

**Supplementary Table S1. Details for specimens used in molecular analyses.**

Species names followed by an asterisk are our reidentifications differing from earlier authors. The order of names corresponds approximately to their order in Figures 30, 31A, and 31B.

Taxon	Specimen ID	MNHN Expedition	Station	16S accession	cox1 accession	Locality	Depth (m)	Latitude	Longitude
<i>Callochiton puniceus</i>	CASIZ-245258; de0107			PZ353059	PZ353242	Atlantic Ocean, Scotia Sea	93	-54.218	-59.843
<i>Callochiton steinenii</i>	CASIZ-245257; de2934			PZ353060	PZ353243	S. Georgia S. Sandw. Is., Shag Rocks	199	-52.233	-40.604
<i>Ischnochiton rissoi</i>	SBMNH-719321; de9591			PZ353061	PZ353244	Italy, Liguria	2	44.207	12.570
<i>Stenosemus simplicissimus</i>	CASIZ-245492; de2490			PZ353062	PZ353245	S. Georgia & S. Sandwich Islands	~200	-53.761	-38.285
<i>Tonicia schrammi</i>	UF450488; de4464			PZ353063	PZ353246	USA, Florida, off St. Petersburg	~30	28.557	-84.275
<i>Acanthochitona avicula</i>	SBMNH-719323; de2080			PZ353064	PZ353247	USA, California, San Onofre	0	33.370	-117.562
<i>Acanthochitona avicula</i>	SBMNH-719322; de2078			NC_47426	NC_47426	USA, California, San Onofre	0	33.370	-117.562
<i>Plaxiphora aurata</i>	SBMNH-360540; de3409			PZ353065	PZ353248	Chile, Isla Grande de Chiloe, Matao	0	-42.578	-73.407
<i>Belknapchiton macleani</i>	NHMUK-20170073			MF157466	MF157523	Peru-Chile Trench	4050	13.864	-116.544
<i>Belknapchiton belknapi</i>	SBMNH-704669; de6922			PZ353066	PZ353249	USA Alaska, Chatham Strait	440	57.579	-134.783
<i>Belknapchiton belknapi</i>	ICML-EMU-11381; de4508			PZ353067	PZ353250	Mexico, off Baja Calif. Sur	657	23.283	-110.345
<i>Leptochiton nexus</i>	SBMNH-704673; de2183			NC_047422	NC_047422	USA, California, off San Pedro	28	33.703	-118.190
<i>Hanleyella oldroydi</i>	SBMNH-704674; de1424			NC_047423	NC_047423	USA, California, off San Pedro	28	33.703	-118.190
<i>Leptochiton cf. darioi</i>	MNHN-IM-2013-56241	GUYANE 2014	CP4363	PZ353068	PZ353251	French Guiana	197-200	6.967	-53.000
<i>Leptochiton cf. darioi</i>	MNHN-IM-2013-56688	GUYANE 2014	CP4363	PZ353069	PZ353252	French Guiana	197-200	6.967	-53.000
<i>Leptochiton rugatus</i>	SBMNH-704670; de2509			PZ353070	PZ353253	USA, California, San Onofre	0	33.370	-117.562
<i>Leptochiton foresti</i>	MNHN-IM-2013-66690	KAVIENG 2014	CP4418	PZ353071	PZ353254	Papua New Guinea	335-340	-2.450	150.670
<i>Leptochiton saitoi</i>	MNHN-IM-2013-66494	EXBODI	CP3807	PZ353072	PZ353255	New Caledonia	352-372	-21.720	166.600
<i>Leptochiton saitoi</i>	MNHN-IM-2013-66504	EXBODI	CP3800	PZ353073	PZ353256	New Caledonia	279-282	-21.530	166.370
