Data Article

Molecular and morphological data supporting phylogenetic reconstruction of the genus *Goniothalamus* (Annonaceae), including a reassessment of previous infragenic classifications

Chin Cheung Tang\textsuperscript{a}, Daniel C. Thomas\textsuperscript{a,b}, Richard M.K. Saunders\textsuperscript{a,*}

\textsuperscript{a} School of Biological Sciences, The University of Hong Kong, Pokfulam Road, Hong Kong, China
\textsuperscript{b} Singapore Botanic Gardens, 1 Cluny Road, Singapore 259569, Singapore

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\section*{A B S T R A C T}

Data is presented in support of a phylogenetic reconstruction of the species-rich early-divergent angiosperm genus *Goniothalamus* (Annonaceae) (Tang et al., Mol. Phylogenetic Evol., 2015) \cite{1}, inferred using chloroplast DNA (cpDNA) sequences. The data includes a list of primers for amplification and sequencing for nine cpDNA regions: \textit{atpB-rbcL}, \textit{matK}, \textit{ndhF}, \textit{psbA-trnH}, \textit{psbM-trnD}, \textit{rbcL}, \textit{trnL-F}, \textit{trnS-G}, and \textit{ycf1}, the voucher information and molecular data (GenBank accession numbers) of 67 ingroup *Goniothalamus* accessions and 14 outgroup accessions selected from across the tribe Annonaeae, and aligned data matrices for each gene region. We also present our Bayesian phylogenetic reconstructions for *Goniothalamus*, with information on previous infragenic classifications superimposed to enable an evaluation of monophyly, together with a taxon-character data matrix (with 15 morphological characters scored for 66 *Goniothalamus* species and seven other species from the tribe Annonaeae that are shown to be phylogenetically correlated).

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### Value of the data

- Data provides a summary of taxa and chloroplast DNA (cpDNA) regions and aligned data matrices that can be used for the phylogenetic reconstruction of *Goniothalamus* (Annonaceae tribe Annoneae) [1].
- Data provides a summary of morphological characters relevant to species in the tribe Annoneae that are important for broader morphological evolutionary studies.
- Comparisons between the resultant phylogeny for *Goniothalamus* species with previous infrageneric classifications [2,3] enable an assessment of congruence between the phylogeny and the infrageneric classifications.

### 1. Data, experimental design, materials and methods

#### 1.1. Primer design and summary

Available sequences of nine chloroplast DNA (cpDNA) regions: *atpB-rbcL*, *matK*, *ndhF*, *psbA-trnH*, *psbM-trnD*, *rbcL*, *trnL-F*, *trnS-G*, and *ycf1* were downloaded from GenBank ([https://www.ncbi.nlm.nih.gov/genbank/](https://www.ncbi.nlm.nih.gov/genbank/)) for species of *Goniothalamus* and related species from Annonaceae tribe Annoneae. Alignment of each region was performed using MAFFT v.7.029b [4] with default settings and the automatic algorithm option. Each alignment was opened in Geneious v.5.4.3 [5] and “Design New Primer” analysis performed with the “Target Region” set as 300–400 bp and other settings kept as default using Primer3 [6,7]. The summary of primer sequences obtained from the analysis and from previous studies [8–18] are listed in Table 1.

#### 1.2. DNA sequencing and upload to GenBank

A modified cetyl trimethyl ammonium bromide (CTAB) method [17,20,21] was used for whole genomic DNA. The extracted DNA was amplified using polymerase chain reaction (PCR). 6.4 μl ddH2O, 1.5 μl MgCl2 (25 mM), 0.25 μl dNTPs (10 mM), 0.375 μl of each forward and reverse primer (10 μM each, listed in Table 1), 0.5 μl bovine serum albumin (BSA, 10 mg/ml), 0.1 μl Flexi-taq DNA polymerase (Promega, Madison, Wisconsin, U.S.A.), and 0.5 μl DNA template were added for each reaction. The following PCR protocol was adopted: 5 min template denaturation at 95 °C followed by 38 cycles of denaturation at 95 °C for 1 min; primer annealing at 50 °C for 1 min; primer extension at 65 °C for 4 min; with the final extension set to 65 °C for 5 min. PCR products were purified, amplified and
Table 1
List of primers used for amplification and sequencing of nine DNA regions.

