

Goldstone, JV. Environmental sensing and response genes in Cnidaria: the chemical defensome in the sea anemone *Nematostella vectensis*

### Supplemental Data

Figure S1. Maximum likelihood phylogenetic tree of cytochrome P450 (CYP) predicted and known protein sequences from *Homo sapiens* (hs, blue), *Strongylocentrotus purpuratus* (Strpu, purple), *Drosophila melanogaster* (drome, green) and *Nematostella vectensis* (Nemve1, red). Sequences were aligned with Muscle (v3.6) and automatically masked using the alignment quality score. Maximum likelihood analysis was performed using the PROTMIXWAGF model in RAxML (v7.0.3).

Table S1. JGI model numbers for ABC, SLC21, and SLC22 (transporter) genes in *N. vectensis* genome assembly version 1.

Table S2. JGI model numbers for oxidative and reducing genes in *N. vectensis* genome assembly version 1.

Table S3. JGI model numbers for conjugating genes in *N. vectensis* genome assembly version 1.

Table S4. JGI model numbers for antioxidant and metal conjugating genes in *N. vectensis* genome assembly version 1.



## Supplemental Table S1

<b>JGI Protein Model</b>	<b>Gene family assignment</b>
Nemve1 102	ABC transporter, ABCC
Nemve1 4776	ABC transporter, ABCC
Nemve1 10039	ABC transporter, ABCC1
Nemve1 10108	ABC transporter, ABCC1
Nemve1 10208	ABC transporter, ABCC
Nemve1 10332	ABC transporter, ABCC
Nemve1 20036	ABC transporter, ABCC4
Nemve1 20166	ABC transporter, ABCC4
Nemve1 23523	ABC transporter, ABCG4
Nemve1 30195	ABC transporter, ABCA3
Nemve1 30362	ABC transporter, ABCC4
Nemve1 31495	ABC transporter, ABCB9
Nemve1 50359	ABC transporter, ABCG
Nemve1 82183	ABC transporter, ABCB1
Nemve1 82333	ABC transporter, ABCA3
Nemve1 84633	ABC transporter, ABCC
Nemve1 87084	ABC transporter, ABCC
Nemve1 87844	ABC transporter, ABCA2
Nemve1 88546	ABC transporter, ABCC10
Nemve1 94692	ABC transporter, ABCC
Nemve1 97844	ABC transporter, ABCC1
Nemve1 99374	ABC transporter, ABCG2
Nemve1 99533	ABC transporter, ABCC
Nemve1 103967	ABC transporter, ABCG
Nemve1 104944	ABC transporter, ABCC
Nemve1 113115	ABC transporter, ABCC
Nemve1 113931	ABC transporter, ABCC4
Nemve1 115547	ABC transporter, ABCC
Nemve1 116645	ABC transporter, ABCG4
Nemve1 116678	ABC transporter, ABCC
Nemve1 116684	ABC transporter, ABCC
Nemve1 118015	ABC transporter, ABCC4
Nemve1 124699	ABC transporter, ABCC
Nemve1 130091	ABC transporter, ABCC
Nemve1 134819	ABC transporter, ABCA
Nemve1 134820	ABC transporter, ABCA
Nemve1 136552	ABC transporter, ABCC11
Nemve1 139647	ABC transporter, ABCC
Nemve1 139660	ABC transporter, ABCC
Nemve1 139662	ABC transporter, ABCC
Nemve1 139684	ABC transporter, ABCC
Nemve1 139853	ABC transporter, ABCC
Nemve1 146653	ABC transporter, ABCC
Nemve1 159164	ABC transporter, ABCC
Nemve1 166963	ABC transporter, ABCC
Nemve1 168119	ABC transporter, ABCD4
Nemve1 168315	ABC transporter, ABCG4
Nemve1 168501	ABC transporter, ABCB10
Nemve1 168693	ABC transporter, ABCC
Nemve1 172449	ABC transporter, ABCF1
Nemve1 180295	ABC transporter, ABCC4
Nemve1 190171	ABC transporter, ABCC1
Nemve1 190285	ABC transporter, ABCF3
Nemve1 195521	ABC transporter, ABCD4
Nemve1 206043	ABC transporter, ABCB10

