

*The following supplement accompanies the article*

## **Genetic structure in the blue and red shrimp *Aristeus antennatus* and the role played by hydrographical and oceanographical barriers**

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Supplement. These additional data include a complete list of haplotypes for single (16S rDNA and COI) and concatenated genes. In addition, data analysis of single genes and mismatch distribution of concatenated genes are provided.

Table S1. *Aristeus antennatus*. List of 16S rDNA haplotypes detected in the eleven sampling sites with respective GenBank accession numbers. Accession numbers in bold refer to previously detected haplotypes by Roldán et al. (2009) and Sardà et al. (2010).

Haplotype	Freq	Faro	Alborán Sea	Almería	Sóller	Cabrera	Palamós	Gulf of Lion	Genoa	Palermo	Ionian Sea	Mozambique	TOTAL	GenBank
h1	0.002						1						1	<b>EU908298</b>
h2	0.642	11	34	37	39	28	48	36	23	27	18	2	303	<b>EU977139</b>
h3	0.193	17	4	3	2	1	3	2	10	2	18	29	91	<b>EU977140</b>
h4	0.002						1						1	<b>EU908312</b>
h5	0.006				1		1		1				3	<b>EU908381</b>
h6	0.002						1						1	<b>EU977163</b>
h7	0.002						1						1	<b>EU908332</b>
h8	0.002						1						1	<b>EU908351</b>
h9	0.002						1						1	<b>EU908353</b>
h10	0.002						1						1	<b>EU908355</b>
h11	0.002								1				1	GU972605
h12	0.002								1				1	GU972606
h13	0.002								1				1	<b>EU908391</b>
h14	0.002									1			1	<b>EU908402</b>
h15	0.006							1		2			3	<b>EU908405</b>
h16	0.002									1			1	<b>EU908414</b>
h17	0.002									1			1	<b>EU977162</b>
h18	0.002									1			1	<b>EU908430</b>
h19	0.017	4	1		1			1				1	8	<b>EU977149</b>
h20	0.002	1											1	GU972607
h21	0.002	1											1	GU972608
h22	0.002	1											1	GU972609
h23	0.002			1									1	GU972610
h24	0.002			1									1	GU972611
h25	0.002			1									1	GU972612
h26	0.004											2	2	GU972613
h27	0.002											1	1	GU972614
h28	0.002											1	1	GU972615
h29	0.004		1									1	2	GU972616
h30	0.002											1	1	GU972617
h31	0.002											1	1	GU972618

Haplotype	Freq	Faro	Alborán Sea	Almería	Sóller	Cabrera	Palamós	Gulf of Lion	Genoa	Palermo	Ionian Sea	Mozambique	TOTAL	GenBank	
h32	0.002												1	1	GU972619
h33	0.002												1	1	GU972620
h34	0.002												1	1	GU972621
h35	0.002												1	1	GU972622
h36	0.002												1	1	GU972623
h37	0.004		1										1	2	GU972624
h38	0.002												1	1	GU972625
h39	0.004							2						2	GU972626
h40	0.002							1						1	GU972627
h41	0.002							1						1	GU972628
h42	0.002							1						1	GU972629
h43	0.002							1						1	GU972630
h44	0.002		1											1	GU972631
h45	0.002		1											1	GU972632
h46	0.002		1											1	GU972633
h47	0.002		1											1	<b>EU977173</b>
h48	0.002		1											1	GU972634
h49	0.002		1											1	GU972635
h50	0.002		1											1	GU972636
h51	0.002		1											1	GU972637
h52	0.002		1											1	GU972638
h53	0.002		1											1	GU972639
h54	0.002		1											1	GU972640
h55	0.002		1											1	GU972641
h56	0.002											1		1	GU972642
h57	0.002											1		1	GU972643
h58	0.002											1		1	GU972644
h59	0.002													1	GU972645
h60	0.002													1	GU972646
h61	0.002													1	GU972647
h62	0.002													1	GU972648
h63	0.002													1	GU972649
h64	0.002													1	GU972650
h65	0.002													1	GU972651
		35	53	43	46	33	59	46	37	35	39	46	472		

Table S2. *Aristeus antennatus*. List of COI haplotypes detected in the eleven sampling sites with respective GenBank accession numbers. Accession numbers in bold refer to previously detected haplotypes by Roldán et al. (2009).

