

# DateLife Workflows

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## Taxon Primates

### I. Query data

There are 526 species in the Open Tree of Life Taxonomy for the taxon Primates. Information on time of divergence is available for 355 of these species across 8 published and peer-reviewed chronograms. Original study citations as well as proportion of Primates species found across those source chronograms is shown in Table 1.

All source chronograms are fully ultrametric.

Table 1: Primates source chronograms.

|           | <b>Taxon<br/>Presence</b> | <b>Original Study Citation</b>  |
|-----------|---------------------------|---|
| <b>1.</b> | 215/526                   | Bininda-Emonds, Olaf R. P., Marcel Cardillo, Kate E. Jones, Ross D. E.  |
| <b>2.</b> | 215/526                   | MacPhee, Robin M. D. Beck, Richard Grenyer, Samantha A. Price, Rutger A.  |
| <b>3.</b> | 215/526                   | Vos, John L. Gittleman, Andy Purvis. 2007. The delayed rise of present-day  |
| <b>4.</b> | 294/526                   | mammals. <i>Nature</i> 446 (7135): 507-512<br>Hedges, S. Blair, Julie Marín, Michael Suleski, Madeline Paymer, Sudhir<br>Kumar. 2015. Tree of life reveals clock-like speciation and diversification.<br><i>Molecular Biology and Evolution</i> 32 (4): 835-845 |
| <b>5.</b> | 330/526                   | Springer, Mark S., Robert W. Meredith, John Gatesy, Christopher A.  |
| <b>6.</b> | 330/526                   | Emerling, Jong Park, Daniel L. Rabosky, Tanja Stadler, Cynthia Steiner,   |
| <b>7.</b> | 330/526                   | Oliver A. Ryder, Jan E. Janečka, Colleen A. Fisher, William J. Murphy. 2012.  |
| <b>8.</b> | 330/526                   | Macroevolutionary dynamics and historical biogeography of primate<br>diversification inferred from a species supermatrix. <i>PLoS ONE</i> 7 (11): e49521.   |

