Supplementary Tables and Figures - Epidemic spread of symbiotic and non-symbiotic Bradyrhizobium genotypes across California

Microbial Ecology

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Supplementary Table S2 Numbers of fixed and shared polymorphisms between lineages as calculated by DnaSP

			Novel III (12)	Novel IV (3)	B. retame (1)	Novel V (6)	B. lablabi (9)	Novel VI (6)	Novel VII (3)	Novel VIII (15)	Novel IX (8)	Novel X (70)	Novel I (134)	Novel II (73)	Novel XI (60)	Novel XII (2)	Novel XIII (19)	B. betae (15)	B. liaoningense (9)	B. cytisi (40)	Novel XIV (2)	B. canariense (798)
Novel III	12	Fixed		43	n/a	38	24	27	27	28	48	45	51	44	50	54	45	32	25	38	48	28
		Shared		1	n/a	25	35	77	43	24	0	13	22	38	19	2	11	35	48	46	4	79
Novel IV	3	Fixed	43		n/a	40	22	48	70	65	84	79	88	67	85	89	85	56	49	61	94	50
		Shared	1		n/a	0	0	2	0	1	0	0	1	1	1	0	0	0	1	3	0	3
B. retame	1	Fixed	n/a	n/a		n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	85	n/a	n/a	n/a	n/a	n/a
		Shared	n/a	n/a		n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	n/a
Novel V	6	Fixed	38	40	n/a		15	40	68	56	69	66	57	56	65	81	n/a	58	44	59	84	54
		Shared	25	0	n/a		8	30	21	11	0	6	11	10	3	0	n/a	13	8	17	1	34
B. lablabi	9	Fixed	24	22	n/a	15		29	47	43	60	59	57	44	59	71	73	42	31	46	76	38
		Shared	35	0	n/a	8		31	12	9	0	8	5	24	12	1	2	19	32	20	4	38
Novel VI	6	Fixed	27	48	n/a	40	29		32	43	54	56	45	36	41	53	66	32	17	34	52	31
		Shared	77	2	n/a	30	31		31	23	0	14	23	34	16	0	5	35	41	54	5	76
Novel VII	3	Fixed	27	70	n/a	68	47	32		45	65	67	61	56	59	67	43	45	42	48	68	40
		Shared	43	0	n/a	21	12	31		15	0	8	13	18	7	2	23	16	17	24	1	48
Novel VIII	15	Fixed	28	65	n/a	56	43	43	45		47	40	55	50	56	57	62	38	38	44	61	34
		Shared	24	1	n/a	11	9	23	15		1	7	8	14	7	0	2	19	11	19	1	30
Novel IX	8	Fixed	48	84	n/a	69	60	54	65	47		41	62	49	60	70	53	42	52	45	74	29
		Shared	0	0	n/a	0	0	0	0	1		0	0	1	0	0	3	0	2	0	0	1
Novel X	70	Fixed	45	79	n/a	66	59	56	67	40	41		55	45	58	60	59	39	42	44	60	27
		Shared	13	0	n/a	6	8	14	8	7	0		6	10	3	0	0	0	7	13	3	27
Novel I	134	Fixed	51	88	n/a	57	57	45	61	55	62	55		19	33	53	40	33	22	37	54	22
		Shared	22	1	n/a	11	5	23	13	8	0	6		16	4	0	4	15	17	22	2	38
Novel II	73	Fixed	44	67	n/a	56	44	36	56	50	49	45	19		8	37	28	13	11	26	40	10
		Shared	38	1	n/a	10	24	34	18	14	1	10	16		21	1	9	29	31	30	4	62
Novel XI	60	Fixed	50	85	n/a	65	59	41	59	56	60	58	33	8		55	38	25	27	30	60	10
		Shared	19	1	n/a	3	12	16	7	7	0	3	4	21		2	7	14	17	10	3	35
Novel XII	2	Fixed	54	89	n/a	81	71	53	67	57	70	60	53	37	55		33	23	38	28	40	14
		Shared	2	0	n/a	0	1	0	2	0	0	0	0	1	2		0	0	0	1	0	1
Novel XIII	19	Fixed	45	85	n/a	73	66	43	62	53	59	50	40	28	38	33		12	27	22	41	13
		Shared	11	0	n/a	2	5	23	2	3	0	1	4	9	7	0		8	9	7	1	12
B. betae	15	Fixed	32	56	n/a	58	42	32	45	38	42	39	33	13	25	23	12		12	15	27	6
		Shared	35	0	n/a	13	19	35	16	19	0	0	15	29	14	0	8		27	25	3	37
B. liaoningense	9	Fixed	25	49	n/a	44	31	17	42	38	52	42	22	11	27	38	27	12		15	34	7
		Shared	48	1	n/a	8	32	41	17	11	2	7	17	31	17	0	9	27		25	4	48
B. cytisi	40	Fixed	38	61	n/a	59	46	34	48	44	45	44	37	26	30	28	22	15	31		26	11
		Shared	46	3	n/a	17	20	54	24	19	0	13	22	30	10	1	7	25	32		3	58
Novel XIV	2	Fixed	48	94	n/a	84	76	52	68	61	74	60	54	40	60	40	41	27	34	26		10
		Shared	4	0	n/a	1	4	5	1	1	0	3	2	4	3	0	1	3	4	3		5
B. canariense	798	Fixed	28	50	n/a	54	38	31	40	34	29	27	22	10	10	14	13	6	7	11	10	
		Shared	79	3	n/a	34	38	76	48	30	1	27	38	62	35	1	12	37	48	58	5	

