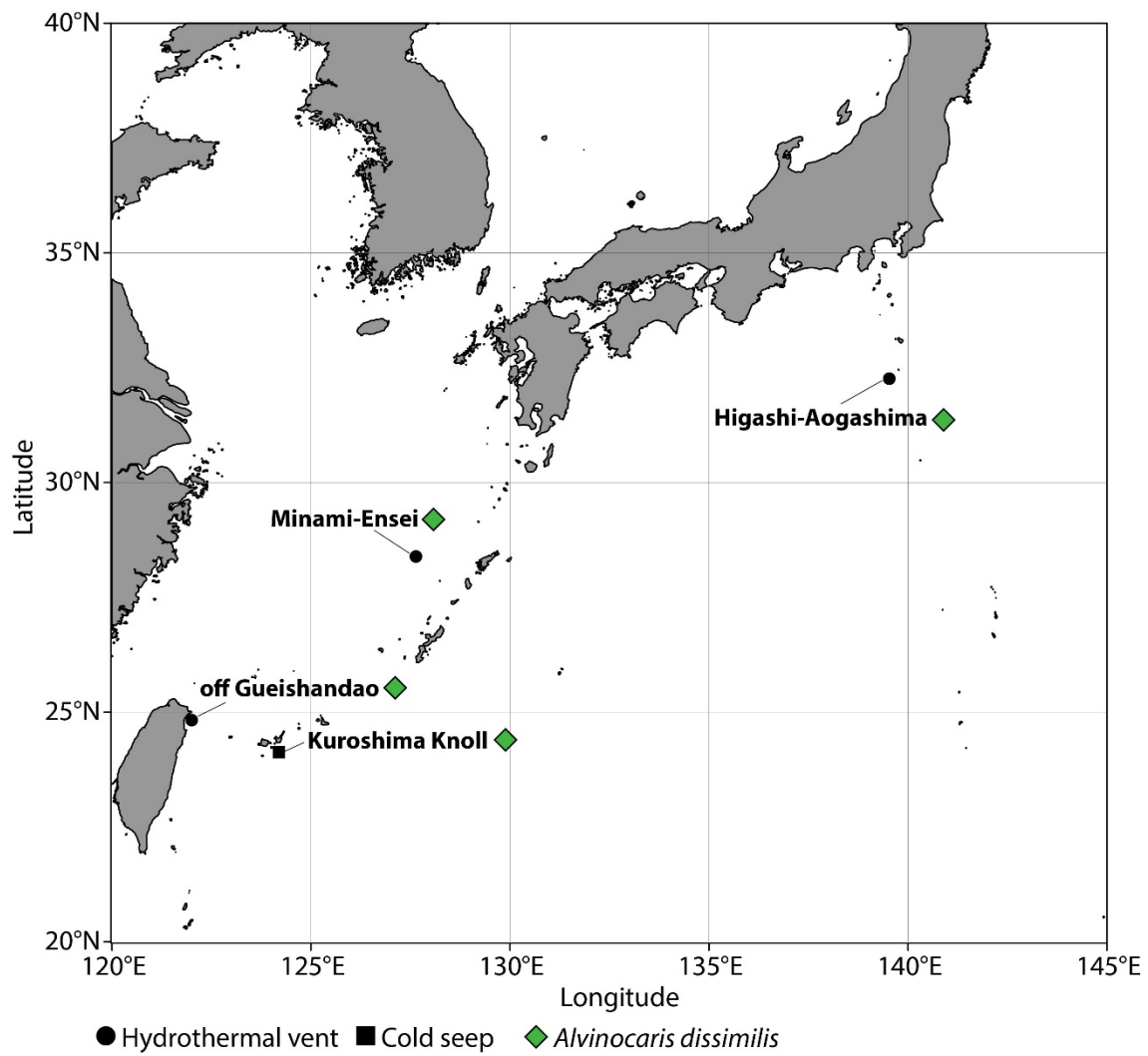
