

**Supplementary information for**

**Genetic demography of the blue and red shrimp, *Aristeus antennatus*: A female-based case study integrating multilocus genotyping and  
morphometric data**

Alba ABRAS,<sup>1</sup> José-Luis GARCÍA-MARÍN,<sup>1</sup> Sandra HERAS,<sup>1</sup> Melania AGULLÓ,<sup>1</sup> Manuel VERA,<sup>2</sup> Laia PLANELLA<sup>1</sup> and María Inés ROLDÁN<sup>1</sup>

<sup>1</sup> Laboratori d'Ictiologia Genètica, Universitat de Girona, Girona, Spain.

<sup>2</sup> Departamento de Zoología, Genética y Antropología Física, Universidad de Santiago de Compostela, Lugo, Spain.

*Correspondence:* María Inés Roldán, Laboratori d'Ictiologia Genètica, Universitat de Girona, Campus Montilivi, E-17003 Girona, Spain. Email: marina.roldan@udg.edu

**This pdf file includes:**

Supplementary Table S1

Supplementary Table S2

Supplementary Table S3

**Table S1.** Concordances used to calculate Cohen's kappa coefficient (K) for the comparison between commercial categories and modal progression analysis (MPA) groups in winter and in summer.

**Winter**

		Commercial categories					Total	
		J	S	M	L	XL		
<b>MPA groups</b>	<b>0+</b>	82	21	0	0	0	103	
	<b>1+</b>	4	65	0	0	0	69	
	<b>2+</b>	0	0	35	0	0	35	
	<b>3+</b>	0	0	21	17	1	39	
	<b>4+</b>	0	0	0	0	8	8	
	<b>NC</b>	19	19	26	5	8	77	
<b>Total</b>		105	105	82	22	17	0	331

**Summer**

		Commercial categories					Total
		S	M	L	XL	NC	
<b>MPA groups</b>	<b>1+</b>	71	7	1	0	0	79
	<b>2+</b>	16	60	0	0	0	76
	<b>3+</b>	0	2	47	0	0	49
	<b>4+ and 5+</b>	0	0	24	27	0	51
	<b>NC</b>	13	30	19	17	0	79
<b>Total</b>		100	99	91	44	0	334

J, juveniles; S, small; M, medium; L, large; XL, extra-large; NC, not classified by MPA.