Supporting Table S3. Collection sites of *Bradyrhizobium* species and clades

	Total # isolates	B. betae	B. canariense	B. cytisi	B. lablabi	B. liaoningense	B. retamae	novel I	novel II	novel III	nove IV	novel V	novel VI	novel VII	novel VIII	novel IX	novel X	novel XI	novel XII	novel XIII	novel IV	# sites found at
Bodega Marine Reserve	211	No	Yes	Yes	No	Yes	No	No	No	No	No	No	Yes	No	Yes	Yes	Yes	Yes	No	Yes	No	9
Pismo Dunes Natural Preserve	21	Yes	No	No	Yes	Yes	No	No	Yes	No	Yes	No	No	No	No	No	No	No	No	No	No	5
Gaudalupe-Nipomo Dunes National Wildlife Refuge	100	No	Yes	No	No	No	No	No	No	No	No	No	No	No	No	No	Yes	No	No	No	No	2
Griffith Park	69	No	Yes	No	No	No	No	Yes	Yes	No	No	No	No	No	No	No	No	No	Yes	No	No	4
Madrona Marsh Preserve	86	No	Yes	No	No	No	No	No	Yes	No	No	No	No	No	No	No	No	No	No	No	No	2
San Dimas Reservoir	63	No	Yes	Yes	Yes	Yes	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	4
San Dimas Canyon	67	Yes	Yes	Yes	No	Yes	No	Yes	Yes	No	No	No	No	No	No	No	No	Yes	No	No	No	7
Robert J. Bernard Biological Field Station	68	No	Yes	Yes	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	2
University of California - Riverside hills	356	No	Yes	Yes	Yes	No	No	Yes	Yes	Yes	No	Yes	Yes	Yes	No	No	Yes	Yes	No	No	No	11
Motte Rimrock Reserve	120	Yes	Yes	Yes	No	Yes	No	Yes	No	Yes	No	No	No	No	No	No	Yes	Yes	No	No	Yes	9
Whitewater Preserve	47	No	Yes	No	No	No	No	Yes	Yes	No	No	No	No	No	No	No	No	No	No	No	No	3
Burns Piñon Ridge Reserve	39	No	Yes	No	No	No	No	Yes	No	No	No	No	No	No	No	No	No	No	No	No	No	2
Anza Borrego Desert State Park - Palm Canyon	9	No	No	No	No	No	Yes	Yes	No	No	No	No	No	No	No	No	No	No	No	No	No	2
Anza Borrego Desert State Park - Roadside	36	No	No	No	No	No	No	Yes	No	No	No	No	No	No	No	No	No	No	No	No	No	1
Total	1292	3	11	6	3	5	1	8	6	2	1	1	2	1	1	1	3	4	2	1	1	

Supplementary Table S4. Ancestral state reconstruction gains and losses as calculated by Mesquite using both parsimony and maximum likelihood methods.