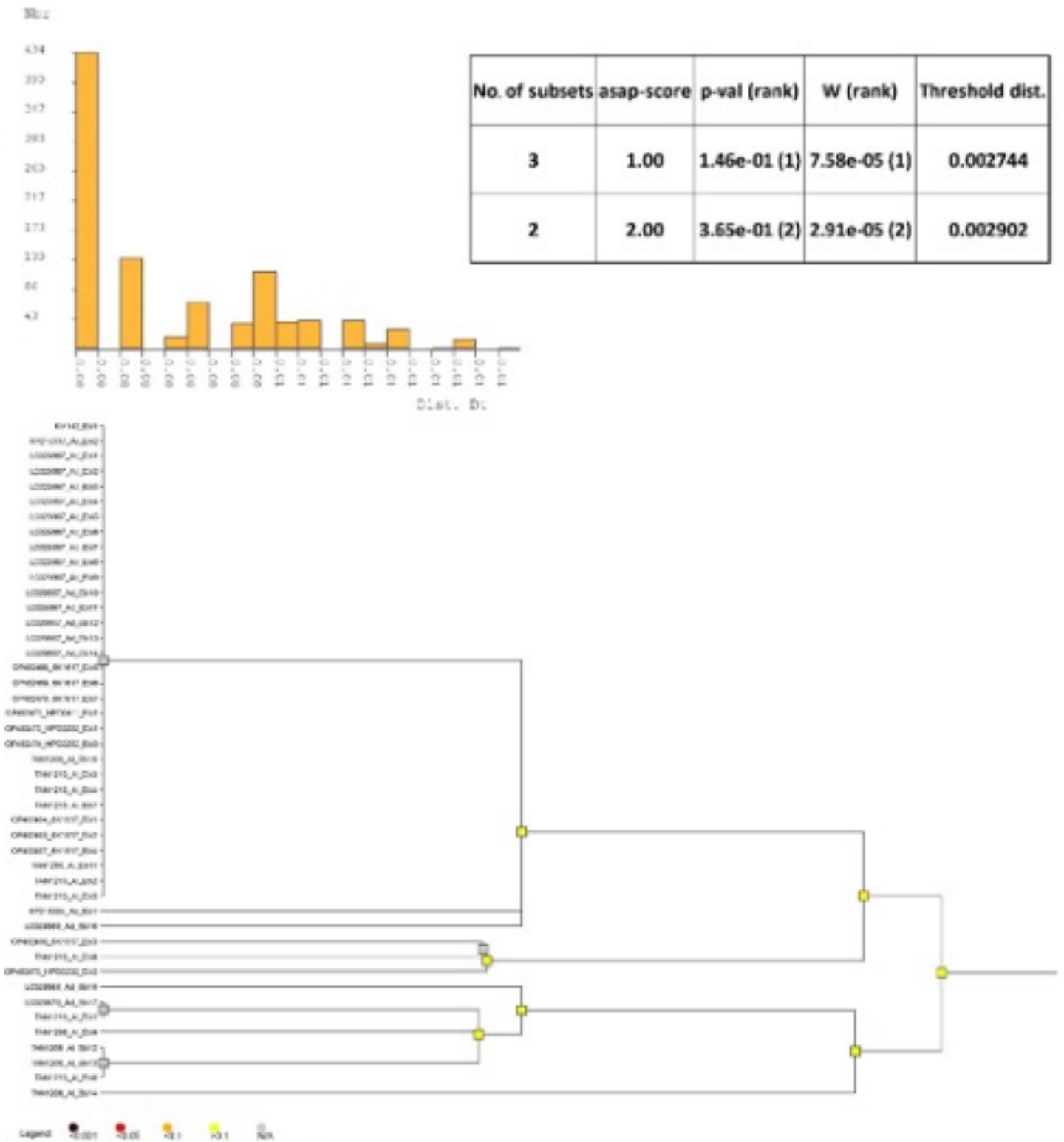