Haplotype	Freq	Faro	Alborán Sea	Almería	Sóller	Cabrera	Palamós	Gulf of Lion	Genoa	Palermo	Ionian Sea	Mozambique	TOTAL	GenBank	
h1	0.004						2						2	<b>EU908436</b>	
h2	0.656	12		39	34	40	34	46	44	28	30	16	3	326	<b>EU908437</b>
h3	0.002							1						1	<b>EU908439</b>
h4	0.002							1						1	<b>EU908440</b>
h5	0.002							1						1	<b>EU908442</b>
h6	0.004			1				1						2	<b>EU908446</b>
h7	0.002							1						1	<b>EU908447</b>
h8	0.002							1						1	<b>EU908463</b>
h9	0.002							1						1	<b>EU908469</b>
h10	0.002							1						1	<b>EU908481</b>
h11	0.004				1			1						2	<b>EU908485</b>
h12	0.006	1						1		1				3	<b>EU908486</b>
h13	0.002							1						1	<b>EU908490</b>
h14	0.054	4		4	1				5		1	12		27	<b>EU908497</b>
h15	0.024	3		2		1		1	2			3		12	<b>EU908498</b>
h16	0.002								1					1	<b>EU908501</b>
h17	0.002								1					1	GU972652
h18	0.002								1					1	<b>EU908512</b>
h19	0.002								1					1	<b>EU908514</b>
h20	0.002								1					1	<b>EU908528</b>
h21	0.002								1					1	<b>EU908529</b>
h22	0.004			1					1					2	<b>EU908537</b>
h23	0.002								1					1	<b>EU908538</b>
h24	0.010	1									4			5	<b>EU908539</b>
h25	0.002										1			1	<b>EU908561</b>
h26	0.002										1			1	<b>EU908563</b>
h27	0.002	1												1	GU972653
h28	0.006	1		1									1	3	GU972654
h29	0.002	1												1	GU972655
h30	0.002	1												1	GU972656
h31	0.006	2									1			3	GU972657
h32	0.028	6		1									7	14	GU972658

Haplotype	Freq	Faro	Alborán Sea	Almería	Sóller	Cabrera	Palamós	Gulf of Lion	Genoa	Palermo	Ionian Sea	Mozambique	TOTAL	GenBank
h33	0.002	1											1	GU972659
h34	0.002	1											1	GU972660
h35	0.006	1		1							1		3	GU972661
h36	0.002	1											1	GU972662
h37	0.002			1									1	GU972663
h38	0.004		1	1									2	GU972664
h39	0.002			1									1	GU972665
h40	0.002											1	1	GU972666
h41	0.002											1	1	GU972667
h42	0.006											3	3	GU972668
h43	0.002											1	1	GU972669
h44	0.002											1	1	GU972670
h45	0.002											1	1	GU972671
h46	0.008											4	4	GU972672
h47	0.002											1	1	GU972673
h48	0.002											1	1	GU972674
h49	0.002											1	1	GU972675
h50	0.002											1	1	GU972676
h51	0.002											1	1	GU972677
h52	0.002											1	1	GU972678
h53	0.002											1	1	GU972679
h54	0.002											1	1	GU972680
h55	0.002											1	1	GU972681
h56	0.004											2	2	GU972682
h57	0.008											4	4	GU972683
h58	0.002											1	1	GU972684
h59	0.002											1	1	GU972685
h60	0.002											1	1	GU972686
h61	0.004											2	2	GU972687
h62	0.004											2	2	GU972688
h63	0.002											1	1	GU972689
h64	0.002											1	1	GU972690
h65	0.004					1		1					2	GU972691
h66	0.004							1			1		2	GU972692
h67	0.002							1					1	GU972693
h68	0.002							1					1	GU972694