	Parsimony			Likelihood		
	Min	Max	Avg.	Min	Max	Avg.
Gains	19	25	21.08	10	10	10
Losses	25	31	28.92	23	23	23

Supplementary Table S5. Results of Pagel's and Fritz Purvis' D tests for significant phylogenetic signal. Fritz Purvis' D can only be conducted on binary data.

Trait	Pagel's Lambda				Fritz Purvis' D			
	λ	lambda significantly greater than 0	lambda significantly lower than 1	Significant Phylogenetic signal?	Estimated D	Probability (random) phylogenetic structure	Probability Brownian phylogenetic structure	Significant Phylogenetic signal?
Symbiotic capacity	0.93	1.5E-21	8.36E-95	YES	0.37	0.00	0.00	YES
Abundance	0.06	1	4.58E-228	NO	n/a			
Spatial Spread	4.5E-05	1	1.15E-38	NO	n/a			

Supplementary Table S6. ANOVA and phylogenetic ANOVA tests of correlated evolution of symbiotic capacity and abundance. Only

plants for which both root surface and nodule samples were collected were included in analysis.

	ANOVA		Phylogenetic ANOVA	
	F-Ratio	p-value	F-Ratio	p-value
	5.5137	0.0199	n/a	0.2047952

Supplementary Table S7. ANOVA and phylogenetic ANOVA tests of correlated evolution of symbiotic capacity and spatial spread. Only plants for which both root surface and nodule samples were collected were included in analysis.

	ANOVA		Phylogenetic ANOVA	
	F-Ratio	p-value	F-Ratio	p-value
	1.4479	0.2304	n/a	0.5544456

Supplementary Table S8. Table of p-values for the "Exact test of population differentiation" conducted on collection sites in Arlequin.

Probability of significant differentation	Anza Borrego State Park Palm Canyon	Anza Borrego State Park Roadside	Bodega Marine Reserve	Robert J. Bernard Biological Field Station	Griffith Park	Madrona Marsh Preserve	Motte Rimrock Reserve	Guadalupe-Nipomo Dunes National Wildlife Refuge	Pismo Dunes Natural Preserve	San Dimas Canyon	San Dimas Reservoir	University of California - Riverside Hills	Whitewater Preserve	Burns Piñon Ridge Reserve
Anza Borrego State Park Palm Canyon														
Anza Borrego State Park Roadside	0.00000+-0.0000													
Bodega Marine Reserve	0.00000+-0.0000	0.00000+-0.0000												
Robert J. Bernard Biological Field Station	0.00000+-0.0000	0.00000+-0.0000	0.00000+-0.0000											
Griffith Park	0.00000+-0.0000	0.00000+-0.0000	0.00000+-0.0000	0.00000+-0.0000										
Madrona Marsh Preserve	0.00000+-0.0000	0.00000+-0.0000	0.00000+-0.0000	0.00000+-0.0000	0.00000+-0.0000									
Motte Rimrock Reserve	0.00000+-0.0000	0.00000+-0.0000	0.00000+-0.0000	0.00000+-0.0000	0.00000+-0.0000	0.00000+-0.0000								
Guadalupe-Nipomo Dunes National Wildlife Refuge	0.00000+-0.0000	0.00000+-0.0000	0.00000+-0.0000	0.00000+-0.0000	0.00000+-0.0000	0.00000+-0.0000	0.00000+-0.0000							
Pismo Dunes Natural Preserve	0.00026+-0.0002	0.00000+-0.0000	0.00000+-0.0000	0.00000+-0.0000	0.00000+-0.0000	0.00000+-0.0000	0.00000+-0.0000	0.00000+-0.0000						
San Dimas Canyon	0.00256+-0.0015	0.00000+-0.0000	0.00000+-0.0000	0.00000+-0.0000	0.00000+-0.0000	0.00000+-0.0000	0.00000+-0.0000	0.00000+-0.0000	0.00000+-0.0000					
San Dimas Reservoir	0.00000+-0.0000	0.00000+-0.0000	0.00000+-0.0000	0.00000+-0.0000	0.00000+-0.0000	0.00000+-0.0000	0.00000+-0.0000	0.00000+-0.0000	0.00000+-0.0000	0.00000+-0.0000				
University of California - Riverside Hills	0.00000+-0.0000	0.00000+-0.0000	0.00000+-0.0000	0.02101+-0.0177	0.00000+-0.0000	0.00000+-0.0000	0.00000+-0.0000	0.00000+-0.0000	0.00000+-0.0000	0.00000+-0.0000	0.25930+-0.0845			
Whitewater Preserve	0.00000+-0.0000	0.00000+-0.0000	0.00000+-0.0000	0.00000+-0.0000	0.00000+-0.0000	0.00000+-0.0000	0.00000+-0.0000	0.00000+-0.0000	0.00000+-0.0000	0.00000+-0.0000	0.00000+-0.0000	0.02404+-0.0175		
Burns Piñon Ridge Reserve	0.00000+-0.0000	0.00000+-0.0000	0.00000+-0.0000	0.00000+-0.0000	0.00000+-0.0000	0.00000+-0.0000	0.00061+-0.0007	0.00000+-0.0000	0.00000+-0.0000	0.00000+-0.0000	0.00054+-0.0004	0.75532+-0.0852	0.00000+-0.0000	