<b>JGI Protein Model</b>	<b>Gene family assignment</b>
Nemve1 216377	ABC transporter, ABCA
Nemve1 224771	ABC transporter, ABCF
Nemve1 234370	ABC transporter, ABCC
Nemve1 234439	ABC transporter, ABCC
Nemve1 237874	ABC transporter, ABCB1
Nemve1 243828	ABC transporter, ABCD4
Nemve1 244883	ABC transporter, ABCF
Nemve1 245176	ABC transporter, ABCD1
Nemve1 246933	ABC transporter, ABCD3
Nemve1 247032	ABC transporter, ABCC
Nemve1 11296	Organic Anion Transporter Polypeptide
Nemve1 20640	Organic Anion Transporter Polypeptide
Nemve1 31122	Organic Anion Transporter Polypeptide
Nemve1 51341	Organic Anion Transporter Polypeptide
Nemve1 52639	Organic Anion Transporter Polypeptide
Nemve1 104948	Organic Anion Transporter Polypeptide
Nemve1 105114	Organic Anion Transporter Polypeptide
Nemve1 119016	Organic Anion Transporter Polypeptide
Nemve1 125243	Organic Anion Transporter Polypeptide
Nemve1 136329	Organic Anion Transporter Polypeptide
Nemve1 205781	Organic Anion Transporter Polypeptide
Nemve1 210013	Organic Anion Transporter Polypeptide
Nemve1 211340	Organic Anion Transporter Polypeptide
Nemve1 215081	Organic Anion Transporter Polypeptide
Nemve1 218525	Organic Anion Transporter Polypeptide
Nemve1 222752	Organic Anion Transporter Polypeptide
Nemve1 247942	Organic Anion Transporter Polypeptide
Nemve1 1130	SLC22 Family
Nemve1 8463	SLC22 Family
Nemve1 10639	SLC22 Family
Nemve1 14487	SLC22 Family
Nemve1 21316	SLC22 Family
Nemve1 40646	SLC22 Family
Nemve1 40753	SLC22 Family
Nemve1 47059	SLC22 Family
Nemve1 50785	SLC22 Family
Nemve1 60630	SLC22 Family
Nemve1 61471	SLC22 Family
Nemve1 63188	SLC22 Family
Nemve1 85329	SLC22 Family
Nemve1 86395	SLC22 Family
Nemve1 89058	SLC22 Family
Nemve1 90692	SLC22 Family
Nemve1 91052	SLC22 Family
Nemve1 94638	SLC22 Family
Nemve1 101713	SLC22 Family
Nemve1 101715	SLC22 Family
Nemve1 104560	SLC22 Family
Nemve1 109102	SLC22 Family
Nemve1 109190	SLC22 Family
Nemve1 111000	SLC22 Family
Nemve1 115717	SLC22 Family
Nemve1 118993	SLC22 Family
Nemve1 119271	SLC22 Family
Nemve1 122742	SLC22 Family
Nemve1 123813	SLC22 Family
Nemve1 125326	SLC22 Family