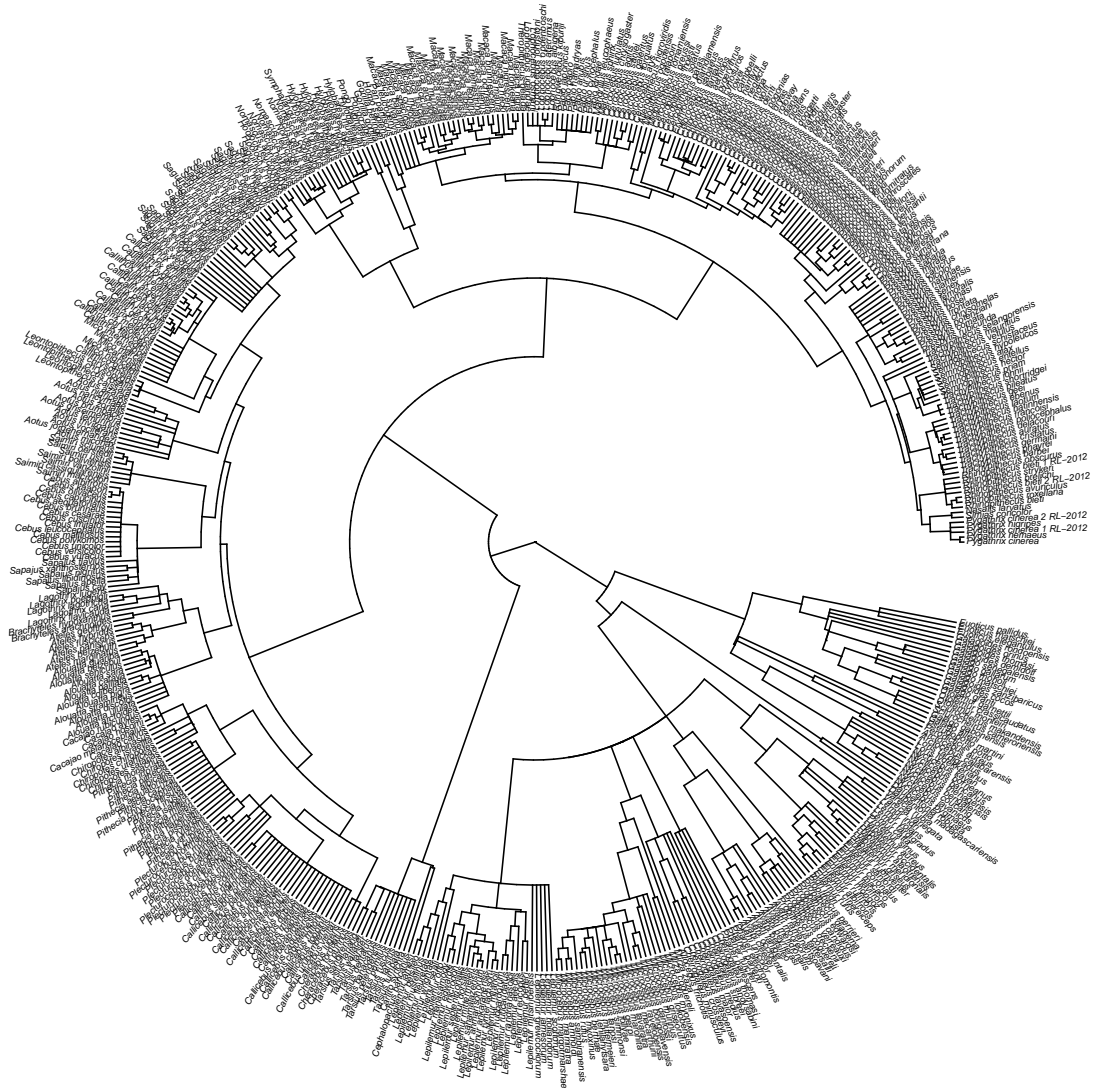


Figure 1: Primates Species Dated Open Tree of Life Induced Subtree. This chronogram was obtained with `get_dated_oto1_induced_subtree()` function.

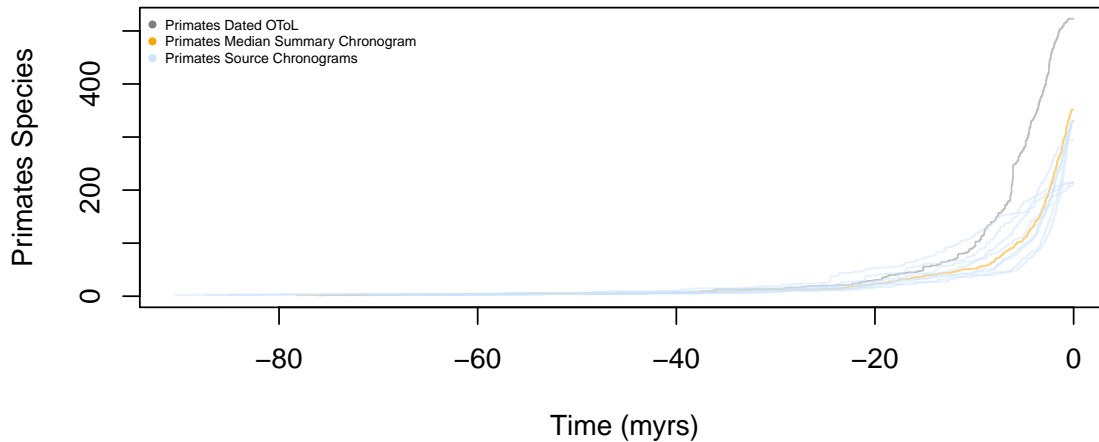


Figure 2: Primates lineage through time (LTT) plots from source chronograms, summary median chronogram and dated Open Tree of Life chronogram.

