8
	Planctomycetes	192.25	1	Modulibacteria	338.633333	6
	Poribacteria	119.038889	3	Verrucomicrobia	557.2	1
Bluntnose stingray						
	Bacteroidetes	130.497164	5	Actinobacteria	381.166667	1
	BRC1	93.666667	8	AncK6	144.333333	6
	Fibrobacteres	69.984616	10	Armatimonadetes	176.333333	5
	Gemmatimonadetes	117.364726	7	Hydrogenedentes	372	2
	Lentisphaerae	245.020496	2	Latescibacteria	100	9
	Modulibacteria	307.6	1	Omnitrophicaeota	270	4
	Patescibacteria	93.666667	9	Patescibacteria	364.333333	3
	PAUC34f	128.403846	6	Planctomycetes	140.166667	7
	Planctomycetes	156.417356	4	Tenericutes	133.166667	8
	Zixibacteria	241.991537	3	Zixibacteria	100	10
Butterfly Ray						
	Bacteroidetes	108	4	Acidobacteria	294.769048	2
	Chloroflexi	6	10	Epsilonbacteraeota	174	8
	Epsilonbacteraeota	44	6	Fibrobacteres	174.333333	7
	Gemmatimonadetes	182	3	Firmicutes	175.885714	6
	Kiritimatiellaeota	44	7	Gemmatimonadetes	167.985714	9
	Latescibacteria	60.2	5	Kiritimatiellaeota	187.238095	5
	Lentisphaerae	218.25	2	Latescibacteria	278.561905	3
	Nitrospirae	23.45	9	Nitrospirae	122	10
	Verrucomicrobia	267.45	1	Patescibacteria	278	4
	Zixibacteria	43	8	Proteobacteria	530	1
Sharpnose						
	Acidobacteria	43.161474	7	Acidobacteria	149.370778	4
	Bacteria unclassified	87.413373	2	Actinobacteria	238.75643	1
	Bacteroidetes	78.562412	4	Calditrichaeota	97.430574	10
	Chlamydiae	30.095681	9	Chlamydiae	200.714097	2
	Chloroflexi	27.967674	10	Fibrobacteres	99.621585	9
	Lentisphaerae	107.677692	1	Gemmatimonadetes	109.449903	8

	Modulibacteria	31.310176	8	Hydrogenedentes	146.944795	5
	Planctomycetes	56.203027	5	Kiritimatiellaeota	132.182291	6
	Spirochaetes	86.569319	3	Planctomycetes	162.157859	3
	Verrucomicrobia	47.920492	6	Proteobacteria	125.14496	7

Table S3. Top ten phyla that were most integral to the network organized alphabetically for internal and external networks by species. Closeness centrality value is reported along with rank (1 = highest rank, 10 = lowest rank). Phyla that were shared within species between internal and external networks are shown in red.

	Internal			External		
	Phyla	Closeness Centrality	Rank	Phyla	Closeness Centrality	Rank
Atlantic Stingray						
	Acidobacteria	0.673077	3	Acidobacteria	0.341463	5
	Calditrichaeota	0.614035	8	AncK6	0.3	10
	Cyanobacteria	0.666667	4	Chloroflexi	0.318182	6
	Elusimicrobia	0.614035	6	Elusimicrobia	0.318182	7
	Firmicutes	1	1	Enttheonellaeota	1	1
	Gemmatimonadetes	0.603448	10	Epsilonbacteraeota	0.358974	3
	Lentisphaerae	0.614035	7	Kiritimatiellaeota	0.306569	9
	Omnitrophicaeota	0.614035	5	Latescibacteria	0.347107	4
	Tenericutes	1	2	Tenericutes	0.318182	8
	WS2	0.614035	9	Verrucomicrobia	0.375	2
Bluntnose stingray						
	Actinobacteria	1	2	Unclassified Bacteria	1	2
	Aquificae	1	1	Bacteroidetes	1	1
	Deinococcus-Thermus	0.666667	4	Calditrichaeota	1	5
	Gemmatimonadetes	0.546875	7	Chlamydiae	1	3
	Latescibacteria	0.530303	8	Dependentiae	0.8	8
	Lentisphaerae	0.564516	6	Elusimicrobia	0.8	9
	Planctomycetes	0.522388	9	Epsilonbacteraeota	1	4
	Tenericutes	0.666667	3	LCP-89	0.666667	10
	WPS-2	0.6	5	Schekmanbacteria	0.833333	7
	Zixibacteria	0.514706	10	Spirochaetes	1	6
Butterfly Ray						
	Acidobacteria	0.571429	9	Acetothermia	1	2
	Actinobacteria	1	2	Armatimonadetes	1	4
	Calditrichaeota	1	4	Cloacimonetes	1	3
	Chloroflexi	1	1	Dadabacteria	0.6	10
	Cyanobacteria	0.8	6	Deinococcus-Thermus	0.666667	9
	Dadabacteria	0.8	7	Elusimicrobia	1	5
	Dependentiae	1	5	Hydrogenedentes	1	6
	Planctomycetes	0.8	8	Spirochaetes	1	7
	Synergistetes	1	3	Thermotogae	1	1

