

Table 1. Concentrations of ions and pH of naturally occurring water bodies.

Source	Calcium (mM)	Phosphate (mM)	Magnesium (mM)	Bicarbonate (mM)	pH	Reference
Rio Negro, Brazil	0.01		0.006		5.9-6.1	[1, 2]
Freshwater (hardwater)	0.75		0.21	1.72		[3]
Freshwater (hardwater)					6.0-9.0	[4]
Freshwater (Lake Huron)	0.90	0.003	0.25	1.75		[5]
Seawater	10.0	0.002	54.0	2.0	8.1 @ 25°C	[6]
Seawater (Pacific Ocean)	10.0	~0.0	47.5	2.0		[5]

Table 2. Fluid composition in the gastrointestinal tract of elasmobranchs. Data from [7]

Species	Calcium (mM)	Phosphate (mM)	Magnesium (mM)	Bicarbonate (mM)	pH
<i>Leucoraja erinacea</i>					
Stomach	16.2	2.92	24.6	1.46	3.1
Intestine	19.7	0.07	44.0	12.94	7.5
Colon	27.9	7.2	28.0	1.43	6.4
<i>Raja eglanteria</i>					
Stomach	9.8	9.2	4.6	0.11	3.4
Intestine	5.3	0.08	4.7	8.60	7.8
Colon	1.0	8.1	3.0	0.85	7.0
<i>Chiloscyllium plagiosum</i>					
Stomach	11.7	n/a	83.3	0.00	2.2
Intestine	3.9	n/a	130.0	73.3	n/a
Colon	7.3	n/a	75.0	0.10	5.5

Table 3. Concentrations of ions in the plasma of fishes.

SW = seawater; FW = freshwater

Species	Calcium (mM)	Phosphate (mM)	Magnesium (mM)	Bicarbonate (mM)	Reference
Marine Species					
Agnathans					
<i>Myxine glutinosa</i>	5.1	5.0	18.9		[8]
<i>Myxine glutinosa</i>	6.25	6.25	19.4		[9]
<i>Eptatretus stoutii</i>	5.5	1.0-1.5	10.4	5.2	[5]
<i>Petromyzon marinus</i>	3.51		7.0		[10]
Elasmobranchs					
<i>Triakis semifasciata</i>	3.7	0.64			[11]
<i>Triakis semifasciata</i>	3.0	0.63			[11]
<i>Triakis semifasciata</i>	4.0	1.1			[12]
<i>Triakis semifasciata</i>	3.3	1.4			[13]
<i>Cephaloscyllium uter</i>	4.7	0.43			[12]
<i>Rhinobatos productus</i>	4.9	1.3			[12]
<i>Heterodontus francisci</i>	4.3	0.36			[12]
<i>Notorhynchus maculatum</i>	3.0	0.85			[12]
<i>Platyrrhinoides triseriata</i>	4.3	0.51			[12]
<i>Urolophus jamaicensis</i>	2.69				[14]
<i>Mustelus antarcticus</i>	4.28	1.93	0.26		[15]
<i>Mustelus atlanticus</i>	2.5	5.0	1.4	10.1	[16]
<i>Squalus acanthias</i>	8.6 ± 0.5	10.9 ± 0.9	5.2 ± 0.4		[17]
<i>Scyliorhinus canicula</i>	5.2				[18]
<i>Leucoraja erinacea</i>	3.11 ± 0.4	0.97 ± 0.2	1.31 ± 0.15	4.19 ± 0.31	[7]
<i>Raja eglanteria</i>	4.56 ± 0.4	1.07 ± 0.17	5.58 ± 1.42	3.87 ± 0.46	[7]
<i>Raja ocellata</i>	4.5 ± 0.1	1.8 ± 0.1	1.1 ± 0.1		[19]
<i>Chiloscyllium plagiosum</i>	3.9 ± 0.1		1.2 ± 0.1	4.3 ± 0.3	[7]
<i>Orectolobus ornatus</i>	4.6	1.8	1.9		[20]
<i>Dasyatis americana</i>	4.12	1.5			[21]

Species	Calcium (mM)	Phosphate (mM)	Magnesium (mM)	Bicarbonate (mM)	Reference
<i>Dasyatis sabina</i>	7.2				[22]
<i>Dasyatis sabina</i> 26% SW	2.5				[22]
<i>Carcharhinus limbatus</i>	3.0	0.84			[23]
<i>Sphyrna tiburo</i>	4.2	2.8		3.0	[24]
<i>Sphyrna tiburo</i>	4.1	0.78			[23]
<i>Carcharhinus leucas</i> SW	4.5	2.0	2.9		[16]
<i>Carcharhinus leucas</i> SW	4.4 ± 0.3		1.8 ± 0.1		[25]
<i>Carcharhinus leucas</i> SW	4.3	0.85			[23]
Teleosts					
<i>Muraena helena</i>	3.87	4.80	2.43	8.03	[9]

Freshwater species or species in FW

Agnatha

<i>Petromyzon marinus</i>	2.4	1.4	1.9	5.2	[5]
<i>Lampetra tridentata</i>	2.8	4.7	1.4	3.1	[5]