Supplementary Table S9. Table of p-values of "Exact test of population differentiation" between locations inhabited on host plant in Arlequin.

	Plant parts	Probability of significant differentiation
Bodega Marine Reserve	(old, nodule)	0.00000+-0.0000
	(tip nodule)	0.00000+-0.0000
	(tip, old)	0.46524+-0.0221
Motte Rimrock Reserve	(old, nodule)	0.00117+-0.0007
	(tip nodule)	0.00000+-0.0000
	(tip, old)	0.00000+-0.0000
University of California - Riverside Hills	(old, nodule)	0.00000+-0.0000
	(tip nodule)	0.00000+-0.0000
	(tip, old)	0.00000+-0.0000

Supplementary Table S10. Table of p-values of "Exact test of population differentiation" between symbiotic and non-symbiotic isolates in Arlequin.

|	Probability of significant differentiation
Bodega Marine Reserve (symbiotic versus non-symbiotic)	0.00000+-0.0000
Motte Rimrock Reserve (symbiotic versus non-symbiotic)	0.00000+-0.0000
University of California - Riverside Hills (symbiotic versus non-symbiotic)	0.09395+-0.0221

Supplementary Table S11. Table of p-values of "Exact test of population differentiation" between collections sites with multiple years in Arlequin.

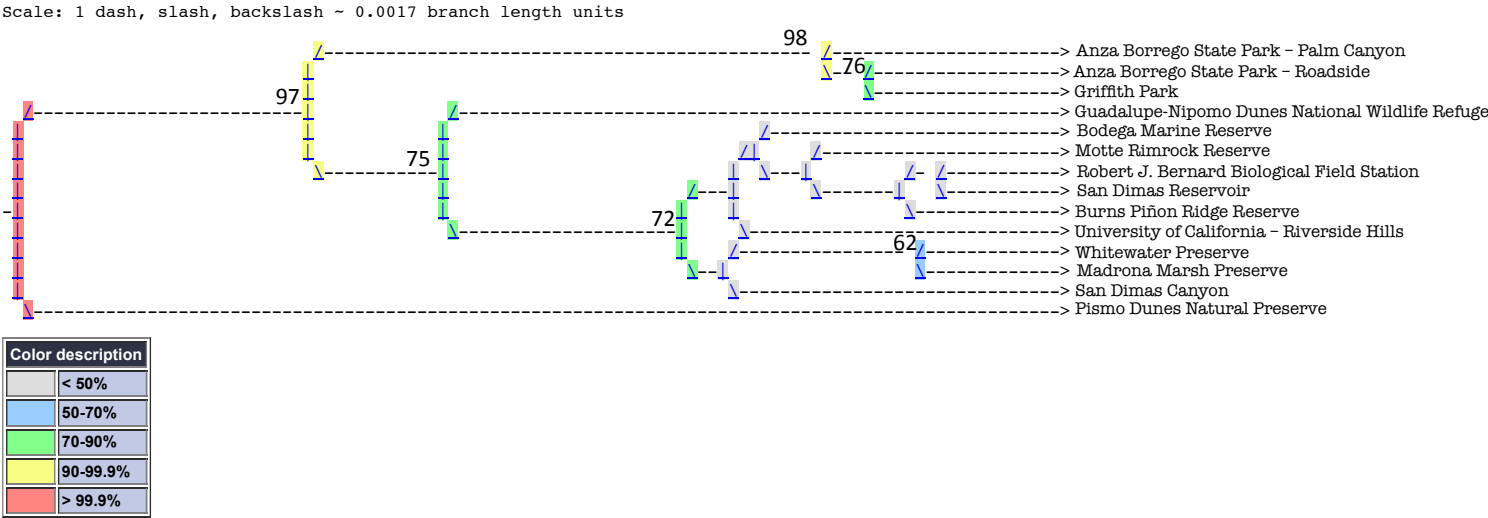|	Probability of significant differentiation
Robert J. Bernard Biological Field Station (2011, 2012)	0.11420+-0.0053
Motte Rimrock Reserve (2011, 2013)	0.04209+-0.0083
San Dimas Canyon (2011, 2012)	0.00429+-0.0023
University of California - Riverside Hills (2009, 2013)	0.51000+-0.0947
Burns Piñon Ridge Reserve (2011, 2013)	0.00442+-0.0006