Haplotype	Freq	Faro	Alborán Sea	Almería	Sóller	Cabrera	Palamós	Gulf of Lion	Genoa	Palermo	Ionian Sea	Mozambique	TOTAL	GenBank
h69	0.002							1					1	GU972695
h70	0.002							1					1	GU972696
h71	0.002		1										1	GU972697
h72	0.002		1										1	GU972698
h73	0.002		1										1	GU972699
h74	0.002		1										1	GU972700
h75	0.002		1										1	GU972701
h76	0.002		1										1	GU972702
h77	0.002		1										1	GU972703
h78	0.002										1		1	GU972704
h79	0.002										1		1	GU972705
h80	0.002										1		1	GU972706
h81	0.002										1		1	GU972707
h82	0.002										1		1	GU972708
h83	0.002										1		1	GU972709
h84	0.002					1							1	GU972710
h85	0.002					1							1	GU972711
h86	0.002					1							1	GU972712
h87	0.002				1								1	GU972713
h88	0.002				1								1	GU972714
h89	0.002				1								1	GU972715
h90	0.002				1								1	GU972716
h91	0.002				1								1	GU972717
h92	0.002				1								1	GU972718
		37	53	43	47	39	59	51	44	37	40	47	497	

Table S3. *Aristeus antennatus*. Estimates of genetic diversity for 16S rDNA and COI gene. Sample size (N), number of sequence obtained (n), number of haplotypes (Nh), number of polymorphic sites (Np), haplotype (h) and nucleotide ( $\pi$ ) diversity for each locality and the total.

Region	Locality	16S rDNA						COI				
		N	n	Nh	Np	$h \pm SD$	$\pi \pm SD$	n	Nh	Np	$h \pm SD$	$\pi \pm SD$
Atlantic Ocean (AO)	Faro, Portugal	38	35	6	6	$0.669 \pm 0.056$	$0.0017 \pm 0.0003$	37	15	23	$0.863 \pm 0.042$	$0.0062 \pm 0.0008$
Alborán Sea (AS)	Alborán Sea, Spain	53	53	17	17	$0.589 \pm 0.081$	$0.0016 \pm 0.0003$	53	12	13	$0.458 \pm 0.085$	$0.0020 \pm 0.0005$
Western Mediterranean (WM)	Almería, Spain	45	43	5	4	$0.259 \pm 0.086$	$0.0005 \pm 0.0002$	43	9	14	$0.378 \pm 0.095$	$0.0019 \pm 0.0007$
	Sóller, Spain	48	46	7	7	$0.283 \pm 0.087$	$0.0007 \pm 0.0003$	47	8	11	$0.278 \pm 0.086$	$0.0012 \pm 0.0005$
	Cabrera, Spain	40	33	6	6	$0.284 \pm 0.102$	$0.0007 \pm 0.0003$	39	6	8	$0.243 \pm 0.091$	$0.0009 \pm 0.0004$
	Palamós, Spain	59	59	10	10	$0.339 \pm 0.080$	$0.0007 \pm 0.0002$	59	13	18	$0.395 \pm 0.082$	$0.0016 \pm 0.0004$
	Gulf of Lion, France	51	46	9	8	$0.389 \pm 0.092$	$0.0009 \pm 0.0002$	51	8	13	$0.258 \pm 0.081$	$0.0014 \pm 0.0005$
	Genoa, Italy	44	37	6	5	$0.553 \pm 0.072$	$0.0011 \pm 0.0002$	44	12	16	$0.589 \pm 0.085$	$0.0039 \pm 0.0008$
	Palermo, Italy	40	35	7	7	$0.407 \pm 0.104$	$0.0010 \pm 0.0003$	37	5	8	$0.338 \pm 0.096$	$0.0016 \pm 0.0006$
Eastern Mediterranean (EM)	Ionian Sea, Greece	40	39	5	4	$0.587 \pm 0.041$	$0.0012 \pm 0.0002$	40	12	18	$0.758 \pm 0.050$	$0.0058 \pm 0.0006$
Indian Ocean (IO)	Mozambique Channel, Mozambique	48	46	16	13	$0.606 \pm 0.086$	$0.0015 \pm 0.0003$	47	28	39	$0.961 \pm 0.015$	$0.0070 \pm 0.0007$
	Total	506	472	65	59	$0.551 \pm 0.024$	$0.0013 \pm 0.0001$	497	92	75	$0.566 \pm 0.027$	$0.0034 \pm 0.0002$

Table S4. *Aristeus antennatus*. Hierarchical analysis of molecular variance (AMOVA) for 16S rDNA and COI gene. Regions code as in Table S3.