| Region      | Primer            | Sequence (5′–3′)                        | Source                        |
|-------------|-------------------|-----------------------------------------|-------------------------------|
| atpB-rbcL   | atpB-rbcL-2       | CCAACACTTGCTTTAGTCTCTTG                 | [14]                          |
|             | atpB-rbcL-c1b     | TGGGTAGATTTMTGGCCATTTTCACA              | [1]; this study               |
|             | atpB-rbcL-c2a     | TTGGCGCAACCACCATCTTGT                  | [1]; this study               |
|             | atpB-rbcL-c2b     | AGTGGCAAGAGGTTGTTCCAC                  | [1]; this study               |
|             | atpB-rbcL-c3a     | GGAATTCGCAATTTAACGAGCTCA               | [1]; this study               |
|             | atpB-rbcL-c3b     | AGCTCAATACGATGATTACCTCGG               | [1]; this study               |
|             | atpB-rbcL-c4a     | TGCGGCCAGAAGCTCAACGCC                  | [1]; this study               |
|             | atpB-rbcL-3       | AGTGTTGACCCAGATCGAAGG                  | [10]                          |
| matK        | matK-1a           | TAATACCTCACCCCTCCATCTTCG               | Designed by Y.C.F. Su         |
|             | matK-c1b          | TGGTTGCGCCTGAACGAGATTTCCA              | [1]; this study               |
|             | matK-c2a          | CGGTGGATTAAATCGAGATTTCCA               | [1]; this study               |
|             | matK-11b          | RATCCTCCGTTCCGAGACCCACCAA             | Designed by Y.C.F. Su         |
|             | matK-449F         | AGAATGGAGAATCTTACCTTGC                | [17]                          |
|             | matK-824R         | ATCCGCCCCAAATGTTGATTGATA             | [17]                          |
| ndhF        | ndhF-1F           | ATGGAGAAGAATCTTACCTTGC                | [9]                           |
|             | ndhF-c1bR         | CCTAAGATTCATTAATAAATACAA              | [1]; this study               |
|             | ndhF-c2aF         | TTGGGAACAGTGAAGGCTGCTGT               | [1]; this study               |
|             | ndhF-689R         | GGCATCRRGGAACATATATGAA                | [16]                          |
|             | ndhF-c1bF         | TGGTTTATTGAAAGATCTTAGG                | [1]; this study               |
|             | ndhF-c3bR         | GCAGCCGAATGATCATATCCTCRG             | [1]; this study               |
|             | ndhF-972F         | GCTCAATTTGAAATTTGAGG                  | [9]                           |
|             | ndhF-c4bR         | AYCCCTGCCGAAATACCTTTGC               | [1]; this study               |
|             | ndhF-c5bR         | TGGTGGACTGCCGAGGATCGYRG               | [1]; this study               |
|             | ndhF-LBCF         | TCAATATCATGATGGGGGAAAG                | [16]                          |
|             | ndhF-c6bR         | ATGCGGGTTGATAATTTTGYG                 | [1]; this study               |
|             | ndhF-c5bF         | CYRCATAYCCCCATATGATCTGCA             | [1]; this study               |
|             | ndhF-2210R        | CCCCTATATGGATATACTCTTCC              | [9]                           |
| psbA-trnH   | psbA              | GTTATGCTGATAGAACTTATATATGCTC          | [19]                          |
|             | psbAtmH-c1b       | TGCCATCGTAAAGAGCAGYATGCA             | [1]; this study               |
|             | psbAtmH-c2a       | GGGTATGAAAGATCGATCTATGCA             | [1]; this study               |
|             | trnH(ami-GUG)     | CGGCCATGCTGATCCACATACC              | [13]                          |
| psbM-trnD   | psbM-F            | AGCAATTTGACGAGATATTTTACTTCAT         | [15]                          |
|             | psbM-c1a          | TTCCGAGATCTTAATCCCAATATGAAAWACT       | [1]; this study               |
|             | psbM-c2a          | TYSRATACGGAATTCYGCTGG                | [1]; this study               |
|             | psbM-c1b          | TGGAGCTGTGACGAGATCGYRG               | [1]; this study               |
|             | psbM-c3a          | CCTCCGAAAGARRRGGGCG                  | [1]; this study               |
|             | psbM-c2b          | TCCAGGAAGAGGAGACTGACCA               | [1]; this study               |
|             | psbM-c4a          | ACTTGTTGCGCGCCGAGAATAC              | [1]; this study               |
|             | psbM-c5a          | AGGAGATCCAGATGCTATGCC                | [1]; this study               |
|             | psbM-c4b1         | AGAGAGAGAGAGAGAGAGGAAGG             | [1]; this study               |
|             | psbM-c4b2         | TGCAGCCCGGCTGATATGCGCG            | [1]; this study               |
|             | trnD(GUC)-R       | GCACATGATGATGATGATGATG              | [15]                          |
| rbcL        | rbcL-7F           | GATTCAAAAGCTGATGTTAAGAAGT            | [17]                          |
|             | rbcL-c1b          | GGAATGGAGAATCTTACCTGGG               | [1]; this study               |
|             | rbcL-c2a          | TCGAGGATCTTGTTCTGAGAGGA             | [1]; this study               |
|             | rbcL-724R         | TCGCAGATCTGATGCAGTACG               | [11]                          |
|             | rbcL-c3a          | CGCCAAAGAATTTAGGCTAAGCG             | [1]; this study               |
|             | rbcL-c3b          | TGGCGTTCCGTTCTGTCCCGTT             | [1]; this study               |
|             | rbcL-4a           | AGACACGCCGCCAGAGCCTCCAA          | [1]; this study               |
|             | rbcL-5a           | ATCCCAGATGACTCGTACCAGAT              | Designed by Y.C.F. Su         |
|             | rbcL-5b           | ACGTCTCCGATCCGAGCTTGA              | Designed by Y.C.F. Su         |
|             | rbcL-c7a          | TGCAGGAGAGAGGACTGAGAAGG            | [1]; this study               |
|             | rbcL-1381R        | TCGAATCTGATGATGATGATG              | [17]                          |
| trnS-G      | trnS(GCU)         | GCACATGATGATGATGATGATG              | [12]                          |
|             | trnS(GCU)         | GCACATGATGATGATGATGATG              | [12]                          |
|             | trnS-G-c1b        | ASYGTTCAAAACAGATTGTTTATCACA         | [1]; this study               |
|             | trnS-G-c2a        | TCAATCCCTGAGCTCACCCTCTGT            | [1]; this study               |
|             | trnS-G-c2b        | TGCTTACTGAGGTTCCGCTCC               | [1]; this study               |
|             | trnS-G-c3a        | CGGATCCTTCAGAATACCTTCTCTTG          | [1]; this study               |
sequenced by BGI (Hong Kong, PR China) using the BigDye Terminator Cycle Sequencing Kit (Applied Biosystems, Foster City, California, U.S.A.), with sequencing run on an AB 3730 DNA Analyzer (Applied Biosystems). The sequences were uploaded to GenBank (https://www.ncbi.nlm.nih.gov/genbank/).