## II. Summarize results.

### II.A. Diagnosing clustering issues.

We identified some issues with chronograms coming from SDM and Median summary matrices. First, clustering algorithms used to go from a summary distance matrix to a tree return trees that are too old (generally with UPGMA algorithms) or non-ultrametric (generally with Neighbour Joining algorithms). In most studied cases, UPGMA returns fully ultrametric trees but with very old ages (we had to multiply the matrix by 0.25 to get ages approximate to source chronograms ages, however this is a number chosen at random, it was just the number that worked well). NJ returned reasonable ages, but trees are way non ultrametric, as you can see in Fig. 3 and Fig. 4.

This taxon's SDM matrix has NO negative values. This taxon's Median matrix has NO negative values.

### II.B. Age distributions form Median and SDM summary trees.

Comparison of summary chronograms reconstructed with min and max ages.

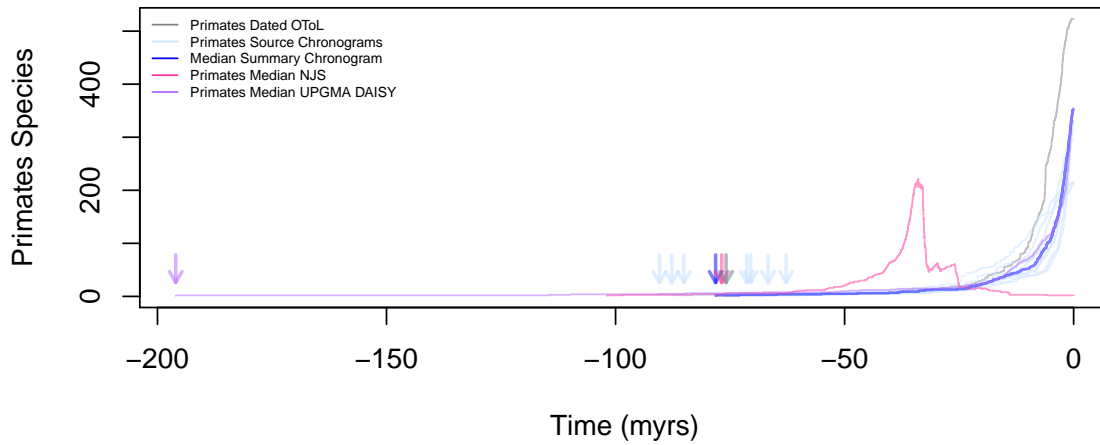


Figure 3: Primates lineage through time (LTT) plots from source chronograms and Median summary matrix converted to phylo with different methods (NJ and UPGMA). Clustering algorithms used often are returning non-ultrametric trees or with maximum ages that are just off (too old or too young). So we developed an alternative algorithm in `datelife` to go from a summary matrix to a fully ultrametric tree.

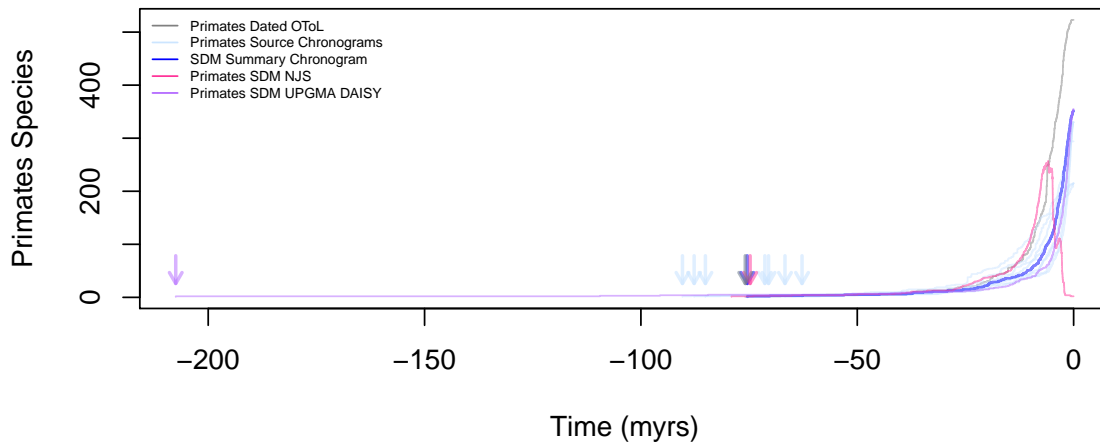


Figure 4: Primates lineage through time (LTT) plots from source chronograms and SDM summary matrix converted to phylo with different methods (NJ and UPGMA). Clustering algorithms used often are returning non-ultrametric trees or with maximum ages that are just off (too old or too young). So we developed an alternative algorithm in `datelife` to go from a summary matrix to a fully ultrametric tree.