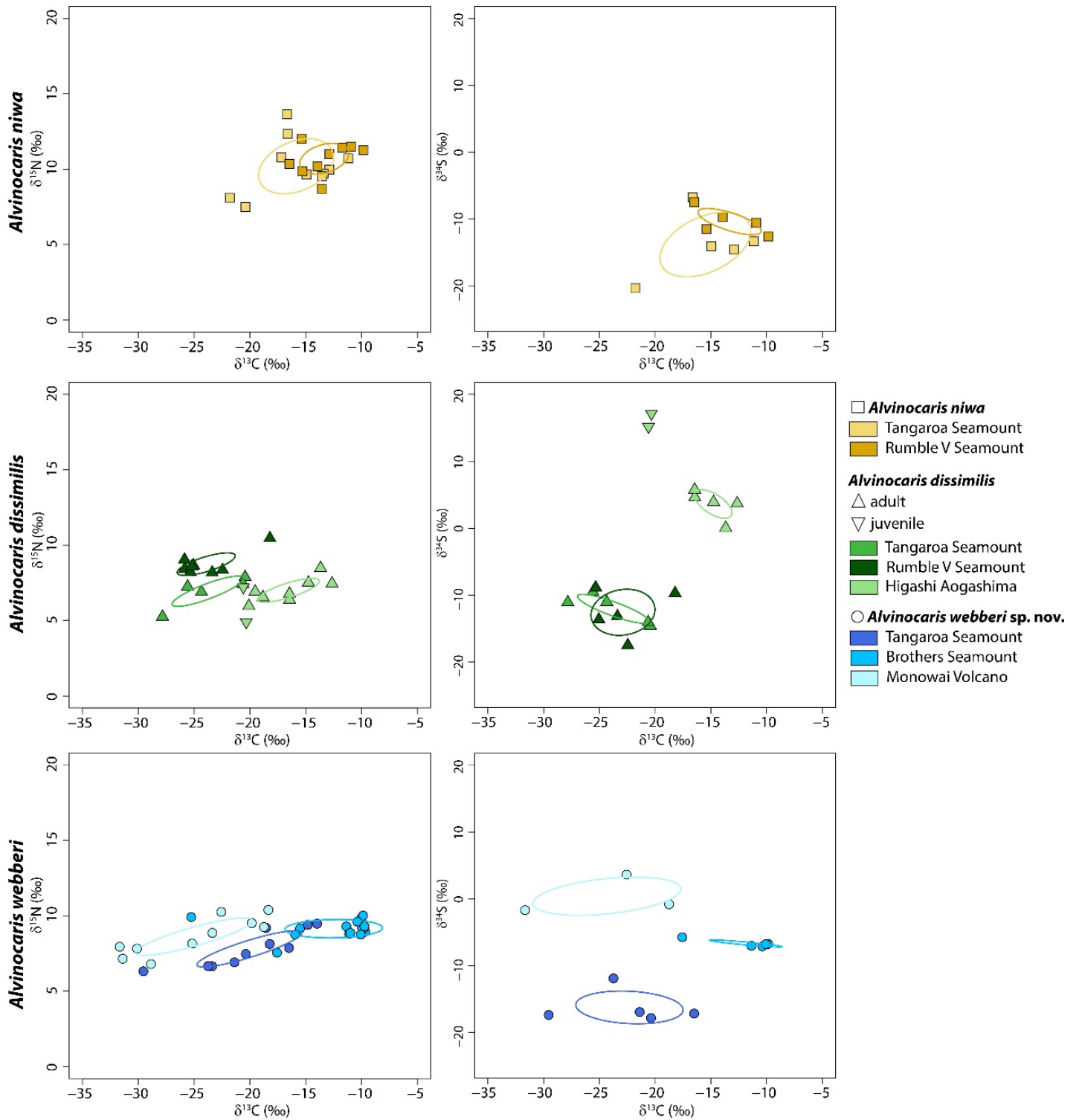
## Supplement 1



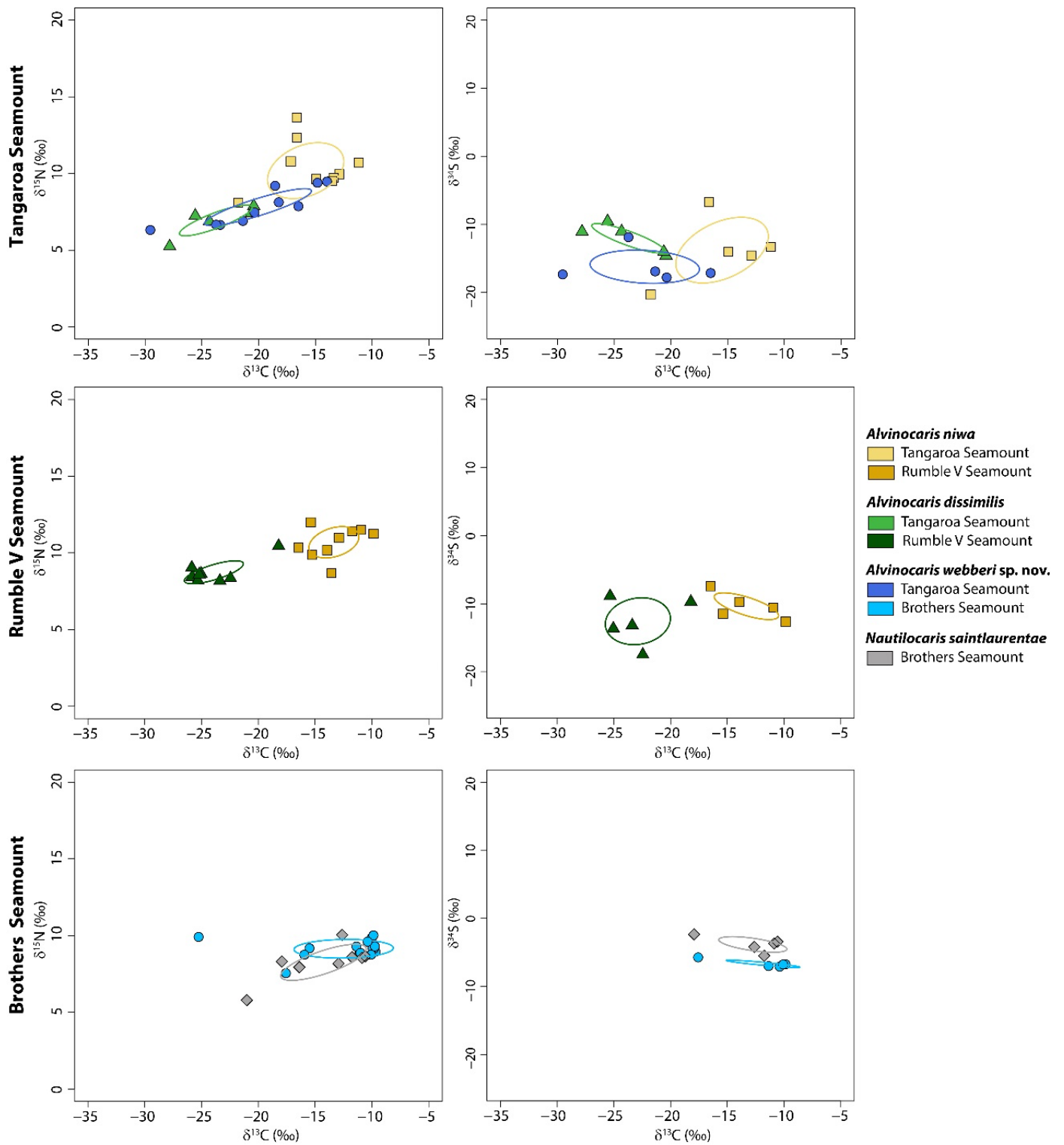
**Figure S1.** Geographical distribution of *Alvinocaris dissimilis* from chemosynthetic ecosystems in the northwestern Pacific.