<b>JGI Protein Model</b>	<b>Gene family assignment</b>
Nemve1 128943	SLC22 Family
Nemve1 128952	SLC22 Family
Nemve1 131775	SLC22 Family
Nemve1 138108	SLC22 Family
Nemve1 145688	SLC22 Family
Nemve1 146442	SLC22 Family
Nemve1 149554	SLC22 Family
Nemve1 160661	SLC22 Family
Nemve1 165851	SLC22 Family
Nemve1 165915	SLC22 Family
Nemve1 170798	SLC22 Family
Nemve1 172071	SLC22 Family
Nemve1 173562	SLC22 Family
Nemve1 174480	SLC22 Family
Nemve1 200404	SLC22 Family
Nemve1 202226	SLC22 Family
Nemve1 205215	SLC22 Family
Nemve1 205600	SLC22 Family
Nemve1 206126	SLC22 Family
Nemve1 207968	SLC22 Family
Nemve1 207969	SLC22 Family
Nemve1 208384	SLC22 Family
Nemve1 211167	SLC22 Family
Nemve1 219492	SLC22 Family
Nemve1 220670	SLC22 Family
Nemve1 223668	SLC22 Family
Nemve1 224087	SLC22 Family
Nemve1 224161	SLC22 Family
Nemve1 225531	SLC22 Family
Nemve1 240064	SLC22 Family
Nemve1 241870	SLC22 Family
Nemve1 241972	SLC22 Family
Nemve1 244617	SLC22 Family

## Supplemental Table S2

<b>JGI Protein Model</b>	<b>Gene family assignment</b>
Nemve1 181421	aldehyde dehydrogenase
Nemve1 179476	aldehyde dehydrogenase
Nemve1 200699	aldehyde dehydrogenase
Nemve1 192075	aldehyde dehydrogenase
Nemve1 245626	aldehyde dehydrogenase
Nemve1 162370	aldehyde dehydrogenase
Nemve1 89632	aldehyde dehydrogenase
Nemve1 235302	aldehyde dehydrogenase
Nemve1 231413	aldehyde dehydrogenase
Nemve1 150665	aldehyde dehydrogenase
Nemve1 177644	aldehyde dehydrogenase
Nemve1 149662	aldehyde dehydrogenase
Nemve1 102986	aldehyde dehydrogenase
Nemve1 175287	aldehyde dehydrogenase
Nemve1 186547	aldehyde dehydrogenase
Nemve1 154509	aldehyde dehydrogenase
Nemve1 170078	aldehyde dehydrogenase
Nemve1 156946	aldehyde dehydrogenase
Nemve1 224399	aldehyde dehydrogenase
Nemve1 96970	aldehyde dehydrogenase
Nemve1 3850	aldehyde dehydrogenase
Nemve1 181888	Aldo/keto reductase family
Nemve1 224560	Aldo/keto reductase family
Nemve1 190239	Aldo/keto reductase family
Nemve1 90844	Aldo/keto reductase family
Nemve1 208820	Aldo/keto reductase family
Nemve1 117787	Aldo/keto reductase family
Nemve1 228986	Aldo/keto reductase family
Nemve1 71477	Aldo/keto reductase family
Nemve1 220742	Aldo/keto reductase family
Nemve1 166341	Aldo/keto reductase family
Nemve1 163935	Aldo/keto reductase family
Nemve1 70665	Aldo/keto reductase family
Nemve1 107875	Cytochrome P450, CYP Clan 2
Nemve1 116955	Cytochrome P450, CYP Clan 2
Nemve1 122119	Cytochrome P450, CYP Clan 2
Nemve1 122140	Cytochrome P450, CYP Clan 2
Nemve1 12630	Cytochrome P450, CYP Clan 2
Nemve1 13146	Cytochrome P450, CYP Clan 2
Nemve1 143569	Cytochrome P450, CYP Clan 2
Nemve1 147800	Cytochrome P450, CYP Clan 2
Nemve1 161477	Cytochrome P450, CYP Clan 2
Nemve1 164344	Cytochrome P450, CYP Clan 2
Nemve1 164939	Cytochrome P450, CYP Clan 2
Nemve1 171703	Cytochrome P450, CYP Clan 2
Nemve1 182833	Cytochrome P450, CYP Clan 2
Nemve1 197176	Cytochrome P450, CYP Clan 2
Nemve1 200272	Cytochrome P450, CYP Clan 2
Nemve1 204234	Cytochrome P450, CYP Clan 2
Nemve1 206900	Cytochrome P450, CYP Clan 2
Nemve1 208281	Cytochrome P450, CYP Clan 2
Nemve1 209361	Cytochrome P450, CYP Clan 2
Nemve1 217770	Cytochrome P450, CYP Clan 2
Nemve1 220856	Cytochrome P450, CYP Clan 2