Hypothesis	Source of variation	df	Components	16S rDNA			COI				
				% of variance	$\Phi$ -statistics	p	df	Components	% of variance	$\Phi$ -statistics	p
Unstructured	Among samples	10	0.08513	22.88	$\Phi_{ST} = 0.229$	< 0.001	10	0.11542	13.21	$\Phi_{ST} = 0.132$	< 0.001
	Within samples	461	0.28698	77.12			486	0.75818	86.79		
Five regions (AO, AS, WM, EM, IO)	Among regions	4	0.13258	31.41	$\Phi_{CT} = 0.314$	0.018	4	0.18502	19.56	$\Phi_{CT} = 0.196$	0.003
	Among samples within regions	6	0.00257	0.61	$\Phi_{SC} = 0.008$	0.004	6	0.00261	0.28	$\Phi_{SC} = 0.003$	0.001
	Within samples	461	0.28698	67.98	$\Phi_{ST} = 0.320$	< 0.001	486	0.75818	80.16	$\Phi_{ST} = 0.198$	< 0.001
Four regions (AS+AO, WM, EM, IO)	Among regions	3	0.10765	25.96	$\Phi_{CT} = 0.259$	0.044	3	0.15482	16.53	$\Phi_{CT} = 0.165$	0.009
	Among samples within regions	7	0.02007	4.84	$\Phi_{SC} = 0.065$	< 0.001	7	0.02373	2.53	$\Phi_{SC} = 0.030$	< 0.001
	Within samples	461	0.28698	69.20	$\Phi_{ST} = 0.307$	< 0.001	486	0.75818	80.94	$\Phi_{ST} = 0.191$	< 0.001
Four regions (AO, AS+WM, EM, IO)	Among regions	3	0.17745	38.01	$\Phi_{CT} = 0.380$	0.005	3	0.24831	24.63	$\Phi_{CT} = 0.246$	0.006
	Among samples within regions	7	0.00248	0.53	$\Phi_{SC} = 0.009$	< 0.001	7	0.00161	0.16	$\Phi_{SC} = 0.002$	< 0.001
	Within samples	461	0.28698	61.46	$\Phi_{ST} = 0.385$	< 0.001	486	0.75818	75.21	$\Phi_{ST} = 0.248$	< 0.001
Three regions (AO, AS+WM, EM)	Among regions	2	0.09743	26.02	$\Phi_{CT} = 0.260$	0.022	2	0.18058	21.63	$\Phi_{CT} = 0.216$	0.023
	Among samples within regions	7	0.00277	0.74	$\Phi_{SC} = 0.010$	0.009	7	0.00392	0.47	$\Phi_{SC} = 0.006$	0.002
	Within samples	416	0.27428	73.24	$\Phi_{ST} = 0.268$	< 0.001	440	0.65050	77.90	$\Phi_{ST} = 0.221$	< 0.001



Table S5. *Aristeus antennatus*. Fu's (1997)  $F_S$  and Ramos-Onsins & Rozas' (2002)  $R_2$  neutrality tests for 16S rDNA and COI genes for samples pooled within four regions and total. <sup>ns</sup> non-significant, \*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$

Region	16S rDNA		COI	
	Fu's $F_S$	$R_2$	Fu's $F_S$	$R_2$
Atlantic Ocean (AO)	-1.709 <sup>ns</sup>	0.088 <sup>ns</sup>	-5.165*	0.063*
Western Mediterranean (AS+WM)	-104.782***	0.008*	-95.080***	0.011***
Eastern Mediterranean (EM)	-1.450 <sup>ns</sup>	0.092 <sup>ns</sup>	-2.292 <sup>ns</sup>	0.077 <sup>ns</sup>
Indian Ocean (IO)	-18.841***	0.035**	-22.081***	0.038***
Total	-138.196***	0.007*	-162.021***	0.011**

Table S6. *Aristeus antennatus*. List of concatenated 16S rDNA and COI haplotypes detected in the eleven sampling sites.