The summary of the taxon-sequence matrix showing the voucher information and molecular data (GenBank accession numbers) of 67 Goniothalamus accessions and 14 accessions in the tribe Annoneae of the family Annonaceae for the nine cpDNA regions is presented in Table 2.

### 1.3. Bayesian phylogenetic reconstructions for Goniothalamus

The sequences of the taxa listed in Table 2 were downloaded and aligned using MAFFT v.7.029b [4] with default settings and the automatic algorithm option. For manual editing and optimizing, an 11-bp inversion in psbA-trnH and a 16-bp region in ycf1 were excluded from the matrix in Geneious. The aligned and edited matrices of each region are presented as Supplementary material (Alignments 1–9, representing atpB-rbcL, matK, ndhF, psbA-trnH, psbM-trnD, rbcL, trnL-F, trnS-G, and ycf1).

For Bayesian phylogenetic reconstructions, MrBayes v.3.1.2 [22,23] was performed using the online portal in the CIPRES Science Gateway [24]. Data was partitioned according to DNA region identity. The best-fitting evolutionary models were selected using MrModeltest v.2.3 [25] under the Akaike Information Criterion (AIC [26]): GTR+Γ+I was selected for the psbA-trnH, psbM-F, rbcL, and ycf1 partitions; GTR+Γ was selected for the matK, ndhF, trnL-F, and trnS-G partitions; and the Hasegawa–Kishino–Yano Model with among-site rate variation modeled with a gamma distribution (HKY+Γ) for the atpB-rbcL partition. Four independent MCMCMC analyses were run in the Bayesian phylogenetic reconstructions, each with 5,000,000 generations, sampled every 1000th generation. Each run involved three incrementally heated and one cold Markov chain with a temperature parameter of 0.16. The parameters for substitution rates of nucleotide substitution models, character state frequencies and rate variation among sites were unlinked. In order to reduce the likelihood of stochastic entrapment in local tree length optima [27,28], the mean branch length prior was adjusted to 0.01 (brlenspr=unconstrained:exponential (100.0)); all other priors were kept as default. Convergence was assessed by checking that the standard deviation of split frequencies was < 0.005. Adequate effective sample sizes (ESS > 200) were checked in Tracer v.1.5 [29], which also showed whether the parameter samples were drawn from a unimodal and stationary distribution. The “Cumulative” and “Compare” functions of AWTY [30] were used to evaluate stationarity of posterior probabilities of splits within runs and convergence between different runs. 25% burn-in of initial samples of each run was excluded and a 50% majority-rule consensus tree (see Interactive Phylogenetic Tree 1) was calculated from the post-burn-in trees. A phylogeny with 66 Goniothalamus species was extracted from the resultant 50% majority-rule consensus tree. Previous infrageneric classifications [2,3] are superimposed onto the phylogeny to show congruence (Fig. 1).
### Table 2
Summary of voucher information and GenBank accession numbers of the 81 accessions.