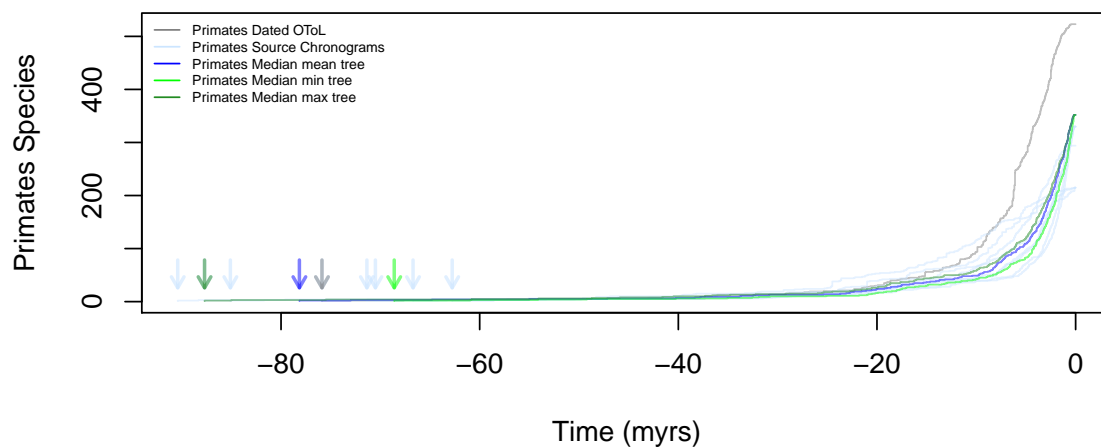


Figure 5: Primates lineage through time (LTT) plots from source chronograms and Median summary matrix converted to phylo with `datelife` algorithm.

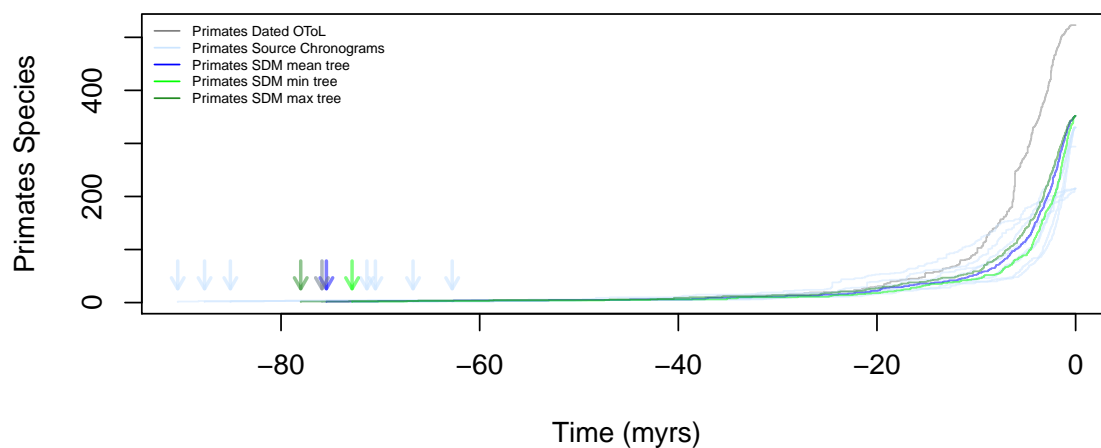


Figure 6: Primates lineage through time (LTT) plots from source chronograms and SDM summary matrix converted to phylo with `datelife` algorithm.

### III. Create new data

As an example, we're gonna date the Open Tree Synthetic tree (mainly because the taxonomic tree is usually less well resolved.)