**Table S2** Genetic diversity for twelve microsatellite loci for commercial sized *Aristeus antennatus* female groups.

Group		Aa123	Aa1255	Aa138	Aa1444	Aa496b	Aa667	Aa681	Aa751	Aa956	Aa1061	Aa1195	Aa818
Winter juveniles	<i>n</i>	104	102	104	100	99	103	105	101	101	105	105	105
	<i>N<sub>A</sub></i>	5	15	22	14	2	7	20	3	6	8	5	6
	<i>A<sub>R</sub></i>	3.386	7.276	11.051	6.995	1.951	3.911	9.051	2.009	4.931	4.504	3.424	4.690
	<i>H<sub>O</sub></i>	0.4231	0.4804	0.7981	0.4500	0.2222	0.4175	0.6000	0.0990	0.6040	0.3429	0.5810	0.3429
	<i>H<sub>E</sub></i>	0.6155	0.7128	0.9095	0.7502	0.2141	0.6905	0.8127	0.1806	0.7100	0.7047	0.6049	0.6726
	<i>F<sub>IS</sub></i>	0.3126*	0.3261*	0.1225*	0.4001*	-0.0380	0.3954*	0.2617*	0.4519*	0.1493	0.5135*	0.0396	0.4902*
Winter small	<i>Nu</i>	0.1195	0.1412	0.0576	0.1701		0.1598	0.1114	0.0745	0.0546	0.2320		0.2036
	<i>n</i>	103	101	104	101	101	95	104	97	103	104	104	103
	<i>N<sub>A</sub></i>	6	15	19	11	2	8	18	3	6	6	4	6
	<i>A<sub>R</sub></i>	3.569	7.964	10.388	6.025	1.948	4.628	9.074	2.094	4.425	4.296	3.178	4.410
	<i>H<sub>O</sub></i>	0.4757	0.4554	0.8654	0.4851	0.2376	0.4842	0.6250	0.1753	0.5243	0.4327	0.6154	0.3883
	<i>H<sub>E</sub></i>	0.6147	0.8055	0.8968	0.7545	0.2103	0.7160	0.8193	0.2720	0.6157	0.6744	0.6242	0.6394
Winter medium	<i>F<sub>IS</sub></i>	0.2261	0.4346*	0.0351	0.3570*	-0.1299	0.3237*	0.2371*	0.3557	0.1485	0.3584*	0.0141	0.3926*
	<i>Nu</i>	0.0944	0.1744		0.1391		0.1405	0.0854	0.0687	0.0576	0.1185		0.1461
	<i>n</i>	79	80	80	79	79	75	81	76	79	82	82	80
	<i>N<sub>A</sub></i>	5	13	20	11	2	9	19	3	6	8	5	6
	<i>A<sub>R</sub></i>	3.572	7.316	10.637	5.830	1.952	4.836	9.120	2.602	4.624	4.716	3.497	4.515
	<i>H<sub>O</sub></i>	0.3924	0.4000	0.8125	0.4051	0.2405	0.4400	0.5432	0.0789	0.5190	0.3049	0.6098	0.3250
Winter large	<i>H<sub>E</sub></i>	0.5873	0.7743	0.8972	0.7318	0.2128	0.7046	0.8193	0.3417	0.6716	0.6790	0.6268	0.6458
	<i>F<sub>IS</sub></i>	0.3319*	0.4834*	0.0944	0.4465*	-0.1304	0.3755*	0.3370*	0.7689*	0.2273	0.5510*	0.0271	0.4968*
	<i>Nu</i>	0.118	0.2128		0.1829		0.1382	0.1266	0.2048	0.0877	0.2225		0.2145
	<i>n</i>	17	16	22	22	20	17	22	18	14	21	22	22
	<i>N<sub>A</sub></i>	3	7	13	6	2	3	12	3	5	5	4	5
	<i>A<sub>R</sub></i>	2.989	5.881	8.998	5.137	1.804	3.000	8.111	2.610	4.745	4.338	3.446	4.700
	<i>H<sub>O</sub></i>	0.4118	0.1875	0.7727	0.5909	0.1000	0.2941	0.5455	0.0556	0.5000	0.3333	0.7273	0.0909
	<i>H<sub>E</sub></i>	0.5919	0.6354	0.8344	0.7208	0.0974	0.6176	0.7673	0.3399	0.6429	0.6381	0.6093	0.7294