Haplotype	Freq	Faro	Alborán Sea	Almería	Sóller	Cabrera	Palamós	Gulf of Lior	Genoa	Palermo	Ionian Sea	Mozambique	TOTAL	Haplogroup
h1	0.002						1						1	HG1
h2	0.536	7	29	31	34	23	38	32	19	21	14		248	HG1
h3	0.002						1						1	HG1
h4	0.002						1						1	HG2
h5	0.002						1						1	HG1
h6	0.002						1						1	HG2
h7	0.002						1						1	HG1
h8	0.002						1						1	HG1
h9	0.006				1		1		1				3	HG1
h10	0.002						1						1	HG1
h11	0.002						1						1	HG1
h12	0.002						1						1	HG2
h13	0.002						1						1	HG1
h14	0.002						1						1	HG1
h15	0.002						1						1	HG1
h16	0.004				1		1						2	HG1
h17	0.004						1		1				2	HG2
h18	0.002						1						1	HG1
h19	0.002						1						1	HG1
h20	0.002						1						1	HG1
h21	0.002						1						1	HG1
h22	0.045	3	2	1					5		10		21	HG2
h23	0.019	2		1		1		1	1		3		9	HG2
h24	0.002								1				1	HG2
h25	0.002								1				1	HG2
h26	0.002								1				1	HG1
h27	0.002								1				1	HG1
h28	0.002								1				1	HG1
h29	0.002								1				1	HG1
h30	0.002								1				1	HG1
h31	0.002								1				1	HG2
h32	0.002								1				1	HG1
h33	0.004			1					1				2	HG1
h34	0.009									4			4	HG1
h35	0.004							1		1			2	HG1
h36	0.002									1			1	HG2
h37	0.002									1			1	HG1

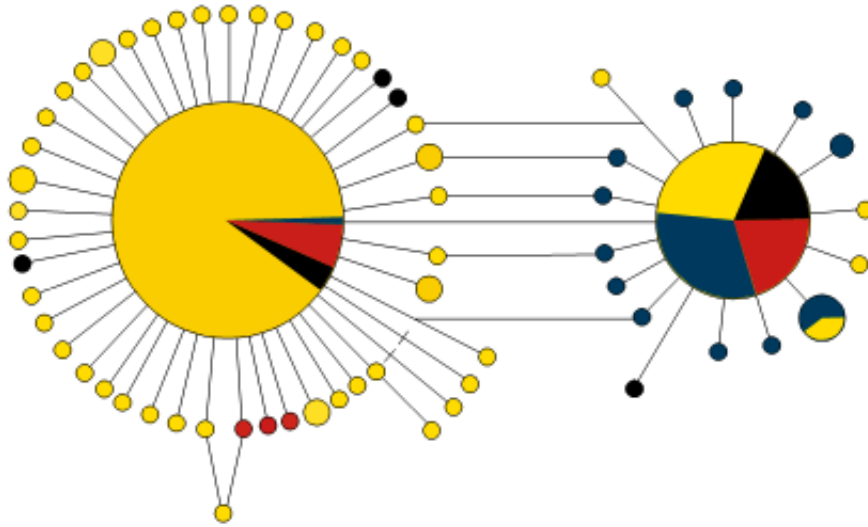
Haplotype	Freq	Faro	Alborán Sea	Almería	Sóller	Cabrera	Palamós	Gulf of Lior	Genoa	Palermo	Ionian Sea	Mozambique	TOTAL	Haplogroup
h38	0.002									1			1	HG2
h39	0.002									1			1	HG2
h40	0.002									1			1	HG1
h41	0.009	2								1		1	4	HG1
h42	0.002	1											1	HG2
h43	0.006	1	1									1	3	HG2
h44	0.002	1											1	HG2
h45	0.002	1											1	HG2
h46	0.002	1											1	HG2
h47	0.002	1											1	HG2
h48	0.011	4										1	5	HG2
h49	0.004	1		1									2	HG2
h50	0.011	2										3	5	HG2
h51	0.002	1											1	HG1
h52	0.002	1											1	HG2
h53	0.002	1											1	HG2
h54	0.006	1		1							1		3	HG2
h55	0.002	1											1	HG2
h56	0.002	1											1	HG1
h57	0.002	1											1	HG1
h58	0.002			1									1	HG1
h59	0.002			1									1	HG1
h60	0.002			1									1	HG1
h61	0.002			1									1	HG1
h62	0.004		1	1									2	HG1
h63	0.002											1	1	HG2
h64	0.002											1	1	HG2
h65	0.002											1	1	HG2
h66	0.002											1	1	HG2
h67	0.002											1	1	HG2
h68	0.004											2	2	HG2
h69	0.002											1	1	HG1
h70	0.002											1	1	HG2
h71	0.006											3	3	HG2
h72	0.002											1	1	HG2
h73	0.002											1	1	HG2
h74	0.002											1	1	HG2
h75	0.002											1	1	HG2
h76	0.002											1	1	HG2