<b>JGI Protein Model</b>	<b>Gene family assignment</b>
Nemve1 221914	Cytochrome P450, CYP Clan 2
Nemve1 22420	Cytochrome P450, CYP Clan 2
Nemve1 227345	Cytochrome P450, CYP Clan 2
Nemve1 229410	Cytochrome P450, CYP Clan 2
Nemve1 230060	Cytochrome P450, CYP Clan 2
Nemve1 231212	Cytochrome P450, CYP Clan 2
Nemve1 231218	Cytochrome P450, CYP Clan 2
Nemve1 234104	Cytochrome P450, CYP Clan 2
Nemve1 234969	Cytochrome P450, CYP Clan 2
Nemve1 235065	Cytochrome P450, CYP Clan 2
Nemve1 238893	Cytochrome P450, CYP Clan 2
Nemve1 33342	Cytochrome P450, CYP Clan 2
Nemve1 60849	Cytochrome P450, CYP Clan 2
Nemve1 80762	Cytochrome P450, CYP Clan 2
Nemve1 82634	Cytochrome P450, CYP Clan 2
Nemve1 87502	Cytochrome P450, CYP Clan 2
Nemve1 87891	Cytochrome P450, CYP Clan 2
Nemve1 94651	Cytochrome P450, CYP Clan 2
Nemve1 114170	Cytochrome P450, CYP Clan 3
Nemve1 120897	Cytochrome P450, CYP Clan 3
Nemve1 120985	Cytochrome P450, CYP Clan 3
Nemve1 122064	Cytochrome P450, CYP Clan 3
Nemve1 129215	Cytochrome P450, CYP Clan 3
Nemve1 12978	Cytochrome P450, CYP Clan 3
Nemve1 132216	Cytochrome P450, CYP Clan 3
Nemve1 142057	Cytochrome P450, CYP Clan 3
Nemve1 175140	Cytochrome P450, CYP Clan 3
Nemve1 176140	Cytochrome P450, CYP Clan 3
Nemve1 176175	Cytochrome P450, CYP Clan 3
Nemve1 181495	Cytochrome P450, CYP Clan 3
Nemve1 190607	Cytochrome P450, CYP Clan 3
Nemve1 219163	Cytochrome P450, CYP Clan 3
Nemve1 220823	Cytochrome P450, CYP Clan 3
Nemve1 233531	Cytochrome P450, CYP Clan 3
Nemve1 32720	Cytochrome P450, CYP Clan 3
Nemve1 32845	Cytochrome P450, CYP Clan 3
Nemve1 890	Cytochrome P450, CYP Clan 3
Nemve1 89564	Cytochrome P450, CYP Clan 3
Nemve1 86714	Cytochrome P450, CYP Clan 4F
Nemve1 136068	Cytochrome P450, CYP Clan 4V
Nemve1 194368	Cytochrome P450, CYP Clan 4V
Nemve1 102678	Cytochrome P450, CYP Clan Mito
Nemve1 107622	Cytochrome P450, CYP Clan Mito
Nemve1 122810	Cytochrome P450, CYP Clan Mito
Nemve1 140839	Cytochrome P450, CYP Clan Mito
Nemve1 162389	Cytochrome P450, CYP Clan Mito
Nemve1 176042	Cytochrome P450, CYP Clan Mito
Nemve1 185054	Cytochrome P450, CYP Clan Mito
Nemve1 202906	Cytochrome P450, CYP Clan Mito
Nemve1 83609	Cytochrome P450, CYP Clan Mito
Nemve1 94936	Cytochrome P450, CYP Clan Mito
Nemve1 101023	Cytochrome P450, CYP unassigned
Nemve1 101105	Cytochrome P450, CYP unassigned
Nemve1 113799	Cytochrome P450, CYP unassigned
Nemve1 11772	Cytochrome P450, CYP unassigned
Nemve1 124567	Cytochrome P450, CYP unassigned
Nemve1 175215	Cytochrome P450, CYP unassigned