| Taxon name                | Origin          | Voucher Information                                      | GenBank accession numbers |
|---------------------------|-----------------|----------------------------------------------------------|---------------------------|
| Annona dumetorum          | Dominican Republic | Abbott, J.R. 20966 (FLAS) 6 June 2006                   | GQ139704 – EU420856 – EU420838 – GU937352 – EU420856 – |
| Annona glabra L.          | USA             | Chatrou, L.W. 467 (U) 468 (U)                            | EF179246 – GQ139717 – EF179281 – AY841596 – AY841673 – EF179323 – GU937365 – AY841656 – |
| Annona herzogii           | R. E. Fr.       | Chatrou, L.W. et al. 347 (U) 512 (U)                    | EF179273 – DQ125062 – EF179308 – AY841656 – AY841734 – EF179350 – AY841656 – |
| Annona mucosa Jacq.       |                | Abbott, J.R. 21032 (FLAS)                                | – GQ139705 – EU420870 – EU420852 – GU937353 – EU420870 – |
| Annona reticulata         |                | Chatrou, L.W. et al. 290 (U) 509 (U)                    | – JQ586491 – EU420863 – EU420845 – EU420863 – |
| Annona squamosa L.        |                | Nakkuntod, M. 45 (BCU)                                  | – EU715064 – EU420865 – EU420847 – EU420865 – |
| Asimina longifolia Kral   | USA             | Weerasooriya, A.D. s.n. (MISS) 18201 (U)                | EF179247 – AF543722 – EF179282 – AY743440 – AY743459 – EF179324 – AY743440 – |
| Asimina rugelii B.L.Rob.  |                | Abbott, J.R. 22361 (FLAS)                                | – GQ139706 – JQ513887 – GQ139881 – GU937354 – JQ513887 – |
| Asimina reticulata        |                | Chatrou, L.W. et al. 276 (U)                            | EF179252 – GQ139711 – AY218171 – AY743441 – AY743460 – EF179324 – AY743441 – |
| Disepalum platypetalum    | Merr.           | Takeuchi, W. & Sambas 18201                              | EF179257 – DQ125057 – EF179292 – – – – – |
| Disepalum pulchrum        |                | Chan, R. 192 (FLAS)                                      | – GQ139736 – JQ513888 – GQ139909 – GU937383 – JQ513888 – |
| Goniothalamus tapis Miq.  | Thailand        | Keßler, P.J.A. 3193 (L)                                  | EF179262 – DQ125058 – EF179297 – AY841622 – AY841700 – EF179339 – AY841622 – |
| Goniothalamus amuyon      | Philippines     | Tung, C.C. 20100907 (HKU)                                | – – – – KMB18318 – KMB18567 – KMB18648 – KMB18728 – KMB18898 – KMB18916 – KMB18979 – KMB18839 – KMB18755 – |
| Goniothalamus andersonii  |                | Anderson, J.R. 512956 (L)                                | KM818519 – KM818568 – KM818711 – KM818867 – KM818949 – KM818789 – |
| Goniothalamus angustifolius |                | Gillespie, J.W. 2198 (A)                                 | – KM818569 – KM818632 – KM818732 – KM818878 – KM818937 – KM818983 – KM818797 – |
| Goniothalamus arvensis    |                | Regalado, J. & Takeuchi, W. 1409 (L)                     | KM818520 – KM818570 – KM818640 – KM818706 – KM818868 – KM818918 – KM818791 – |
| Goniothalamus australis   | Australia       | Unknown collector 3178 (HKU)                             | KM818521 – KM818571 – KM818638 – KM818709 – KM818887 – KM818910 – KM818973 – KM818836 – KM818769 – |
| Goniothalamus borneensis  | Borneo          | Arbainsyah et al. AA1011 (L)                             | KM818522 – KM818572 – KM818673 – KM818893 – KM818952 – KM818826 – KM818747 – |
| Goniothalamus bracteosis  |                | Clemens, J. & Clemens, M.S. 27619 (L)                    | – KM818573 – KM818730 – KM818906 – KM818967 – KM818796 – |
| Goniothalamus tapis       |                | – – – – KM818717 – KM818927 – KM818994 – KM818810 –    |

