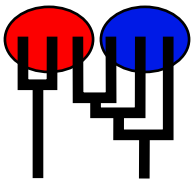
Rhinichthys osculus dataset

POPULATION SIZE, MIGRATION, DIVERGENCE, ASSIGNMENT, HISTORY
Bayesian inference using the structured coalescent
Migrate-n version 4.4.4(git:v4-series-26-ge85c6ff) [June-1-2019]
Compiled for a SYMMETRIC multiprocessors (Grandcentral)
Program started at Fri May 21 08:48:22 2021
Program finished at Fri May 21 15:48:20 2021 [Runtime:0000:06:59:58]



Options

Inheritance scalers in use for Thetas:
All loci use an inheritance scaler of 1.0
[The locus with a scaler of 1.0 used as reference]
Random number seed: (with internal timer) 2442895471
Start parameters:

Theta values were generated RANDOM start value from the prior

M values were generated RANDOM start value from the prior

Connection matrix:
m = average (average over a group of Thetas or M,
s = symmetric migration M, S = symmetric 4Nm,
0 = zero, and not estimated,
* = migration free to vary, Thetas are on diagonal
d = row population split off column population, D = split and then migration

Population	1	2	3
1 Great_Salt_lake	*	*	0
2 Great_Salt_Lake	D	*	*
3 Sevier_Desert	0	D	*

Order of parameters:

1	Θ_1	<displayed>
2	Θ_2	<displayed>
3	Θ_3	<displayed>

4	$M_{2->1}$	<displayed>
5	$M_{1->2}$	<displayed>
6	$M_{3->2}$	<displayed>
7	$M_{2->3}$	<displayed>
8	$\Delta_{1->2}$	<displayed>
9	$\sigma_{1->2}$	<displayed>
10	$\Delta_{2->3}$	<displayed>
11	$\sigma_{2->3}$	<displayed>

Mutation rate among loci: Mutation rate is constant for all loci

Analysis strategy: Bayesian inference
-Population size estimation: Exponential Distribution
-Geneflow estimation: Exponential Distribution
-Divergence time estimation: Normal Distribution Shortcut (mean and standard dev.)

Proposal distributions for parameter

Parameter	Proposal
Theta	Metropolis sampling
M	Metropolis sampling
Divergence	Metropolis sampling
Divergence Spread	Metropolis sampling
Genealogy	Metropolis-Hastings

Prior distribution for parameter

Parameter		Prior	Minimum	Mean	Maximum	Delta	Bins	UpdateFreq
1	Theta **	Uniform	0.000000	0.050	0.100	0.010	1500	0.04545
2	Theta **	Uniform	0.000000	0.050	0.100	0.010	1500	0.04545
3	Theta **	Uniform	0.000000	0.050	0.100	0.010	1500	0.04545
4	M **	Uniform	0.000000	500.0	1000.	100.0	1500	0.04545
5	M **	Uniform	0.000000	500.0	1000.	100.0	1500	0.04545
6	M **	Uniform	0.000000	500.0	1000.	100.0	1500	0.04545
7	M **	Uniform	0.000000	500.0	1000.	100.0	1500	0.04545
8	Splittime mean **	Uniform	0.000000	0.250	0.500	0.050	1500	0.04545
9	Splittime std **	Uniform	0.000000	0.250	0.500	0.050	1500	0.04545
10	Splittime mean **	Uniform	0.000000	0.250	0.500	0.050	1500	0.04545
11	Splittime std **	Uniform	0.000000	0.250	0.500	0.050	1500	0.04545

[* * means priors were set globally]

Markov chain settings: Long chain

Number of chains				1
Recorded steps [a]				10000
Increment (record every x step [b]				1000
Number of concurrent chains (replicates) [c]				2
Visited (sampled) parameter values [a*b*c]				20000000
Number of discard trees per chain (burn-in)				1000

Multiple Markov chains:

Static heating scheme		4 chains with	temperatures	
	1000000.00	3.00	1.50	1.00
		Swapping interval is 1		

Print options:

Data file:	infile
Haplotyping is turned on:	NO
Output file:	outfile
Log file:	logfile
Posterior distribution raw histogram file:	bayesfile
Raw data from the MCMC run:	bayesallfile.gz
Print data:	No
Print genealogies [only some for some data type]:	None

Data summary

Data file: infile
Datatype: Haplotype data
Number of loci: 2

Mutationmodel:

Locus	Sublocus	Mutationmodel	Mutationmodel parameters
1	1	Kimura	[Basefreq: =0.25, kappa=4.0900]
2	1	Kimura	[Basefreq: =0.25, kappa=4.0900]