	<i>F<sub>IS</sub></i>	0.3043	0.7049*	0.0739	0.1802	-0.0270	0.5238	0.2891	0.8365	0.2222	0.4776	-0.1936	0.8754*
	<i>Nu</i>	0.1743	0.2832		0.1678		0.1477	0.2024					0.3608
	<i>n</i>	12	11	17	17	16	15	17	17	16	17	17	16

	$N_A$	4	6	14	6	2	6	11	3	4	4	3	5
Winter extra-large	$A_R$	3.917	6.000	10.786	5.508	1.976	5.338	9.295	2.529	3.975	3.529	2.963	4.901
	$H_O$	0.2500	0.3636	0.9412	0.5882	0.1875	0.4667	0.3529	0.1765	0.5625	0.2353	0.4706	0.1875
	$H_E$	0.5909	0.7955	0.8621	0.7445	0.1750	0.6405	0.8989	0.1691	0.6937	0.5974	0.5754	0.7208
	$F_{IS}$	0.5769	0.5429	-0.0917	0.2099	-0.0714	0.2714	0.6074*	-0.0435	0.1892	0.6062*	0.1821	0.7399*
	$Nu$							0.3672					0.2841
Summer small	$n$	100	95	100	98	100	100	92	100	99	100	98	
	$N_A$	5	14	22	13	2	8	23	3	6	7	4	6
	$A_R$	3.587	7.539	11.156	6.770	1.857	4.231	9.229	2.069	4.823	4.966	3.142	4.585
	$H_O$	0.5000	0.4632	0.8800	0.5408	0.1600	0.5800	0.6700	0.1196	0.6500	0.4343	0.5600	0.3571
	$H_E$	0.6412	0.7690	0.9058	0.7222	0.1479	0.6875	0.8205	0.2218	0.6941	0.7085	0.5909	0.6104
	$F_{IS}$	0.2202	0.3977*	0.0284	0.2512	-0.0820	0.1564	0.1834*	0.4610*	0.0635	0.3870*	0.0523	0.4149*
	$Nu$	0.0993	0.1797		0.0999		0.0634	0.1094	0.0901		0.1692		0.1840
	$n$	99	90	98	95	97	95	98	97	98	99	99	98
Summer medium	$N_A$	4	16	20	12	2	8	20	3	6	7	5	6
	$A_R$	3.103	7.932	10.824	7.019	1.847	4.172	9.019	2.202	4.636	5.079	3.460	4.367
	$H_O$	0.4343	0.5000	0.8469	0.5053	0.1546	0.4526	0.6939	0.1340	0.5306	0.4141	0.6566	0.3469
	$H_E$	0.5971	0.8060	0.9078	0.7770	0.1434	0.6992	0.8150	0.1973	0.6192	0.7131	0.5965	0.6178
	$F_{IS}$	0.2726	0.3796*	0.0670	0.3497*	-0.0787	0.3526*	0.1486	0.3206	0.1431	0.4192*	-0.1007	0.4384*
	$Nu$	0.0943	0.1668		0.1517		0.1540	0.0506	0.0465	0.0677	0.1720		0.1353
Summer large	$n$	88	83	88	85	90	86	90	84	88	91	90	89
	$N_A$	4	15	20	12	2	9	19	3	6	8	5	5
	$A_R$	3.411	7.340	11.378	7.480	1.953	4.396	8.062	2.187	4.298	4.956	3.521	4.279
	$H_O$	0.5114	0.5422	0.8523	0.5412	0.2444	0.5116	0.6444	0.1071	0.5114	0.4725	0.6556	0.3371
	$H_E$	0.6165	0.7898	0.9210	0.8277	0.2156	0.6982	0.7436	0.2235	0.6152	0.6714	0.6096	0.6419
	$F_{IS}$	0.1706	0.3136*	0.0747*	0.3462*	-0.1338	0.2672	0.1334	0.5205*	0.1688	0.2962	-0.0754	0.4749*
Summer extra-large	$Nu$	0.0788	0.1708	0.0375	0.1516		0.0818	0.0524	0.0968		0.1617		0.1864
	$n$	42	36	44	43	42	37	42	42	41	44	43	44
	$N_A$	5	13	17	11	2	5	16	3	5	6	3	6
	$A_R$	3.846	7.894	9.971	6.736	1.603	3.956	8.518	2.184	4.059	4.794	2.995	4.960