Supporting Figure S1.PhyML 3.0 Phylogenetic tree reconstructed from concatenated *glnII* and *recA* loci haplotypes with associated heat maps for abundance (# times a given haplotype was collected), dominance (% of isolates haplotype includes), spatial spread (in km) symbiotic capacity and collection site. Species are indicated and branch support was estimated by the fast approximate likelihood ratio test (aLRT) with the Shimodaira-Hasegawa-like (SH-like) procedure.
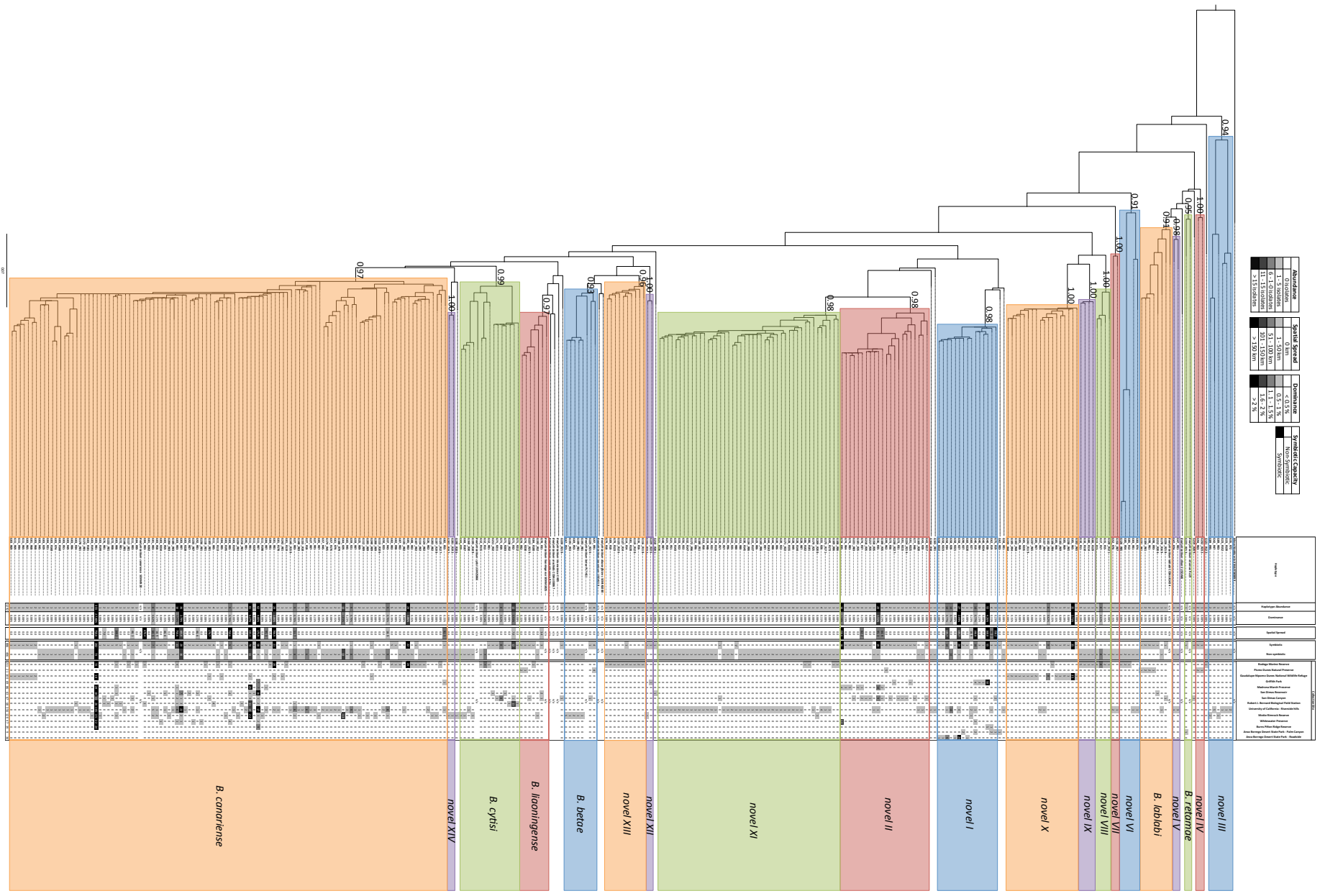
Supporting Figure S2. Parsimony ancestral state reconstruction conducted in Mesquite. Estimated non-symbiotic lineages indicated in white, and symbiotic lineages indicated with black.