**Figure S2.** Species delimitation using Assemble Species by Automatic Partitioning (ASAP) with the Kimura 80 substitution model for the *Alvinocariss dissimilis* species complex. **A.** Histogram of distances. **B.** Two-best partitions and their associated metrics (number of subsets, asap-score, p-values of partitions and associated ranks, W (rank): width of the barcode gap, threshold distance). **C.** Dendrogram of partitions.



**Figure S3.** Comparison of isotopic niches ( $\delta^{13}\text{C}$  against  $\delta^{15}\text{N}$  on the left and  $\delta^{13}\text{C}$  against  $\delta^{34}\text{S}$  on the right) displayed by species.



**Figure S4.** Comparison of isotopic niches ( $\delta^{13}\text{C}$  against  $\delta^{15}\text{N}$  on the left and  $\delta^{13}\text{C}$  against  $\delta^{34}\text{S}$  on the right) displayed by vent fields.

Note: Table S1 is in a separate .xlsx file (Supplement 2)

**Table S2.** Number of COI haplotypes per localities with corresponding GenBankID

	Glendhu	Clark	Rumble V	Tangaroa	Brothers	Monowai	H.-Aogashima	M.-Ensei	Gueishandao	Kuroshima	GenBankID
<b><i>Alvinocaris niwa</i></b>											
An_Hap1			5	8							OR766472
An_Hap2			2	3							OR766473
An_Hap3			1	1							OR766474
An_Hap4			1								OR766475
An_Hap5				1							OR766476
An_Hap6				1							OR766477
An_Hap7				1							OR766478
<b><i>Alvinocaris webberi</i> sp. nov.</b>											
Aw_Hap1	6			8	12	3					OR766479
Aw_Hap2	2			1	1	1					OR766480
Aw_Hap3				1							OR766481
Aw_Hap4					1						OR766482
Aw_Hap5					1						OR766483
Aw_Hap6				1							OR766484
Aw_Hap7	1										OR766485
Aw_Hap8	1										OR766486
Aw_Hap9	1										OR766487
Aw_Hap10	1										OR734016
<b><i>Alvinocaris dissimilis</i></b>											
Ad_Hap1			5	2			9	14	1	1	OR766468
Ad_Hap2			1	2							OR766469
Ad_Hap3			1					1			OR734008
Ad_Hap4			1								OR766470
Ad_Hap5				1							OR766471
Ad_Hap6		1									OR734009
Ad_Hap7							1				OP482466
Ad_Hap8							1				OP482473
Ad_Hap9								1			LC029868
Ad_Hap10								1			LC029869
Ad_Hap11									1		KP215334

**Table S3.** Detailed p-values of Dunn tests comparing stable isotope ratios of alvinocaridid shrimps from distinct localities for carbon (d13C), nitrogen (d15N) and sulfur (d34S).

<b>d13C</b>	An_Tangaroa	An_RumbleV	Ad_Haogashima	Ad_Tangaroa	Ad_RumbleV	Aw_Monowai	Aw_Brothers	Aw_Tangaroa
An_Tangaroa								
An_RumbleV	3.404177e-01							
Ad_Haogashima	6.741361e-01	1.608807e-01						
Ad_Tangaroa	3.736139e-02	3.700347e-03	9.304231e-02					
Ad_RumbleV	1.456039e-02	9.409412e-04	4.595485e-02	9.844068e-01				
Aw_Monowai	1.090331e-02	5.832028e-04	3.866702e-02	1.000000e+00	1.000000e+00			
Aw_Brothers	1.176857e-01	6.593373e-01	3.693518e-02	6.913683e-04	3.316298e-05	1.523842e-05		
Aw_Tangaroa	1.985382e-01	2.259281e-02	4.101059e-01	3.440921e-01	2.626566e-01	2.593611e-01	2.403224e-03	
Ns_Brothers	5.442469e-01	7.973263e-01	2.935910e-01	1.152699e-02	3.224937e-03	2.244488e-03	4.529045e-01	5.419001e-02