<i>Leptochiton aff. perscitus</i>	MNHN-IM-2013-66599	PANGLAO 2005	CP2361	PZ353074	PZ353257	Philippines	516-543	8.883	123.567
<i>Leptochiton samadiae</i>	MNHN-IM-2013-66624	PAPUA NIUGINI	CP4036	PZ353075	PZ353258	Papua New Guinea	505	-4.483	145.517
<i>Leptochiton samadiae</i>	MNHN-IM-2013-66625	PAPUA NIUGINI	CP4036	PZ353076	PZ353259	Papua New Guinea	505	-4.483	145.517
<i>Leptochiton vanbellei</i>	MNHN-IM-2013-66574	PAPUA NIUGINI	CP4039	PZ353077	PZ353260	Papua New Guinea	1022	-4.317	145.617
<i>Leptochiton vanbellei</i>	MNHN-IM-2013-66637	PAPUA NIUGINI	CP3982	PZ353078	PZ353261	Papua New Guinea	724	-5.167	147.050
<i>Leptochiton dykei</i>	MNHN-IM-2013-66600	PAPUA NIUGINI	CP3994	PZ353079	PZ353262	Papua New Guinea	650	-6.000	147.583
<i>Leptochiton dykei</i>	MNHN-IM-2013-66641	PAPUA NIUGINI	CP3970	PZ353080	PZ353263	Papua New Guinea	573	-4.650	145.867
<i>Leptochiton rogeri</i>	MNHN-IM-2013-40452	PAPUA NIUGINI	CP3994	PZ353081	PZ353264	Papua New Guinea	650	-6.000	147.583
<i>Leptochiton rogeri</i>	MNHN-IM-2013-66634	PAPUA NIUGINI	CP3982	PZ353082	PZ353265	Papua New Guinea	724	-5.167	147.050
<i>Astrochiton binghami</i>	MNHN-IM-2013-60073	KARUBENTHOS 2	CP4513	PZ353083	PZ353266	Guadeloupe	406-644	16.217	-61.900
<i>Astrochiton binghami</i>	MNHN-IM-2013-60162	KARUBENTHOS 2	CP4512	PZ353084	PZ353267	Guadeloupe	409-532	16.217	-61.900
<i>Astrochiton incongruus</i>	SIO S0219; M17067			–	PQ449422	off Costa Rica, Rio Bongo Scar	661	9.283	-85.281
<i>Nierstraszella lineata</i>	SBMNH-704671; de0100			NC_047421	NC_047421	Japan, Mie, Owase	350	34.076	136.235
<i>Nierstraszella lineata</i>	MNHN-IM-2013-66512	MADEEP	CP4337	PZ353085	PZ353268	Solomon Sea, Ainto Bay	287-447	-6.117	149.283
<i>Nierstraszella lineata</i>	MNHN-IM-2013-66513	MADEEP	CP4337	PZ353086	PZ353269	Island Region, Papua New Guinea	287-447	-6.117	149.283
<i>Nierstraszella lineata</i>	CASIZ-187870; de3217			PZ353087	PZ353270	Philippines, Luzon Island	325	13.790	120.848
<i>Nierstraszella lineata</i>	CASIZ-187921(a); de3358			PZ353088	PZ353271	Philippines, Luzon Island	456	13.693	120.696
<i>Nierstraszella lineata</i>	MNHN-IM-2013-66514	MADEEP	CP4337	PZ353089	–	Island Region, Papua New Guinea	287-447	-6.117	149.283
<i>Nierstraszella lineata</i>	MNHN-IM-2013-66631	PAPUA NIUGINI	CP3994	PZ353090	–	Papua New Guinea	648-652	-6.000	147.583
<i>Nierstraszella lineata</i>	MNHN-IM-2013-66632	PAPUA NIUGINI	CP3994	PZ353091	–	Papua New Guinea	648-652	-6.000	147.583
<i>Nierstraszella lineata</i>	CASIZ-187885(c); de3352			PZ353092	–	Philippines, Luzon Island	281	13.820	120.750
<i>Nierstraszella lineata</i>	CASIZ-187929; de3359			–	PZ353272	Philippines, Luzon Island	478	13.740	120.760
<i>Nierstraszella lineata</i>	ZSM-20034397			–	HQ907877	Japan, Suruga Bay	not listed	34.830	138.540