Now, let's say you like the Open Tree of Life Taxonomy and you want to stick to that tree. Dates from available studies were tested over the Open Tree of Life Synthetic tree of Primates and a tree was constructed, but all branch lengths are NA. We also tried each source chronogram independently, with the Dated OToL and with each other, as a form of cross validation in Table 2. This is not working perfectly yet, but we are developping new ways to use all calibrations efficiently.

Table 2: Was it successful to use each source chronogram independently as calibration (CalibN) against the Dated Open Tree of Life (dOToL) and each other (ChronoN)?

|               | dOToL | Chrono1 | Chrono2 | Chrono3 | Chrono4 | Chrono5 | Chrono6 | Chrono7 | Chrono8 |
|---------------|-------|---------|---------|---------|---------|---------|---------|---------|---------|
| Calibrations1 | TRUE  | FALSE   | FALSE   | TRUE    | TRUE    | TRUE    | TRUE    | TRUE    | TRUE    |
| Calibrations2 | TRUE  | FALSE   | FALSE   | TRUE    | TRUE    | TRUE    | TRUE    | TRUE    | TRUE    |
| Calibrations3 | TRUE  | FALSE   | FALSE   | TRUE    | TRUE    | TRUE    | TRUE    | TRUE    | TRUE    |
| Calibrations4 | TRUE  | FALSE   | FALSE   | TRUE    | TRUE    | TRUE    | TRUE    | TRUE    | TRUE    |
| Calibrations5 | TRUE  | FALSE   | FALSE   | TRUE    | TRUE    | TRUE    | TRUE    | TRUE    | TRUE    |
| Calibrations6 | TRUE  | FALSE   | FALSE   | TRUE    | TRUE    | TRUE    | TRUE    | TRUE    | TRUE    |
| Calibrations7 | TRUE  | FALSE   | FALSE   | TRUE    | TRUE    | TRUE    | TRUE    | TRUE    | TRUE    |
| Calibrations8 | TRUE  | FALSE   | FALSE   | TRUE    | TRUE    | TRUE    | TRUE    | TRUE    | TRUE    |

### III. Simulate data

An alternative to generate a dated tree from a set of taxa is to take the available information and simulate into it the missing data. We will take the median and sdm summary chronograms to date the Synthetic tree of Life:

```
#> Error in paste0("\n![" , figcap_lttplot_sdm, "](plots/", taxon, "_LTTplot_sdm.pdf)\n"): object 'fig'
#> Error in cat(lttplot): object 'lttplot' not found
```