	Verrucomicrobia	0.547619	10	WS2	0.666667	8
Sharpnose						
	Acidobacteria	0.787234	6	Acidobacteria	0.625	2
	Bacteroidetes	0.822222	4	Chlamydiae	0.584416	8
	BRC1	1	1	Fibrobacteres	0.608108	6
	Chloroflexi	0.770833	8	Gemmatimonadetes	0.616438	4
	Lentisphaerae	0.755102	9	Kiritimatiellaeota	0.6	7
	Modulibacteria	0.787234	7	Lentisphaerae	0.576923	9
	Nitrospinae	1	2	Planctomycetes	0.661765	1
	Omnitrophicaeota	1	3	Proteobacteria	0.56962	10
	Planctomycetes	0.804348	5	Verrucomicrobia	0.616438	5
	Verrucomicrobia	0.755102	10	WPS-2	0.621622	3

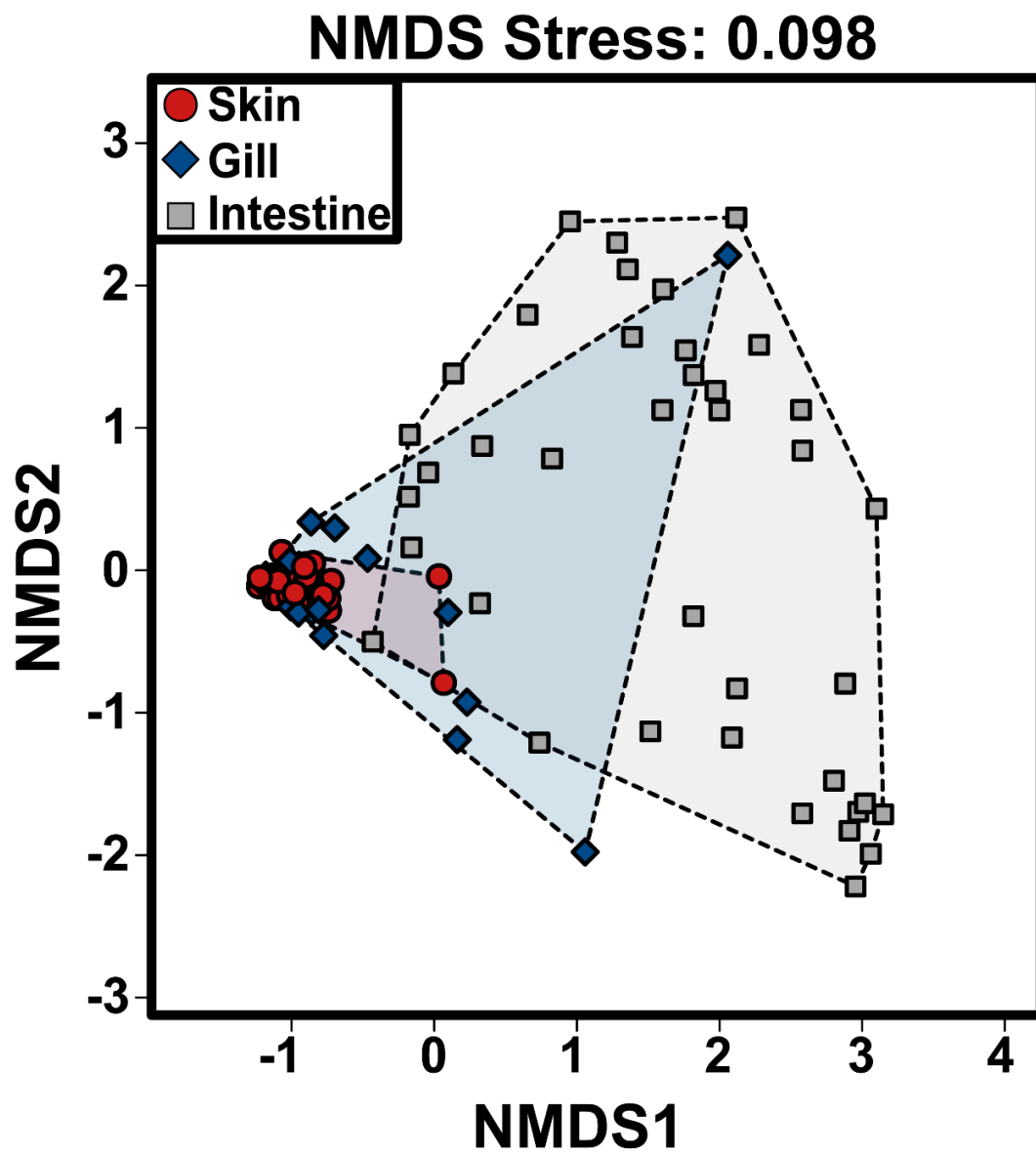


Figure S1. NMDS analysis plot of ASV based Bray-Curtis distances depicting bacterial beta diversity of skin, gill and intestinal samples of 4 different host species (Atlantic stingray, Bluntnose stingray, Butterfly ray, and Sharpnose).