Haplotype	Freq	Faro	Alborán Sea	Almería	Sóller	Cabrera	Palamós	Gulf of Lior	Genoa	Palermo	Ionian Sea	Mozambique	TOTAL	Haplogroup
h77	0.002											1	1	HG2
h78	0.002											1	1	HG2
h79	0.002											1	1	HG2
h80	0.002											1	1	HG2
h81	0.002											1	1	HG2
h82	0.002											1	1	HG2
h83	0.002											1	1	HG2
h84	0.002											1	1	HG2
h85	0.002											1	1	HG2
h86	0.002											1	1	HG2
h87	0.002											1	1	HG2
h88	0.006											3	3	HG2
h89	0.002											1	1	HG2
h90	0.004		1									1	2	HG1
h91	0.002											1	1	HG2
h92	0.004											2	2	HG2
h93	0.002											1	1	HG2
h94	0.002											1	1	HG1
h95	0.002											1	1	HG2
h96	0.002											1	1	HG2
h97	0.004							2					2	HG1
h98	0.002							1					1	HG1
h99	0.004					1		1					2	HG1
h100	0.004							1			1		2	HG1
h101	0.002							1					1	HG1
h102	0.002							1					1	HG2
h103	0.002							1					1	HG2
h104	0.002							1					1	HG1
h105	0.002							1					1	HG1
h106	0.002							1					1	HG1
h107	0.002							1					1	HG1
h108	0.002		1										1	HG1
h109	0.002		1										1	HG1
h110	0.002		1										1	HG2
h111	0.002		1										1	HG2
h112	0.002		1										1	HG1
h113	0.002		1										1	HG1
h114	0.002		1										1	HG1
h115	0.002		1										1	HG1

Haplotype	Freq	Faro	Alborán Sea	Almería	Sóller	Cabrera	Palamós	Gulf of Lior	Genoa	Palermo	Ionian Sea	Mozambique	TOTAL	Haplogroup
h116	0.002		1										1	HG2
h117	0.002		1										1	HG1
h118	0.002		1										1	HG1
h119	0.002		1										1	HG2
h120	0.002		1										1	HG1
h121	0.002		1										1	HG1
h122	0.002		1										1	HG1
h123	0.002		1										1	HG1
h124	0.002		1										1	HG1
h125	0.002		1										1	HG1
h126	0.002		1										1	HG1
h127	0.002										1		1	HG1
h128	0.002										1		1	HG2
h129	0.002										1		1	HG2
h130	0.002										1		1	HG2
h131	0.002										1		1	HG1
h132	0.002										1		1	HG2
h133	0.002										1		1	HG1
h134	0.002										1		1	HG2
h135	0.002										1		1	HG1
h136	0.002										1		1	HG2
h137	0.002						1						1	HG1
h138	0.002						1						1	HG1
h139	0.002						1						1	HG1
h140	0.002						1						1	HG1
h141	0.002						1						1	HG1
h142	0.002						1						1	HG1
h143	0.002						1						1	HG2
h144	0.002				1								1	HG2
h145	0.002				1								1	HG1
h146	0.002				1								1	HG1
h147	0.002				1								1	HG2
h148	0.002				1								1	HG1
h149	0.002				1								1	HG2
h150	0.002				1								1	HG1
h151	0.002				1								1	HG1
h152	0.002				1								1	HG1
		34	53	41	45	32	58	46	37	32	39	46	463	