<i>Nierstraszella lineata</i>	MNHN-IM-2009-10307	SANTO2006	AT92	–	JQ950257	Vanuatu	722-780	-15.000	166.867
<i>Nierstraszella lineata</i>	MNHN-IM-2009-10301	SANTO2006	AT92	–	JQ950256	Vanuatu	722-780	-15.000	166.867
<i>Nierstraszella lineata</i>	MNHN-IM-2009-10308	SANTO2006	AT127	–	JQ950258	Vanuatu	562-580	-16.433	167.883
<i>Nierstraszella lineata</i>	none listed	PANGLAO 2005	CP2380	–	HQ907876	Philippines	150-163	8.683	123.300
<i>Nierstraszella lineata</i>	CASIZ-187885(a); de3350			–	PZ353273	Philippines, Luzon Island	281	13.820	120.750
<i>Nierstraszella lineata</i>	CASIZ-187885(b); de3351			–	PZ353274	Philippines, Luzon Island	281	13.820	120.750
<i>Nierstraszella lineata*</i>	1816P1			–	OR483958	China	–	–	–
<i>Nierstraszella lineata*</i>	1956P1			–	OR483959	China	–	–	–

Taxon	Specimen ID	MNHN Expedition	Station	16S accession	cox1 accession	Locality	Depth (m)	Latitude	Longitude
<i>Rissochiton vietnamensis</i>	MNHN-IM-2013-46415	MADEEP	CP4339	PZ353093	PZ353275	Island Region, Papua New Guinea	510-743	-6.167	149.300
<i>Rissochiton vietnamensis</i>	MNHN-IM-2013-66569	MADEEP	CP4339	PZ353094	PZ353276	Island Region, Papua New Guinea	510-743	-6.167	149.300
<i>Rissochiton vietnamensis</i>	MNHN-IM-2013-66614	PAPUA NIUGINI	CP3994	PZ353095	–	Papua New Guinea	648-652	-6.000	147.583
<i>Rissochiton vietnamensis</i>	MNHN-IM-2013-66621	PAPUA NIUGINI	CP4006	PZ353096	–	Papua New Guinea	440-475	-6.050	148.133
<i>Rissochiton vietnamensis</i>	MNHN-IM-2013-66613	PAPUA NIUGINI	CP3994	PZ353097	–	Papua New Guinea	648-652	-6.000	147.583
<i>Rissochiton vietnamensis</i>	MNHN-IM-2013-66620	PAPUA NIUGINI	CP4006	PZ353098	–	Papua New Guinea	440-475	-6.050	148.133
<i>Rissochiton vietnamensis</i>	MNHN-IM-2013-66570	MADEEP	CP4339	PZ353099	–	Island Region, Papua New Guinea	510-743	-6.167	149.300
<i>Rissochiton vietnamensis</i>	MNHN-IM-2013-66622	PAPUA NIUGINI	CP4006	PZ353100	–	Papua New Guinea	440-475	-6.050	148.133
<i>Rissochiton vietnamensis</i>	MNHN-IM-2013-66615	PAPUA NIUGINI	CP3994	PZ353101	–	Papua New Guinea	650	-6.000	147.583
<i>Rissochiton vietnamensis</i> *	none listed	BOA1	CP2462	–	HQ907863	Vanuatu	618-641	-16.633	167.950
<i>Rissochiton vietnamensis</i> *	none listed	PANGLAO 2005	CP2356	–	HQ907870	Philippines	1764	9.350	124.150
<i>Rissochiton andamanicus</i>	MNHN-IM-2013-16529	PAPUA NIUGINI	CP3961	PZ353102	PZ353277	Papua New Guinea	513	-5.000	145.833
<i>Rissochiton andamanicus</i>	MNHN-IM-2013-66519	MADEEP	CP4337	PZ353103	PZ353278	Island Region, Papua New Guinea	287-447	-6.117	149.283
<i>Rissochiton andamanicus</i>	MNHN-IM-2013-66520	MADEEP	CP4337	PZ353104	–	Island Region, Papua New Guinea	287-447	-6.117	149.283