Elasmobranchs

<i>Potamotrygon</i> sp.	1.5	1.3 ± 0.24	1.2	8.0 ± 0.79	[26]
<i>Potamotrygon motoro</i>	1.1		3.3		[27]
<i>Potamotrygon circularis</i>	1.3				[28]
<i>Potamotrygon laticeps</i>	1.4		5.9		[28]
<i>Potamotrygon</i> sp.	3.6		1.8	6.7	[29]
<i>Potamotrygon</i> sp.	3.0 ± 0.4				[26]
<i>Dasyatis sabina</i>	4.3	0.24			[30]
<i>Pristis microdon</i>				3.1	[31]
<i>Carcharhinus leucas</i>	3.0	4.0	2.0	6.0	[16]
<i>Carcharhinus leucas</i>	3.0 ± 0.1		1.3 ± 0.1		[25]
<i>Carcharhinus leucas</i>	4.5 ± 0.15				[32]

Chondrosteans

<i>Acipenser nacarii</i>	1.2				[33]
<i>Acipenser nacarii</i>	4.7				[34]
<i>Acipenser fulvescens</i>	1.2				[35]
<i>Acipenser persicus</i>	2.15				[36]
<i>Polyodon spathula</i>	2.07		0.93		[37]

Teleosts

<i>Oncorhynchus kisutch</i>	1.85-2.04		0.72-0.91		[38]
<i>Coregonus clupeoides</i>	2.67	1.6	1.69	5.29	[9]

Table 4. Concentrations of additional ions in the plasma of elasmobranch fishes.*SW = seawater; FW = freshwater*

Species	Sodium (mM)	Chloride (mM)	Potassium (mM)	pH	Reference
<i>Squalus acanthias</i> SW				7.52	[39]
<i>Squalus acanthias</i> SW	255	249	4.1	7.45	[40]
<i>Squalus acanthias</i> SW	255	239	6.6	7.56	[41]
<i>Scyliorhinus canicula</i> SW				7.72	[42]
<i>Scyliorhinus canicula</i> SW	307	289	6.15		[43]
<i>Scyliorhinus stellaris</i> SW				7.78	[44]
<i>Raja ocellata</i> SW	270	246	4.2	7.82	[45]
<i>Triakis semifasciata</i> SW				7.78	[46]
<i>Chiloscyllium plagiosum</i> SW	272	238	5.02		[47]
<i>Sphyrna tiburo</i> SW	258	279	6.0		[48]
<i>Heterodontus portusjacksoni</i> SW	359	310	4.4	7.77	[49]
<i>Carcharhinus leucas</i> SW	288	288	6.1		[32]
<i>Carcharhinus leucas</i> SW	304	315	5.8		[25]
<i>Carcharhinus leucas</i> FW	245	219	6.4		[32]
<i>Carcharhinus leucas</i> FW	221	220	4.2		[25]
<i>Dasyatis sabina</i> SW	278	288			[50]
<i>Dasyatis sabina</i> FW	187	167	2		[51]
<i>Potamotrygon</i> sp. FW	178	146			[1]
<i>Potamotrygon</i> sp. FW	146	135			[52]
<i>Potamotrygon</i> sp. FW	150	149	5.9		[29]
<i>Potamotrygon laticeps</i> FW	146.5	154.7	3.4	7.58	[28]
<i>Potamotrygon motoro</i> FW	149	167	2.72	7.66	[28]
<i>Himantura signifer</i> FW	167	164		7.52	[53]

Table 5. Urine to plasma ratios for various species of aquatic vertebrates.*SW = seawater; FW = freshwater*

Species	Calcium	Phosphate	Magnesium	Bicarbonate	Reference
Agnatha					
<i>Myxine glutinosa</i> SW	1.82		4.41		[54]
<i>Eptatretus stouti</i> SW	0.80	3.91	1.23		[55]
Chondrichthyans					
<i>Squalus acanthias</i> SW	0.86	34	33.3		[55]
<i>Squalus acanthias</i> SW	1.0	30	40		[56]
<i>Chiloscyllium plagiosum</i> SW	0.86		21.1		[57]
<i>Pristis microdon</i> FW		2.22			[31]
<i>Hydrolagus colliei</i> SW	3.87	15.6	8.80		
Sarcopterygians					
<i>Latimeria chalumnae</i> SW	0.35	7.53	5.72	0.21	[58]
Chondrosteans					
<i>Acipenser guildenstadtii</i> FW	1.02		0.75		[59]
<i>Acipenser ruthenus</i> FW	0.34		0.78		[59]
<i>Acipenser baeri</i> FW	0.32		0.22		[59]
<i>Acipenser guildenstadtii</i> SW	0.94		1.69		[59]
<i>Acipenser transmontanus</i> FW	1.47				[60]
<i>Polyodon spathula</i> FW	0.52		0.43		[37]
Teleosts					
<i>Oncorhynchus mykiss</i> FW	0.24				[55]
<i>Salvelinus namaycush</i> FW	0.46		0.73		[55]
<i>Esox lucius</i> FW	0.054	0.79			[55]
<i>Channa argus</i> FW	0.26				[55]
<i>Fundulus kansae</i> FW	0.56				[55]

Species	Calcium	Phosphate	Magnesium	Bicarbonate	Reference
<i>Anguilla anguilla</i> FW	0.27	2.55	0.097		[55]
<i>Ameiurus nebulosus</i> FW				0.12	
<i>Paralichthys lethostigma</i> SW	7.07	3.52	124.7		[55]
<i>Lophius americanus</i> SW	2.25	0.28	54.5		[55]
<i>Trematomus bernachii</i> SW	2.00		175		[61]
<i>Dissostichus mawsoni</i> SW	4.17		48.2		[61]
<i>Gymnodraco acuticeps</i> SW	0.89		51.1		[61]
<i>Rhigophila dearborni</i> SW	5.46		90.1		[61]

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