$H_O$	0.4286	0.6111	0.7045	0.5581	0.0714	0.4865	0.5714	0.0714	0.4634	0.5000	0.5349	0.2955
$H_E$	0.6376	0.8163	0.8964	0.7738	0.0697	0.7001	0.8098	0.1974	0.6332	0.7061	0.6030	0.7077
$F_{IS}$	0.3279	0.2513	0.2140*	0.2787	-0.0250	0.3051	0.2944*	0.6382	0.2682	0.2919	0.1129	0.5825*
$Nu$	0.1261	0.1003	0.1099	0.0889		0.1096	0.0788			0.1224		0.1990

n, number of genotyped females;  $N_A$ , Number of alleles;  $A_R$ , allelic richness;  $H_O$ , observed heterozygosity;  $H_E$ , expected heterozygosity;  $F_{IS}$ , inbreeding coefficient;  $Nu$ , null allele frequency. \* Significant departure from Hardy-Weinberg equilibrium after Bonferroni correction ( $\alpha/108$ ,  $P < 0.0005$ ).

**Table S3.** Genetic diversity for twelve microsatellite loci for *Aristeus antennatus* female groups identified through the modal progression analysis of the cephalothorax length (CL) frequency distributions.

Group		Aa123	Aa1255	Aa138	Aa1444	Aa496b	Aa667	Aa681	Aa751	Aa956	Aa1061	Aa1195	Aa818
Winter 0+	<i>n</i>	102	100	102	99	98	100	103	98	100	103	103	103
	<i>N<sub>A</sub></i>	5	15	21	13	2	8	21	3	6	8	5	6
	<i>A<sub>R</sub></i>	3.053	5.086	6.997	4.855	1.705	3.460	5.894	1.756	3.929	3.705	2.891	3.762
	<i>H<sub>O</sub></i>	0.4808	0.4500	0.8137	0.5051	0.2041	0.3800	0.6019	0.1327	0.6000	0.3592	0.5243	0.3398
	<i>H<sub>E</sub></i>	0.6071	0.7677	0.9114	0.7721	0.2003	0.6895	0.8229	0.2098	0.7051	0.7038	0.5973	0.6877
	<i>F<sub>IS</sub></i>	0.2087	0.4138*	0.1072	0.3458*	-0.0189	0.4489*	0.2685*	0.3676	0.1491	0.4896*	0.1222	0.5058*
	<i>N<sub>u</sub></i>	0.0882	0.1751	0.0507	0.1513		0.1674	0.1090	0.0722	0.0596	0.2085		0.1952
Winter 1+	<i>n</i>	68	67	68	65	66	62	68	63	67	68	68	67
	<i>N<sub>A</sub></i>	5	12	18	11	2	7	18	3	6	5	4	6
	<i>A<sub>R</sub></i>	3.067	5.021	6.960	4.684	1.739	3.940	5.723	1.914	3.475	3.136	3.005	3.471
	<i>H<sub>O</sub></i>	0.4118	0.4627	0.8971	0.4923	0.2424	0.5484	0.5582	0.1429	0.5224	0.3824	0.6471	0.4328
	<i>H<sub>E</sub></i>	0.6358	0.7732	0.9078	0.7722	0.2145	0.7398	0.8201	0.2837	0.5925	0.6411	0.6340	0.6140
	<i>F<sub>IS</sub></i>	0.3523	0.4016*	0.0118	0.3625*	-0.1304	0.2588	0.2828*	0.4964*	0.1183	0.4036*	-0.0206	0.2950
	<i>N<sub>u</sub></i>	0.1413	0.1419		0.1322		0.1248	0.1128	0.0879		0.1290		0.1177
Winter 2+	<i>n</i>	33	34	35	34	35	31	35	34	34	35	35	35
	<i>N<sub>A</sub></i>	4	9	16	7	2	7	14	3	6	6	3	6
	<i>A<sub>R</sub></i>	3.108	4.849	6.936	4.704	1.810	3.791	5.716	2.412	3.752	3.543	2.829	3.614
	<i>H<sub>O</sub></i>	0.3939	0.4118	0.8286	0.3529	0.2857	0.4516	0.5714	0.0588	0.5882	0.4286	0.5714	0.2571
	<i>H<sub>E</sub></i>	0.5975	0.7741	0.9063	0.8030	0.2479	0.7177	0.8193	0.3944	0.6430	0.6689	0.5866	0.6458
	<i>F<sub>IS</sub></i>	0.3407	0.4680*	0.0858	0.5605*	-0.1525	0.3708*	0.3026	0.8508*	0.0852	0.3593	0.0258	0.6018*
	<i>N<sub>u</sub></i>	0.1413	0.2175		0.2430		0.1303	0.1006	0.2708		0.1104		0.2525
Winter 3+	<i>n</i>	34	33	38	38	37	32	39	32	31	38	39	36
	<i>N<sub>A</sub></i>	3	8	18	7	2	7	16	2	6	6	4	5
	<i>A<sub>R</sub></i>	2.885	4.107	6.785	3.797	1.595	3.770	5.864	1.871	3.916	3.213	2.984	3.788
	<i>H<sub>O</sub></i>	0.3529	0.2121	0.8158	0.5263	0.1622	0.3125	0.5128	0.0312	0.5484	0.2632	0.7179	0.1944
	<i>H<sub>E</sub></i>	0.6368	0.7225	0.8979	0.6650	0.1509	0.7067	0.8185	0.2933	0.7188	0.6394	0.6245	0.7032
	<i>F<sub>IS</sub></i>	0.4458	0.7064*	0.0915	0.2086	-0.0746	0.5578*	0.3735*	0.8935*	0.2371	0.5884*	-0.1496	0.7235*