Sites per locus

Locus	Sites
1	1140
2	297

Site rate variation and probabilities:

Locus	Sublocus	Region type	Rate of change	Probability	Patch size
1	1	1	1.000	1.000	1.000
2	1	1	1.000	1.000	1.000

Population	Locus	Gene copies data	(missing)
1 Great_Salt_lake	1	10	
	2	1	
2 Great_Salt_Lake_Desert	1	22	
	2	11	
3 Sevier_Desert	1	21	
	2	6	
Total of all populations	1	53	(0)
	2	18	(0)

Bayesian Analysis: Posterior distribution table

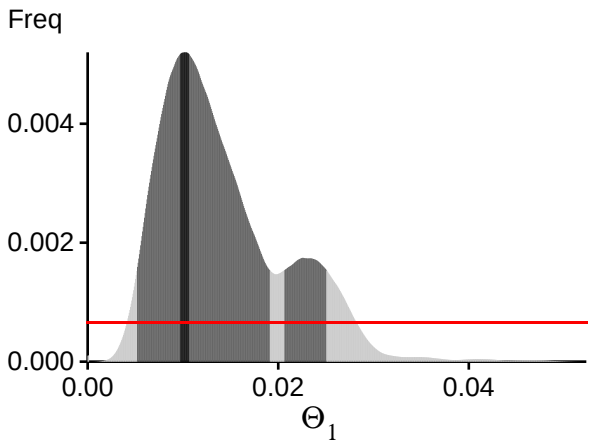
Locus	Parameter	2.5%	25.0%	Mode	75.0%	97.5%	Median	Mean
1	Θ_1	0.00393	0.00707	0.00897	0.01133	0.02013	0.01110	0.01214
1	Θ_2	0.00627	0.00993	0.01230	0.01447	0.02193	0.01330	0.01390
1	Θ_3	0.00980	0.01540	0.01837	0.01947	0.02473	0.01743	0.01805
1	$M_{2->1}$	0.000	0.000	2.333	22.000	62.000	19.000	28.668
1	$M_{1->2}$	0.000	0.000	16.333	39.333	150.000	45.000	60.647
1	$M_{3->2}$	0.000	4.000	26.333	38.667	175.333	60.333	75.199
1	$M_{2->3}$	0.000	2.000	19.667	40.000	202.667	47.667	79.849
1	$D_{1->2}$	0.00000	0.00000	0.00217	0.02433	0.10467	0.02683	0.09627
1	$S_{1->2}$	0.00233	0.00333	0.01050	0.05167	0.10167	0.07317	0.14633
1	$D_{2->3}$	0.00000	0.00000	0.00050	0.02333	0.03400	0.20950	0.21891
1	$S_{2->3}$	0.00000	0.00167	0.00550	0.02133	0.03167	0.22917	0.23184
2	Θ_1	0.00353	0.02353	0.02537	0.02920	0.05433	0.03537	0.03625
2	Θ_2	0.00693	0.02113	0.02190	0.02313	0.03587	0.02010	0.02144
2	Θ_3	0.01100	0.01620	0.01643	0.01673	0.03660	0.04443	0.04824
2	$M_{2->1}$	0.000	0.000	3.000	74.000	245.333	85.667	210.667
2	$M_{1->2}$	0.000	18.667	47.000	76.000	296.667	106.333	146.541
2	$M_{3->2}$	0.000	29.333	43.667	58.000	180.000	77.000	94.157
2	$M_{2->3}$	57.333	80.667	154.333	184.000	454.667	268.333	337.367
2	$D_{1->2}$	0.00000	0.00000	0.00150	0.02933	0.04933	0.20517	0.21972
2	$S_{1->2}$	0.22433	0.22467	0.22583	0.22633	0.23200	0.25417	0.25298
2	$D_{2->3}$	0.35467	0.35633	0.35683	0.35700	0.36133	0.24383	0.24469
2	$S_{2->3}$	0.07233	0.07267	0.07317	0.07333	0.07467	0.25550	0.25265
All	Θ_1	0.00513	0.00967	0.01030	0.01067	0.01913	0.01277	0.01431
All	Θ_2	0.00853	0.01120	0.01323	0.01567	0.02313	0.01437	0.01504
All	Θ_3	0.01020	0.01447	0.01750	0.01987	0.02920	0.01783	0.01846
All	$M_{2->1}$	0.000	0.000	0.333	14.667	58.667	15.000	19.841
All	$M_{1->2}$	0.000	8.667	28.333	53.333	136.000	45.667	54.579
All	$M_{3->2}$	5.333	15.333	33.000	50.667	63.333	49.667	58.206
All	$M_{2->3}$	0.000	15.333	102.333	148.000	256.667	100.333	111.220
All	$D_{1->2}$	0.00000	0.00000	0.00017	0.01333	0.16300	0.01350	0.03435
All	$S_{1->2}$	0.00000	0.00433	0.01617	0.04233	0.18600	0.03983	0.06855
All	$D_{2->3}$	0.00000	0.00000	0.00017	0.08133	0.19967	0.08983	0.09863
All	$S_{2->3}$	0.00000	0.00000	0.01050	0.05933	0.09933	0.10817	0.11146