<i>Rissochiton andamanicus</i>	MNHN-IM-2013-66521	MADEEP	CP4337	PZ353105	–	Island Region, Papua New Guinea	287-447	-6.117	149.283
<i>Rissochiton andamanicus</i>	MNHN-IM-2013-66571	PAPUA NIUGINI	CP4008	PZ353106	–	Papua New Guinea	500-555	-6.067	148.167
<i>Rissochiton andamanicus</i>	MNHN-IM-2013-66572	PAPUA NIUGINI	CP4008	PZ353107	–	Papua New Guinea	500-555	-6.067	148.167
<i>Rissochiton andamanicus</i>	MNHN-IM-2013-66573	PAPUA NIUGINI	CP4008	PZ353108	–	Papua New Guinea	500-555	-6.067	148.167
<i>Rissochiton andamanicus</i>	MNHN-IM-2013-66645	AURORA 2007	CP2658	PZ353109	–	Philippines	422-431	15.967	121.818
<i>Rissochiton andamanicus</i>	none listed	PANGLAO 2005	CP2385	–	HQ907875	Philippines	982-989	8.850	123.167
<i>Rissochiton quincuncialis</i> sp. nov.	MNHN-IM-2013-66578	PAPUA NIUGINI	CP4039	PZ353110	PZ353279	Papua New Guinea	1022	-4.317	145.617
<i>Rissochiton quincuncialis</i> sp. nov.	MNHN-IM-2013-16743	PAPUA NIUGINI	CP3963	PZ353111	–	Papua New Guinea	960-980	-5.100	145.883
<i>Rissochiton quincuncialis</i> sp. nov.	MNHN-IM-2013-44877	MADEEP	CP4251	PZ353112	–	Papua New Guinea	842-933	-3.500	148.033
<i>Rissochiton quincuncialis</i> sp. nov.	MNHN-IM-2013-66579	PAPUA NIUGINI	CP4039	–	PZ353280	Papua New Guinea	1022	-4.317	145.617
<i>Rissochiton quincuncialis</i> sp. nov.	MNHN-IM-2013-66580	PAPUA NIUGINI	CP4039	–	PZ353281	Papua New Guinea	1022	-4.317	145.617
<i>Rissochiton rissoi</i>	MNHN-IM-2013-16739	PAPUA NIUGINI	CP3963	PZ353113	PZ353282	Papua New Guinea	960-980	-5.100	145.883
<i>Rissochiton rissoi</i>	MNHN-IM-2013-66646	AURORA 2007	CC2704	PZ353114	–	Philippines	1347-1392	15.050	123.117
<i>Rissochiton rissoi</i>	MNHN-IM-2013-66647	AURORA 2007	CP2684	PZ353115	–	Philippines	1413-1449	15.033	123.083
<i>Rissochiton rissoi</i>	MNHN-IM-2013-44878	MADEEP	CP4251	PZ353116	–	Papua New Guinea	842-933	-3.500	148.033
<i>Rissochiton rissoi</i>	MNHN-IM-2013-17061	EXBODI	CP3917	PZ353117	–	New Caledonia	753-951	-19.867	165.917
<i>Rissochiton rissoi</i>	MNHN-IM-2013-17022	PAPUA NIUGINI	CP3965	PZ353118	–	Papua New Guinea	980-985	-5.100	145.883
<i>Rissochiton rissoi</i>	MNHN-IM-2013-66679	PAPUA NIUGINI	CP3967	–	PZ359893	Papua New Guinea	980	-5.117	145.883
<i>Rissochiton rissoi</i> *	none listed	SALOMON2	CP2246	–	HQ907867	Solomon Islands	618-626	-6.017	147.583
<i>Rissochiton rissoi</i> *	none listed	PANGLAO 2005	CP2385	–	HQ907872	Philippines	982-989	8.850	123.167
<i>Rissochiton</i> cf. <i>rissoi</i>	MNHN-IM-2013-66695	KAVIENG 2014	CP4435	PZ353119	–	Papua New Guinea	1218-1252	-2.283	150.850
<i>Rissochiton</i> cf. <i>rissoi</i>	MNHN-IM-2013-66696	KAVIENG 2014	CP4435	PZ353120	–	Papua New Guinea	1218-1252	-2.283	150.850