<b>JGI Protein Model</b>	<b>Gene family assignment</b>
Nemve1 180149	Cytochrome P450, CYP unassigned
Nemve1 194035	Cytochrome P450, CYP unassigned
Nemve1 236002	Cytochrome P450, CYP unassigned
Nemve1 241155	Cytochrome P450, CYP unassigned
Nemve1 141685	Epoxide Hydrolase
Nemve1 231029	Flavin-binding monooxygenase-like
Nemve1 185021	Flavin-binding monooxygenase-like
Nemve1 110766	Flavin-binding monooxygenase-like
Nemve1 235461	Flavin-binding monooxygenase-like
Nemve1 33129	Flavin-binding monooxygenase-like
Nemve1 55039	Flavin-binding monooxygenase-like



## Supplemental Table S3

JGI Protein Model	Gene family assignment
Nemve1 178546	eEF1-gamma
Nemve1 237669	Glutathione S-transferase, GSTtheta
Nemve1 186779	Glutathione S-transferase, GSTzeta
Nemve1 83876	Glutathione S-transferase, fungal-type
Nemve1 184426	Glutathione S-transferase, GSTmu
Nemve1 86756	Glutathione S-transferase, GSTmu
Nemve1 226731	Glutathione S-transferase, GSTmu
Nemve1 210927	Glutathione S-transferase, GSTomega
Nemve1 80855	Glutathione S-transferase, GSTomega
Nemve1 202412	Glutathione S-transferase, GSTomega
Nemve1 198281	Glutathione S-transferase, GSTpi
Nemve1 188039	Glutathione S-transferase, GSTpi
Nemve1 192646	Glutathione S-transferase, GSTsigma
Nemve1 162659	Glutathione S-transferase, GSTsigma
Nemve1 236609	Glutathione S-transferase, GSTsigma
Nemve1 216187	Glutathione S-transferase, GSTsigma
Nemve1 179696	Glutathione S-transferase, GSTsigma
Nemve1 113255	Glutathione S-transferase, GSTsigma
Nemve1 195944	MAPEG family
Nemve1 238552	MAPEG family
Nemve1 240887	MAPEG family
Nemve1 248820	MAPEG family
Nemve1 82570	MAPEG family
Nemve1 78952	Sulfotransferase SULT3A
Nemve1 79079	Sulfotransferase SULT3A
Nemve1 106039	Sulfotransferase SULT3A
Nemve1 106239	Sulfotransferase SULT3A
Nemve1 86774	Sulfotransferase SULT3A
Nemve1 111868	Sulfotransferase SULT3A
Nemve1 199956	Sulfotransferase SULT3A
Nemve1 149898	Sulfotransferase SULT4
Nemve1 113472	Sulfotransferase SULT3B
Nemve1 111938	Sulfotransferase SULT3A
Nemve1 247365	Sulfotransferase SULT4
Nemve1 231277	Sulfotransferase SULT3B
Nemve1 2578	Sulfotransferase SULT4
Nemve1 207647	Sulfotransferase SULT4
Nemve1 34192	Sulfotransferase keratan/chondroitin sulfatase
Nemve1 202521	Sulfotransferase keratan/chondroitin sulfatase
Nemve1 20906	Sulfotransferase SULT4
Nemve1 207646	Sulfotransferase keratan/chondroitin sulfatase
Nemve1 207648	Sulfotransferase keratan/chondroitin sulfatase
Nemve1 182889	Sulfotransferase keratan/chondroitin sulfatase
Nemve1 122621	Sulfotransferase keratan/chondroitin sulfatase
Nemve1 107994	Sulfotransferase keratan/chondroitin sulfatase
Nemve1 122091	UDP-glucuronosyl and UDP-glucosyl transferase
Nemve1 116699	UDP-glucuronosyl and UDP-glucosyl transferase
Nemve1 240864	UDP-glucuronosyl and UDP-glucosyl transferase
Nemve1 170378	UDP-glucuronosyl and UDP-glucosyl transferase
Nemve1 111143	UDP-glucuronosyl and UDP-glucosyl transferase
Nemve1 90373	UDP-glucuronosyl and UDP-glucosyl transferase
Nemve1 11044	UDP-glucuronosyl and UDP-glucosyl transferase
Nemve1 140893	UDP-glucuronosyl and UDP-glucosyl transferase
Nemve1 122110	UDP-glucuronosyl and UDP-glucosyl transferase