Character: Character 1
Parsimony
reconstruction (
Unordered) [Steps: 50]

0
1
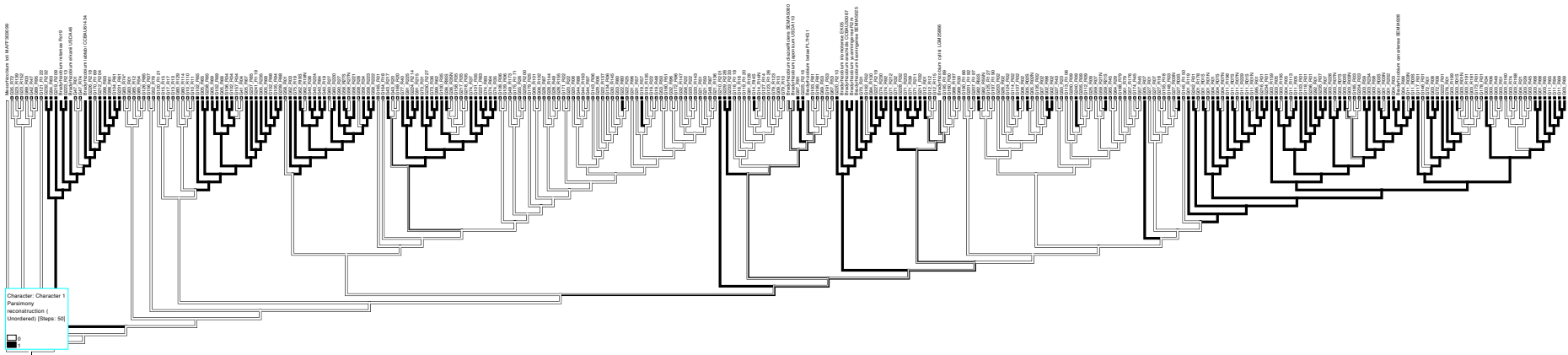
Supplementary Figure S3. Fast UniFrac clustering with jackknife for collection site community analysis.

Scale: 1 dash, slash, backslash ~ 0.0017 branch length units

Color description	
	< 50%
	50-70%
	70-90%
	90-99.9%
	> 99.9%

Supplementary Figure S4. Fast UniFrac distance matrix for collection site community analysis.