

INPHEST Development Journal

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1 Simulation of Summary Statistics

1. Generate source host tree \bar{T} .

Inputs

- Sequence data.
- Divergence time calibration priors.

Outputs

- \bar{T} : time-calibrated phylogeny.

Procedure

- Use BEAST to generate sample from the posterior distribution of trees given the data, \mathcal{T} .
- Summarize \mathcal{T} using MCCT or other criteria to produce \bar{T} .

2. Generate samples of biogeographical history augmented host trees, \mathbf{T}^* .

Inputs

- \bar{T} : time-calibrated phylogeny.
- Labeling of tips on \bar{T} by geography (distributional range, specified as presence/absence over set of areas, for each tip).

Outputs

- \mathbf{T}^* : samples of host tree augmented with biogeographical history.

Procedure

- Use BayArea or RevBayes to generate stochastic mapped samples.

3. Generate samples of schedule of host events, \mathbb{H} .

Inputs

- \mathbf{T}^* : samples of host tree augmented with biogeographical history.

Outputs

- \mathbb{H} : samples of a schedule of host events, where each distinct element $\mathcal{H}_i, \mathcal{H}_i \in \mathbb{H}$ bijectively corresponds to a distinct tree from \mathbf{T}^* , and consists of a vector of ordered pairs of (τ, η) , where τ is the simulation time of an event and η is the event (host speciation, host extinction, host dispersal, etc.) that occurs at that time on the particular tree to which it corresponds.
4. For *each* simulation replicate:
 - (a) Sample a schedule of host tree events, \mathcal{H}_i , from \mathbb{H} .
 - (b) Simulate symbiont tree, ψ , conditioned on \mathcal{H} and other parameters.
 - (c) Calculate summary statistics on the symbiont tree, ψ .

2 Event Dynamics

Host lineage speciation

- Daughter host lineages inherit parent symbiont load:
 - Both host daughters inherit full symbiont load of parent?
 - Some other scheme?

Host lineage extinction

- Symbiont lineages loses host. If this results in any symbiont lineage host set being reduced to the null set, the symbiont lineage goes extinct.

Host lineage area gain

- No action (passive area gain by proxy by symbiont lineages associated with this host).

Host lineage area loss

- If host lineage does not go extinct (host lineage range not reduced to the null set): no action (passive area loss by proxy by symbiont lineages associated with this host).
- If host lineage goes extinct (host lineage range reduced to the null set): as with host lineage extinction (above).

Symbiont lineage speciation

- Daughter symbiont lineages inherit parent host set pseudo-allopatrically: one daughter lineage inherits one host, other inherit remaining.
- Daughter symbiont lineages inherit parent host set pseudo-subset-sympatrically: one daughter lineage inherits one host, other inherits entire host set.
- Daughter symbiont lineages inherit parent host set by random sampling with replacement.
- Daughter symbiont lineages partition parent host set (randomly).

Symbiont lineage extinction

- Symbiont lineage removed from tree.

Symbiont lineage host gain

- Symbiont lineage gains host.
- Note: potential (new) hosts restricted to hosts that share one or more biogeographical areas with a current host.

Symbiont lineage host loss

- Symbiont lineage loses host, going extinct if host set reduced to the null set.

Symbiont lineage host jumping

- Symbiont lineage gains host.
- Note: potential (new) hosts restricted to hosts that share one or more biogeographical areas with a current host.