Note: Collection date for Annona glabra L. is 6 June 2006.
| Species                          | Collectors              | Collection Details | Country       | Location         | Date    | Genbank Accessions                      |
|---------------------------------|-------------------------|--------------------|---------------|------------------|---------|----------------------------------------|
| Goniothalamus calcaris          | Mat-Salleh              | Cultivated         | India         | Raghavan, R.S.   | 16 Feb 1963 | KM818524 KM818575 KM818654 KM818692 KM818879 KM818912 – KM818799 KM818752 |
| Goniothalamus calvicarpus       | Craib                   | Cultivated         | Papua New Guinea | Hartley, T.G.   | 15 Feb 1962 | KM818525 KM818576 KM818663 KM818696 KM818869 KM818919 – KM818807 KM818757 |
| Goniothalamus cardiopetalus     | Hook. & Thomson         | Cultivated         | India         | Saunders, R.M.K., Su, Y.C.F. & Chalermglin, P. 04/22 (HKU) | 25 Jul 2004 | KM818526 KM818577 KM818661 KM818678 KM818901 KM818926 KM818892 KM818831 KM818758 |
| Goniothalamus cauliensis        | Bân                     | Borneo             | Java          | Martati, T.     | 3 Jan 1984 – KM818578 – KM818736 KM818844 KM818915 – KM818780 – |
| Goniothalamus costulatus        | Miq.                    |Java                | New Caledonia | Dumontet, V. & Poullain, C. 716 (HKU) | 15 Jun 2006 | – KM818580 – KM818729 KM818861 KM818954 – KM818840 – |
| Goniothalamus dumontetii        | R.M.K. Saunders & Munzinger | Cultivated     | Papua New Guinea | Beamann, J.H. 8184 (L) | 3 Jan 1984 – KM818578 – KM818736 KM818844 KM818915 – KM818780 – |
| Goniothalamus elegans           | Ast                     | Thailand           | Thailand      | Nakkunthod, M. 40 (BCU) | 28 Oct 2005 | – KM818582 KM818639 KM818677 KM818882 KM818924 KM819003 KM818811 – |
| Goniothalamus elmeri            | Merr.                   | Philippines        | Philippines   | Rosario et al. 11-014 (University of Santo Tomas Herbarium) | s.a. | – KM818582 KM818639 KM818677 KM818882 KM818924 KM819003 KM818811 – |
| Goniothalamus expansus          | Craib                   | Thailand           | Thailand      | Kitamura, S. MN22 (BCU) | 9 Jun 2004 – KM818583 KM818634 KM818714 KM818853 KM818931 KM818987 KM818829 – |
| Goniothalamus fasciculatus      | Boerl.                  | Borneo             | Sri Lanka     | Kefßler, P.J.A. et al. 2846 (HKU) | 10 Apr 2000 | KM818528 KM818584 KM818636 – KM818890 KM818950 – KM818805 – |
| Goniothalamus gardneri          | Hook. & Thomson         | Sri Lanka           | Sri Lanka     | Tillekaratne, H.I. G29 (HKU) | s.a. | KM818529 KM818585 KM818656 KM818704 KM818871 KM818923 KM819001 KM818784 KM818773 |
| Goniothalamus giganteus         | Hook. & Thomson         | Cultivated         | Indonesia     | Saunders, R.M.K., Su, Y.C.F. & Chalermglin, P. 04/22 (HKU) | 25 Jul 2004 | KM818530 KM818586 KM818655 KM818698 KM818892 KM818963 KM818996 KM818837 KM818754 |
| Goniothalamus grandiflorus      | Boerl.                  | Papua New Guinea   | Papua New Guinea | Takeuchi, W.N. 8771 (L) | 11 Feb 1993 | KM818531 KM818587 KM818637 KM818691 KM818851 KM818930 – KM818802 KM818770 |
| Goniothalamus griffithii        | Hook. & Thomson         | Thailand           | Thailand      | Saunders, R.M.K. & Chalermglin, P. 04/30 (HKU) | 28 Jul 2004 | KM818532 KM818588 KM818651 KM818701 KM818894 KM818939 KM819000 KM818798 KM818748 |