	<i>Nu</i>	0.2087	0.2547			0.2343	0.1639	0.2112		0.2624		0.2451
Winter 4+	<i>n</i>	5	6	8	8	8	8	8	7	8	8	8
	<i>N<sub>A</sub></i>	4	4	7	6	2	5	7	2	4	3	3
	<i>A<sub>R</sub></i>	4.000	3.818	5.339	5.302	1.964	4.089	5.920	1.625	3.647	2.625	2.867
	<i>H<sub>O</sub></i>	0.4000	0.3333	1.0000	0.6250	0.3750	0.3750	0.3750	0.1250	0.4286	0.3750	0.2500
	<i>H<sub>E</sub></i>	0.6750	0.7833	0.7768	0.8661	0.3214	0.6875	0.9196	0.1250	0.7143	0.6071	0.5893
	<i>F<sub>IS</sub></i>	0.4074	0.5745	-0.2874	0.2784	-0.1667	0.4545	0.5922	0.0000	0.4000	0.3824	0.5758
	<i>Nu</i>						0.4286					0.4286
Summer 1+	<i>n</i>	79	74	79	77	79	79	74	79	79	79	77
	<i>N<sub>A</sub></i>	5	13	20	13	2	8	21	3	6	7	4
	<i>A<sub>R</sub></i>	3.108	5.144	6.891	4.539	1.557	3.469	5.643	1.761	3.841	3.927	2.840
	<i>H<sub>O</sub></i>	0.5063	0.5000	0.8734	0.5844	0.1519	0.5443	0.6582	0.0946	0.6329	0.4557	0.5316
	<i>H<sub>E</sub></i>	0.6365	0.7878	0.9044	0.7294	0.1412	0.6797	0.8020	0.2070	0.6746	0.7175	0.5918
	<i>F<sub>IS</sub></i>	0.2045	0.3653*	0.0343	0.1988	-0.0759	0.1992	0.1793*	0.5429*	0.0618	0.3649*	0.1016
	<i>Nu</i>	0.1008	0.1696		0.0742		0.0866	0.1003	0.1029		0.1730	0.1734
Summer 2+	<i>n</i>	76	70	75	74	75	73	76	73	75	75	75
	<i>N<sub>A</sub></i>	3	14	21	12	2	7	21	3	6	7	5
	<i>A<sub>R</sub></i>	2.891	4.913	7.183	4.950	1.510	3.504	5.938	1.876	3.735	3.881	3.025
	<i>H<sub>O</sub></i>	0.4342	0.5143	0.8667	0.5405	0.1333	0.5068	0.6974	0.1644	0.6133	0.4267	0.6711
	<i>H<sub>E</sub></i>	0.6265	0.7816	0.9169	0.7652	0.1252	0.7002	0.8348	0.2420	0.6465	0.7114	0.5979
	<i>F<sub>IS</sub></i>	0.3069	0.3420*	0.0548	0.2936*	-0.0647	0.2762	0.1647	0.3208	0.0513	0.4002*	-0.1224
	<i>Nu</i>	0.0997	0.1465		0.1348		0.1116	0.0769			0.1465	0.1377
Summer 3+	<i>n</i>	47	44	48	46	49	46	49	45	47	49	49
	<i>N<sub>A</sub></i>	4	13	18	9	2	7	16	2	5	6	5
	<i>A<sub>R</sub></i>	3.009	5.248	7.323	4.994	1.747	3.569	5.245	1.712	3.491	3.583	2.936
	<i>H<sub>O</sub></i>	0.5957	0.5000	0.8958	0.5870	0.2449	0.4348	0.6531	0.0889	0.5532	0.4694	0.6250
	<i>H<sub>E</sub></i>	0.6422	0.8158	0.9253	0.8060	0.2168	0.7159	0.7617	0.2010	0.6376	0.6735	0.5962
	<i>F<sub>IS</sub></i>	0.0724	0.3871*	0.0319	0.2718	-0.1294	0.3927	0.1426	0.5578	0.1324	0.3030*	-0.0483
	<i>Nu</i>		0.1862		0.1062		0.1474		0.1049		0.1881	0.2217
Summer 4+	<i>n</i>	39	35	39	37	39	38	39	38	39	41	40
	<i>N<sub>A</sub></i>	4	10	17	11	2	7	15	2	6	7	4

	$A_R$	3.001	4.326	7.257	5.582	1.574	3.296	4.958	1.644	3.731	3.728	2.995	3.495
	$H_O$	0.4872	0.6000	0.8205	0.4595	0.1538	0.4737	0.5641	0.0789	0.4329	0.5122	0.6000	0.2000
	$H_E$	0.6255	0.7538	0.9261	0.8446	0.1437	0.6547	0.7520	0.1717	0.6852	0.6640	0.6234	0.6506
	$F_{IS}$	0.2211	0.2040	0.1140	0.4560*	-0.0704	0.2765	0.2499	0.5375	0.3639	0.2287	0.0375	0.6926*
	$Nu$		0.1164		0.1799					0.1042		0.2117	
Summer	$n$	10	8	10	10	9	9	10	9	10	10	10	10
5+	$N_A$	4	8	9	7	2	4	9	1	4	6	3	5
	$A_R$	2.998	6.374	5.981	5.010	1.837	3.840	6.051	1.000	3.467	4.289	2.951	3.940
	$H_O$	0.2000	0.6250	0.6000	0.7000	0.2222	0.4444	0.6000	0.0000	0.6000	0.3000	0.6000	0.2000
	$H_E$	0.6222	0.9018	0.8611	0.7944	0.2083	0.7569	0.8667	0.0000	0.7111	0.6556	0.6556	0.7556
	$F_{IS}$	0.6786	0.3069	0.3032	0.1189	-0.0667	0.4128	0.3077		0.1563	0.5424	0.0847	0.7353*
	$Nu$		0.1397							0.2222			

$n$ , number of genotyped females;  $N_A$ , Number of alleles;  $A_R$ , allelic richness;  $H_O$ , observed heterozygosity;  $H_E$ , expected heterozygosity;  $F_{IS}$ , inbreeding coefficient;  $Nu$ , null allele frequency. \* Significant departure from Hardy-Weinberg equilibrium after Bonferroni correction ( $\alpha/120$ ,  $P < 0.0004$ ).