Figure S1. *Aristeus antennatus*. Median-joining network of haplotypes detected for 16S rDNA (A) and COI (B) genes from the sampling locations of the Atlantic Ocean (black), Western Mediterranean Sea (yellow), Eastern Mediterranean Sea (red) and Indian Ocean (blue). The area of each circle is proportional to the number of individuals exhibiting that haplotype. Each line in the network represents one mutational step, and vertices represent missing or undetected haplotypes.

**A**



**B**

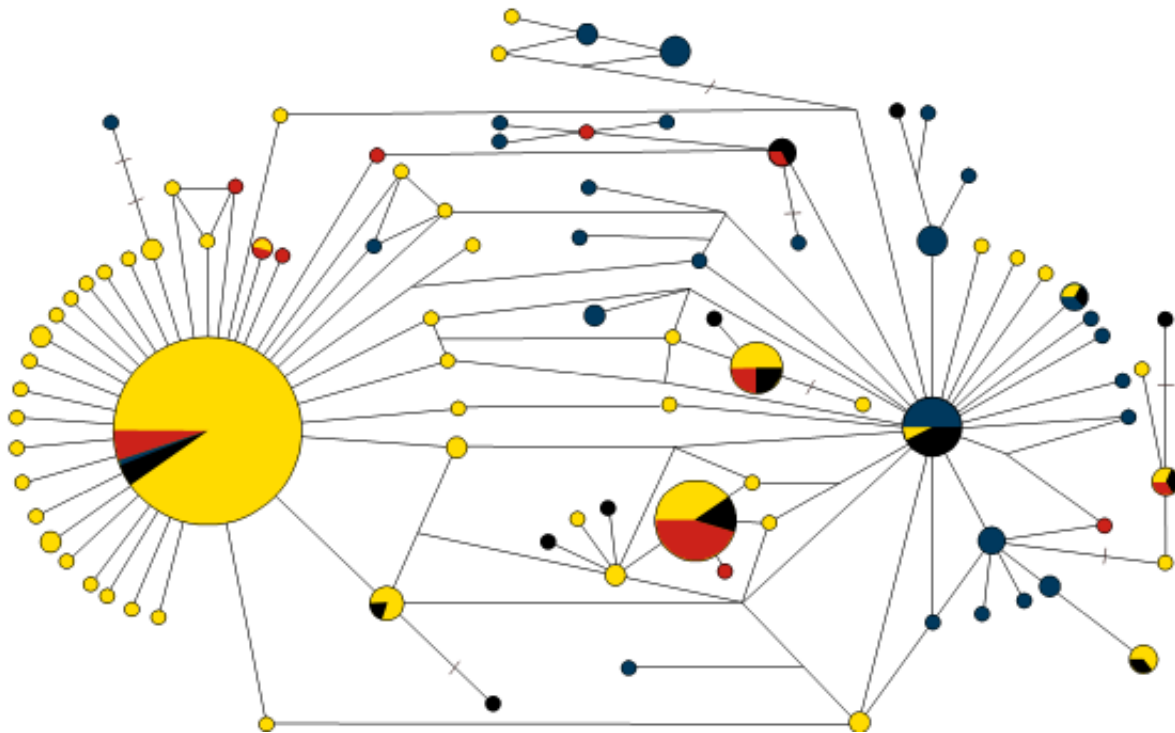


Figure S2. *Aristeus antennatus*. Frequency distributions of the number of pairwise nucleotide differences (mismatch) between merged haplotypes for the four regions considered. Solid line is the theoretical distribution under the assumption of population expansion.