<b>d15N</b>	An_Tangaroa	An_RumbleV	Ad_Haogashima	Ad_Tangaroa	Ad_RumbleV	Aw_Monowai	Aw_Brothers	Aw_Tangaroa
An_Tangaroa								
An_RumbleV	4.302626e-01							
Ad_Haogashima	1.207702e-04	4.698079e-06						
Ad_Tangaroa	2.059378e-03	2.525919e-04	9.233899e-01					
Ad_RumbleV	1.598798e-01	3.328938e-02	3.079615e-02	9.230541e-02				
Aw_Monowai	9.859194e-02	2.049391e-02	9.362957e-02	9.202337e-01	3.214479e-02			
Aw_Brothers	4.168491e-01	1.071126e-01	5.706568e-04	1.017495e-02	4.422294e-01	3.513329e-01		
Aw_Tangaroa	7.574733e-03	5.929253e-04	2.788899e-01	4.036914e-01	2.691955e-01	2.878883e-01	3.461986e-02	
Ns_Brothers	4.894131e-02	8.401220e-03	1.024811e-01	2.050111e-01	5.927508e-01	6.472527e-01	1.817747e-01	5.592377e-01

<b>d34S</b>	An_Tangaroa	An_RumbleV	Ad_Haogashima	Ad_Tangaroa	Ad_RumbleV	Aw_Monowai	Aw_Brothers	Aw_Tangaroa
An_Tangaroa								
An_RumbleV	0.5312460170							
Ad_Haogashima	0.0072747635	0.0306841035						
Ad_Tangaroa	0.7979626529	0.6938994735	0.0100964543					
Ad_RumbleV	0.7935691117	0.6969130596	0.0104974175	0.9578941556				
Aw_Monowai	0.0344213496	0.1255064948	0.7783974386	0.0582194447	0.0565382499			
Aw_Brothers	0.1152727838	0.4194396723	0.2155645686	0.1925906104	0.1825065545	0.5076373853		
Aw_Tangaroa	0.5911925598	0.2033710719	0.0006834586	0.4368645421	0.4548466190	0.0113041277	0.0310809265	
Ns_Brothers	0.0667364920	0.2260646228	0.5826495293	0.1120960503	0.1159857849	0.7763874743	0.6998734259	0.0205830698