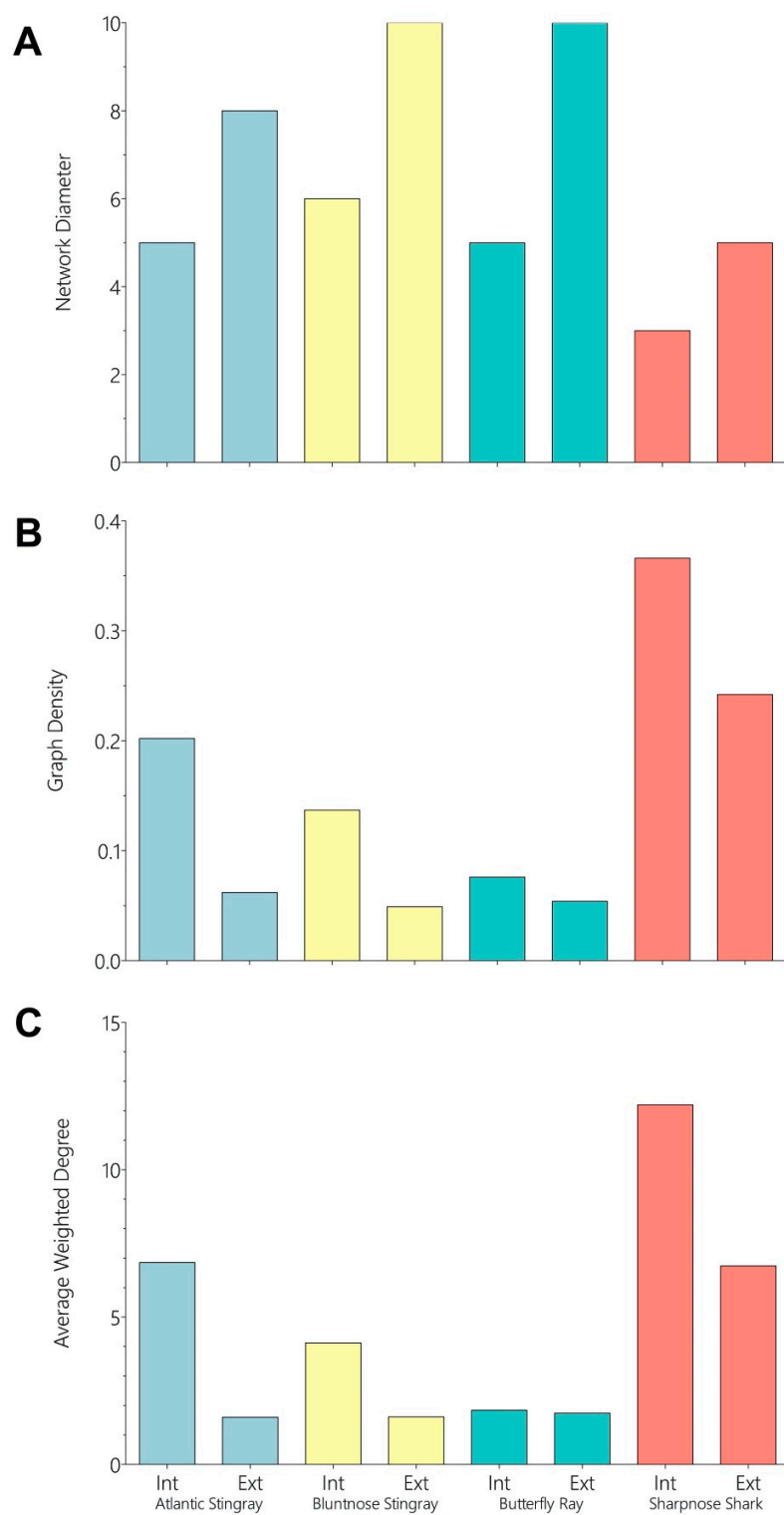


Figure S2. Comparative metrics for internal (“Int”) and external (“Ext”) networks for four species of elasmobranchs. A) Network diameter is a measure of network size, that accounts for the spread of both number of nodes and edges. B) Graph density is a measure of the tightness of the network by size. C) Average weighted degree is the mean number of edges radiating out from any given node in an undirected network.