## Supplemental Table S4

JGI Protein Model	Gene family assignment
Nemve1 103289	catalase
Nemve1 236349	manganese superoxide dismutase
Nemve1 231554	Iron/manganese superoxide dismutase
Nemve1 94316	Iron/manganese superoxide dismutase
Nemve1 165732	Copper/zinc superoxide dismutase
Nemve1 234825	Copper/zinc superoxide dismutase
Nemve1 227361	Copper chaperone for copper/zinc superoxide dismutase
Nemve1 3582	Extracellular Copper/zinc superoxide dismutase
Nemve1 110690	Phytochelatin synthase
Nemve1 136743	Phytochelatin synthase
Nemve1 202690	Phytochelatin synthase
Nemve1 96744	Phytochelatin synthase
Nemve1 90698	Glutathione Peroxidase
Nemve1 93209	Glutathione Peroxidase
Nemve1 55851	Glutathione Peroxidase
Nemve1 140021	Glutathione Peroxidase
Nemve1 225874	Glutathione Peroxidase
Nemve1 131086	Glutathione Peroxidase
Nemve1 63846	Glutathione Peroxidase
Nemve1 238222	Glutathione Peroxidase
Nemve1 81508	Glutathione Peroxidase
Nemve1 81388	Glutathione Peroxidase
Nemve1 114609	Glutathione Peroxidase
Nemve1 9969	Glutathione Peroxidase
Nemve1 180776	Glutamate-cysteine ligase
Nemve1 75832	Glutamate-cysteine ligase
Nemve1 130991	Eukaryotic glutathione synthase
Nemve1 105627	Hsp20 protein
Nemve1 105643	Hsp20 protein
Nemve1 127462	Hsp20 protein
Nemve1 127468	Hsp20 protein
Nemve1 127482	Hsp20 protein
Nemve1 127489	Hsp20 protein
Nemve1 127508	Hsp20 protein
Nemve1 127544	Hsp20 protein
Nemve1 129111	Hsp20 protein
Nemve1 129113	Hsp20 protein
Nemve1 142100	Hsp20 protein
Nemve1 143593	Hsp20 protein
Nemve1 143610	Hsp20 protein
Nemve1 156025	Hsp20 protein
Nemve1 160645	Hsp20 protein
Nemve1 239200	Hsp20 protein
Nemve1 46373	Hsp20 protein
Nemve1 86804	Hsp20 protein
Nemve1 86017	Hsp70 protein
Nemve1 216823	Hsp70 protein
Nemve1 189485	Hsp70 protein
Nemve1 195315	Hsp70 protein
Nemve1 234533	Hsp70 protein
Nemve1 233881	Hsp70 protein

<b>JGI Protein Model</b>	<b>Gene family assignment</b>
Nemve1 172038	Hsp70 protein
Nemve1 243437	Hsp70 protein
Nemve1 79267	Hsp70 protein
Nemve1 178640	Hsp90 protein
Nemve1 181671	Hsp90 protein
Nemve1 162107	Hsp90 protein
Nemve1 153358	Hsp90 protein