**Table S4.** Morphometric comparison of four *Alvinocaris* species from the *A. dissimilis* species complex.

	<i>A. dissimilis</i>	<i>A. alexander</i>	<i>A. chelys</i>	<i>A. stactophila</i>
CL range (mm)	5.1-9.8	7.4-13.2	5.3-9.6	4.2-7.0
dorsal angle (°)	155	145	155	<b>170</b>
length of rostrum (× cl)	<b>0.53-0.61</b>	0.25-0.39	0.28-0.45	0.42
rostrum dorsal teeth	13-17 (8-10 rostrum, 5-8 postorbital)	9-16 (6-10 rostrum, 3-6 postorbital)	12-17 (7-10 rostrum, 4-7 postorbital)	16 (8 rostrum, 8 postorbital)
rostrum length relative to second antennular segment	<b>usually reaching to A2 to slightly overreaching</b>	not reaching midlength of A2	not reaching end of A2 (reaching end of A1 to midlength A2)	not reaching end of A2 (slightly overreaching A1)
rostrum ventral spines	0–2 subdistal teeth	0-1 small subdistal tooth	0-1 minute subdistal tooth	1 small subdistal tooth
posteriormost rostral tooth	0.19-0.31	0.17-0.27	0.19-0.24	0.28
postrostral median ridge	0.60-0.70 cl	0.50–0.75 cl	0.53-0.73 cl	0.60 cl
carapace w/l	0.65-0.80	0.65-0.70	0.63-0.69	?
abdominal pleuron 3	unarmed	unarmed	unarmed	unarmed
abdominal pleuron 4	small posteroventral tooth and 2-3 tiny teeth on posterior margin	unarmed to blunt angular posteroventrally, posterior margin unarmed or with 4-5 small teeth	unarmed or with small posterolateral spine, rarely minute posterior tooth.	small posteroventral tooth and 2-3 tiny teeth on posterior margin
abdominal somite 6 l/h	1.30-1.40	1.25-1.53	1.20-1.45	1.38
telson length/ anterior width	2.7-2.9	2.2-3.0	2.0-2.6	3
telson length/ posterior width	4.3-4.6	3.2-5.0	4.5-6.0	4.7
telson dorsolateral spines	5 to 8	6 to 8	6 to 8	5 to 8
telson posterior margin (spines)	2 pairs of posterolateral spines, plumose setae	2 pairs of posterolateral spines, plumose setae	2 pairs of posterolateral spines, plumose setae	<b>8 pairs of spines; longest pair (2nd pair) distinctly curved</b>
telson posterior margin (shape)	convex	convex or with shallow notch	convex	convex
antennular peduncle 2 l/w	1.43–1.78	1.25–1.43	1.30-1.70	1.80
antennal scale	1.90-2.16	1.50-2.00	1.67-1.80	2.0
movable spines on merus of P3	2 spines	0-3 spines (usually 2)	0-2	1 spine
movable spines on ischium of P3	2 strong movable spines present	0-2 movable spines present	usually absent, 1 rarely present	strong movable spines present
dactylus of P3	distalmost accessory spine largest, proximally declining in size	distalmost accessory spine largest, proximally declining in size	distalmost accessory spine largest, proximally declining in size	<b>distal four accessory spines subequal in size, larger than distalmost spine</b>
distribution	Ryukyu-Kyushu Arc, Izu-Bonin Arc	Kermadec Ridge	Queishandao, Taiwan	Louisiana slope, Gulf of Mexico
habitat	Vent and seep	vent	vent	<b>seep</b>
depth (m)	691-705	367-1346	252-300	534-650

**Table S5.** Pairwise  $F_{st}$  values with corresponding p-values and genetic distance (Da) among populations of *Alvinocaris niwa*, *Alvinocaris dissimilis* and *Alvinocaris webberi* sp. nov.

	$F_{st}$	p-values	Da
<b><i>Alvinocaris niwa</i></b>			
Tangaroa vs Rumble V	-0.04447	NS	-0.00007
<b><i>Alvinocaris dissimilis</i> complex</b>			
Gueishandao vs MinamiEnsei	0.01724	NS	0.00002
Gueishandao vs HigashiAogashima	0.03810	NS	0.00006
Gueishandao vs Tangaroa	0.28000	NS	0.00106
Gueishandao vs RumbleV	0.04762	NS	0.00011
MinamiEnsei vs HigashiAogashima	0.06325	NS	0.00008
MinamiEnsei vs Tangaroa	0.20881	NS	0.00066
MinamiEnsei vs RumbleV	-0.02551	NS	-0.00005
HigashiAogashima vs Tangaroa	0.30000	NS	0.00112
HigashiAogashima vs RumbleV	0.01238	NS	0.00003
Tangaroa vs RumbleV	0.03106	NS	0.00011
<b><i>Alvinocaris webberi</i> sp. nov.</b>			
Tangaroa vs Monowai	-0.09091	NS	-0.00006
Tangaroa vs Glendhu	-0.01748	NS	-0.00002
Tangaroa vs Brothers	-0.02504	NS	-0.00002
Monowai vs Glendhu	-0.10227	NS	-0.00009
Monowai vs Brothers	-0.13018	NS	-0.00008
Glendhu vs Brothers	-0.02910	NS	-0.00003