## Appendix

The following species were completely absent from the chronogram data base: *Alouatta arctoidea*, *Alouatta discolor*, *Alouatta stramineus*, *Alouatta ululata*, *Aotus azarae*, *Aotus jorgehernandezi*, *Aotus zonalis*, *Avahi mooreorum*, *Avahi ramanantsoavani*, *Cacajao rubicundus*, *Callicebus aureipalatii*, *Callicebus baptista*, *Callicebus barbarabrownae*, *Callicebus caquetenesis*, *Callicebus caquetensis*, *Callicebus discolor*, *Callicebus lucifer*, *Callicebus medemi*, *Callicebus melanocheir*, *Callicebus miltoni*, *Callicebus ornatus*, *Callicebus pallescens*, *Callicebus regulus*, *Callicebus stephennashi*, *Callicebus toppinii*, *Callicebus urubambensis*, *Callicebus vieirai*, *Callithrix cf. emiliae*, *Callithrix chrysolaia*, *Carlito syrichta*, *Cebus aequatorialis*, *Cebus brunneus*, *Cebus cesarae*, *Cebus cuscinus*, *Cebus imitator*, *Cebus leucocephalus*, *Cebus malitiosus*, *Cebus polykomos*, *Cebus unicolor*, *Cebus versicolor*, *Cebus yuracus*, *Cephalopachus bancanus*, *Cercocebus lunulatus*, *Cercocebus sanjei*, *Cercopithecus denti*, *Cercopithecus doggetti*, *Cercopithecus kandti*, *Cercopithecus lomamiensis*, *Cercopithecus lowei*, *Cheirogaleus andysabini*, *Cheirogaleus lavasoensis*, *Cheirogaleus minusculus*, *Cheirogaleus thomasi*, *Cheracebus lugens*, *Cheracebus purinus*, *Cheracebus torquatus*, *Chiropotes utahickae*, *Chlorocebus djamdjamensis*, *Daubentonia robusta*, *Euoticus matschiei*, *Galagoides cocos*, *Galagoides orinus*, *Galagoides rondoensis*, *Galagoides thomasi*, *Hylobates entelloides*, *Hylobates funereus*, *Lemur indri*, *Lemur tardigradus*, *Lemur volans*, *Lepilemur grewcockorum*, *Lepilemur hollandorum*, *Lepilemur jamesorum*, *Lepilemur mitsinjoensis*, *Lepilemur scottorum*, *Lepilemur tymerlachsoni*, *Lophocebus johnstoni*, *Lophocebus opdenboschi*, *Lophocebus osmani*, *Lophocebus ugandae*, *Macaca balantak*, *Macaca leucogenys*, *Macaca speciosa*, *Mico acariensis*, *Mico intermedius*, *Mico leucippe*, *Mico marcai*, *Mico nigriceps*, *Microcebus lokobensis*, *Microcebus marohita*, *Microcebus myonixus*, *Microcebus tanosi*, *Nomascus annamensis*, *Nycticebus bancanus*, *Nycticebus borneanus*, *Nycticebus kayan*, *Papio japonicus*, *Papio kindae*, *Phaner electromontis*, *Phaner parienti*, *Ptilocolobus bouvieri*, *Ptilocolobus epieni*, *Ptilocolobus oustaleti*, *Ptilocolobus parmentieri*, *Ptilocolobus semlikiensis*, *Ptilocolobus temminckii*, *Ptilocolobus waldronae*, *Pithecia cazuzai*, *Pithecia chryscephala*, *Pithecia hirsuta*, *Pithecia inusta*, *Pithecia isabela*, *Pithecia milleri*, *Pithecia mittermeieri*, *Pithecia napensis*, *Pithecia pissinattii*, *Pithecia rylandsi*, *Pithecia vanzolinii*, *Plecturocebus bernhardi*, *Plecturocebus brunneus*, *Plecturocebus caligatus*, *Plecturocebus cinerascens*, *Plecturocebus cupreus*, *Plecturocebus donacophilus*, *Plecturocebus hoffmannsi*, *Plecturocebus miltoni*, *Plecturocebus moloch*, *Presbytis bicolor*, *Presbytis canicrus*, *Presbytis mitrata*, *Presbytis natunae*, *Presbytis sabana*, *Presbytis senex*, *Presbytis siamensis*, *Presbytis siberu*, *Presbytis sumatrana*, *Propithecus candidus*, *Pseudopotto martini*, *Pygathrix cinerea 1 RL-2012*, *Pygathrix cinerea 2 RL-2012*, *Rhinopithecus bieti 1 RL-2012*, *Rhinopithecus bieti 2 RL-2012*, *Saguinus cruzlimai*, *Saguinus illigeri*, *Saguinus lagonotus*, *Saguinus leucogenys*, *Saguinus nigrifrons*, *Saguinus pileatus*, *Saguinus ursulus*, *Saguinus weddelli*, *Saimiri cassiquiarensis*, *Saimiri macrodon*, *Sapajus apella*, *Sapajus cay*, *Sapajus flavius*, *Sapajus libidinosus*, *Sapajus nigritus*, *Sapajus xanthosternus*, *Sciurocheirus cameronensis*, *Sciurocheirus makandensis*, *Semnopithecus ajax*, *Semnopithecus hypoleucos*, *Semnopithecus schistaceus*, *Tarsius banacanus*, *Tarsius fuscus*, *Tarsius pelengensis*, *Tarsius tarsius*, *Tarsius tumpara*, *Trachypithecus ebenus*, *Trachypithecus mauritius*, *Trachypithecus selangorensis*, *Trachypithecus shortridgei*