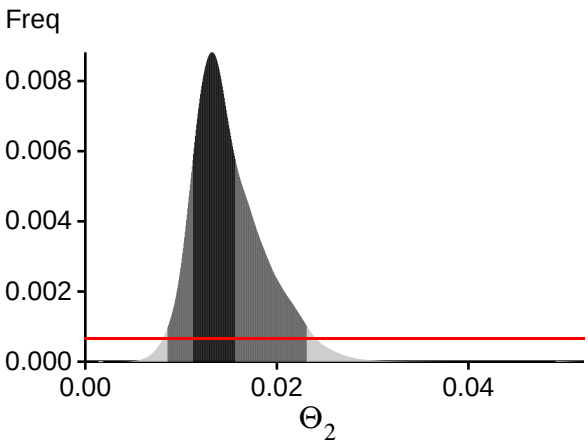
Citation suggestions:

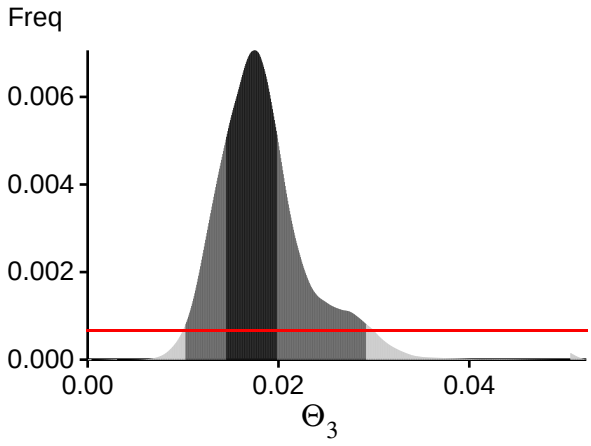
Beerli P., 2006. Comparison of Bayesian and maximum-likelihood inference of population genetic parameters. Bioinformatics 22:341-345

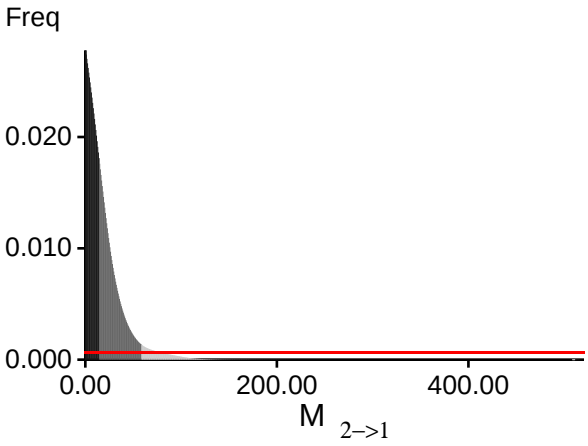
Beerli P., 2009. How to use MIGRATE or why are Markov chain Monte Carlo programs difficult to use? In Population Genetics for Animal Conservation, G. Bertorelle, M. W. Bruford, H. C. Hauffe, A. Rizzoli, and C. Vernesi, eds., vol. 17 of Conservation Biology, Cambridge University Press, Cambridge UK, pp. 42-79.

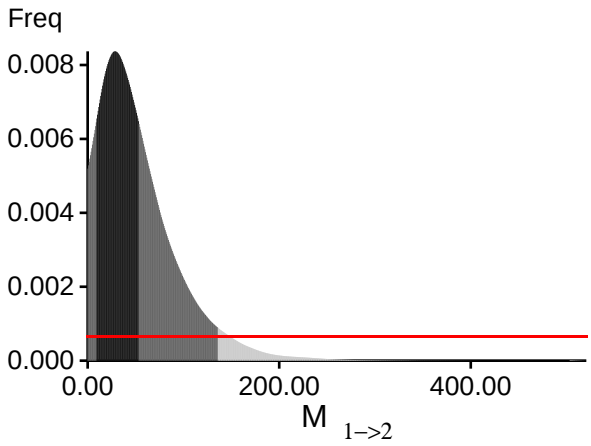
Bayesian Analysis: Posterior distribution over all loci

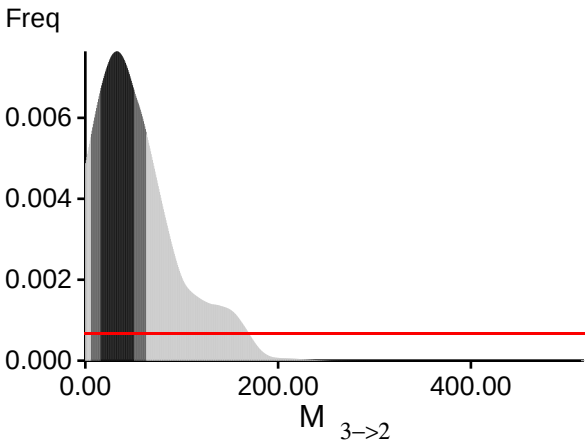


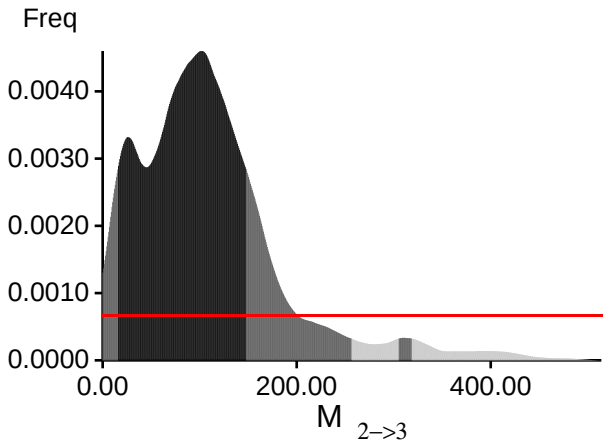


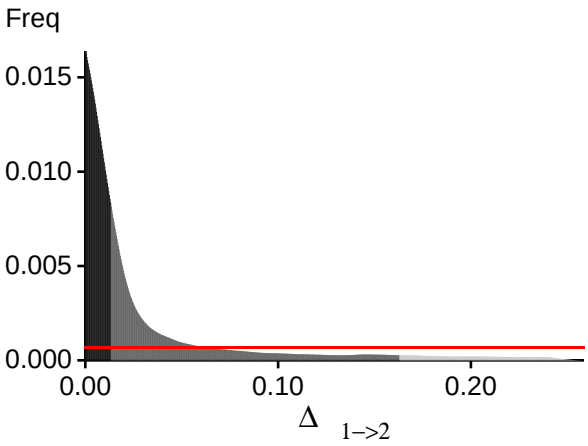


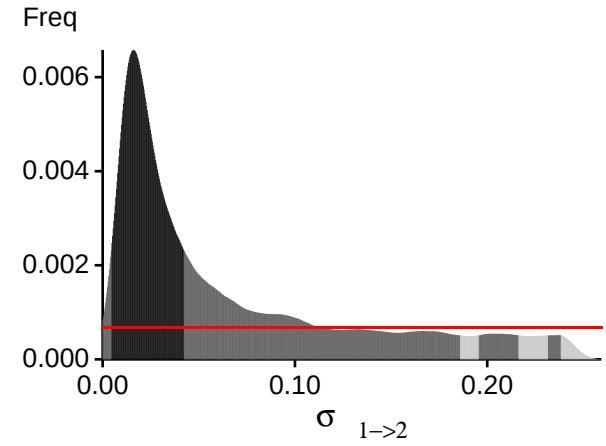


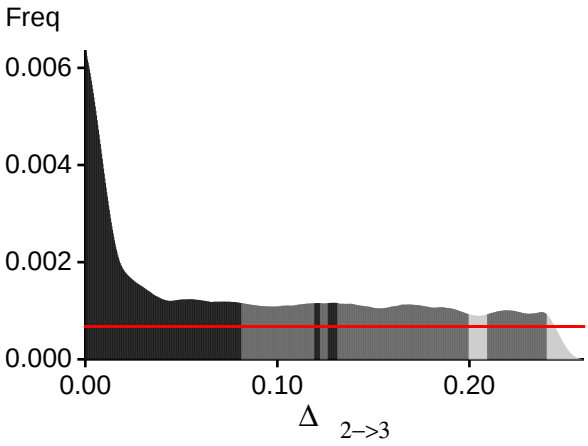


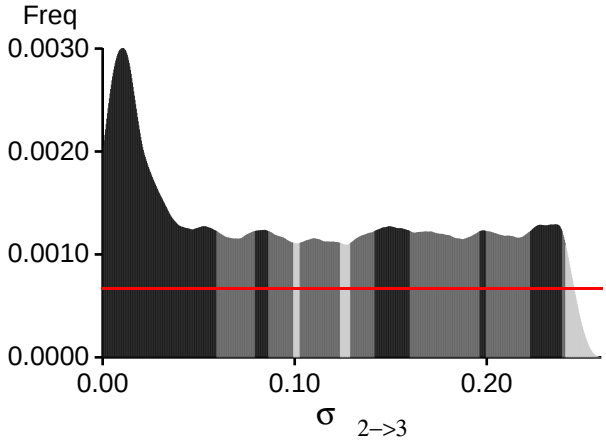



Freq
0.0040
0.0030
0.0020
0.0010
0.0000
0.00
200.00
400.00
M 2–>3


Freq
0.015
0.010
0.005
0.000
0.00
0.10
0.20
Δ 1–>2


Freq
0.006
0.004
0.002
0.000
0.00
0.10
0.20
σ 1–>2


Freq
0.006
0.004
0.002
0.000
0.00
0.10
0.20
Δ 2–>3


Freq
0.0030
0.0020
0.0010
0.0000
0.00
0.10
0.20
σ 2–>3

Log-Probability of the data given the model (marginal likelihood)

Use this value for Bayes factor calculations:
BF = Exp[ln(Prob(D | thisModel) - ln(Prob(D | otherModel)
or as LBF = 2 (ln(Prob(D | thisModel) - ln(Prob(D | otherModel))
shows the support for thisModel]

Locus	Raw thermodynamic score(1a)	Bezier approximation score(1b)	Harmonic mean(2)
1	-4685.92	-3535.70	-3325.87
2	-875.20	-757.27	-739.69
All	-5583.30	-4315.15	-4087.74

(1a, 1b and 2) are approximations to the marginal likelihood, make sure that the program run long enough!
(1a, 1b) and (2) should give similar results, in principle.
But (2) is overestimating the likelihood, it is presented for historical reasons and should not be used
(1a, 1b) needs heating with chains that span a temperature range of 1.0 to at least 100,000.
(1b) is using a Bezier-curve to get better approximations for runs with low number of heated chains
[Scaling factor = -22.180558]
Citation suggestions:
Beerli P. and M. Palczewski, 2010. Unified framework to evaluate panmixia and migration direction among multiple sampling locations, Genetics, 185: 313-326.

Acceptance ratios for all parameters and the genealogies

Parameter	Accepted changes	Ratio
Θ_1	1081492/1817373	0.59509
Θ_2	922427/1820637	0.50665
Θ_3	1244064/1817101	0.68464
$M_{2->1}$	961580/1817839	0.52897
$M_{1->2}$	940529/1818286	0.51726
$M_{3->2}$	1180770/1818002	0.64949
$M_{2->3}$	1060176/1818346	0.58304
$\Delta_{1->2}$	1200890/1815145	0.66159
$\sigma_{1->2}$	1299728/1817175	0.71525
$\Delta_{2->3}$	1653449/1818441	0.90927
$\sigma_{2->3}$	1674133/1818418	0.92065
Genealogies	1957567/20003237	0.09786

MCMC-Autocorrelation and Effective MCMC Sample Size

Parameter	Autocorrelation	Effective Sampe Size
Θ_1	0.42598	18830.53
Θ_2	0.43753	18055.19
Θ_3	0.41607	19126.43
$M_{2->1}$	0.69218	8126.27
$M_{1->2}$	0.58700	10870.29
$M_{3->2}$	0.74885	6700.54
$M_{2->3}$	0.70112	7643.44
$\Delta_{1->2}$	0.27003	23955.17
$\sigma_{1->2}$	0.20712	27611.60
$\Delta_{2->3}$	0.10264	33518.05
$\sigma_{2->3}$	0.07503	35172.26
Genealogies	0.07503	35172.26

Potential Problems

This section reports potential problems with your run, but such reporting is often not very accurate. Whith many parameters in a multilocus analysi s, it is very common that some parameters for some loci will not be very informative, triggering suggestions (for example to increase the prior ran ge) that are not sensible. This suggestion tool will improve with time, therefore do not blindly follow its suggestions. If some parameters are fla gged, inspect the tables carefully and judge wether an action is required. For example, if you run a Bayesian inference with sequence data, for mac roscopic species there is rarely the need to increase the prior for Theta beyond 0.1; but if you use microsatellites it is rather common that your prior distribution for Theta should have a range from 0.0 to 100 or more. With many populations (>3) it is also very common that some migration rou tes are estimated poorly because the data contains little or no information for that route. Increasing the range will not help in such situations, reducing number of parameters may help in such situations.

No warning was recorded during the run