| Goniothalamus hookeri           | Tiwhaites               | Sri Lanka           | Sri Lanka     | Rattanayake, R.M.C.S. 100 (HKU) | 10 Feb 2003 | KM818533 KM818589 KM818657 KM818734 KM818872 KM818956 – KM818814 KM818774 |
| Goniothalamus howii             | Merr.                   | China               | China         | Wang, X.B. W2011003 (HUTB) | 3 Aug 2011 | KM818534 KM818590 – KM818689 KM818886 KM818938 KM818986 KM818833 KM818767 |
| Goniothalamus imbricatus        | Schef.                  | Papua New Guinea   | Papua New Guinea | Bau, B. LAE89112 (LAE) | s.a. | KM818535 KM818591 – KM818722 KM818847 KM81946 KM818998 KM818806 KM818753 |
| Goniothalamus kinabaluensis     | 81 ex Mat-Salleh        | Borneo              | Borneo        | Vogel, E.F. de 8387 (L) | 18 Oct 1986 | KM818536 KM818592 KM818672 KM818684 KM818876 KM818935 – KM818787 KM818745 |
| Taxon name                  | Origin              | Voucher                  | Collection date | GenBank accession numbers | vouchr info | GenBank accession numbers |
|----------------------------|---------------------|--------------------------|-----------------|--------------------------|-------------|--------------------------|
| *Goniothalamus laoticus*   | Cultivated          | Saunders, R.M.K., Su, Y.C.F. & Chalermglin, P. 04/9 (HKU) | 25 Jul 2004     | KM818537 KM818593 KM818666 KM818699 KM818881 KM818959 KM818993 KM818808 KM818760 | (Finet & Gagnep.) Bân | – KM818594 – KM818724 KM818902 KM818947 – KM818782 – |
| *Goniothalamus loerzingii* | Sumatra             | Kostermans, A.J.G.H. 22015 (L) | 13 Dec 1965     | KM818538 KM818595 KM818643 KM818695 KM818873 KM818928 KM818995 KM818792 KM818776 | R. M.K. Saunders   |
| *Goniothalamus macranthus* | Andamans            | King’s collector 347 (L)  | 1884            | – KM818594 – KM818601 – KM818735 – KM818969 – KM818790 – | Boerl.               |
| *Goniothalamus macrophyllum* | Cultivated          | Saunders, R.M.K., Su, Y.C.F. & Chalermglin, P. 04/16 (HKU) | 25 Jul 2004     | KM818539 KM818596 KM818665 KM818688 KM818897 KM818940 KM819002 KM818843 KM818766 | (Blume) Hook.f. & Thoms. |
| *Goniothalamus maevongensis* | Thailand            | Saunders, R.M.K., Nakkuntod, M. & Chalermglin, P. 04/35 (HKU) | 29 Jul 2004     | KM818540 KM818597 KM818659 KM818725 KM818888 KM818962 KM818977 KM818838 KM818746 | R.M.K. Saunders & Chalermglin |
| *Goniothalamus majestatis* | Sulawesi            | McDonald, J.A. 3896 (L)  | 26 July 1993    | KM818541 KM818598 – KM818713 KM818903 KM818958 – KM818788 KM818756 | Kessler             |
| *Goniothalamus malayanus*  | Cultivated          | Saunders, R.M.K., Su, Y.C.F. & Chalermglin, P. 04/24 (HKU) | 25 Jul 2004     | KM818542 KM818599 KM818650 KM818718 KM818891 KM818914 KM819006 KM818835 KM818743 | Hoek.f. & Thom.     |
| *Goniothalamus megalocalyx* | Borneo              | Tang, C.C. et al. TCC117 (HKU) | 11 Nov 2011    | KM818543 KM818600 KM818645 KM818726 KM818885 KM818960 KM819007 KM818822 KM818763 | I.M. Turner & R.M.K. Saunders |
| *Goniothalamus monospermus* | Fiji                | Smith, A.C. 5111 (L)     | 7 Jul-18 Sep 1947 | – KM818601 – KM818735 – KM818969 – KM818790 – | (A.Gray) R. M.K. Saunders |
| *Goniothalamus montanus*   | Peninsular Malaysia | Soepadmo, E. & Suhaimi, M. 43 (L) | 11 Nov 1989     | KM818544 KM818602 KM818674 KM818710 KM818856 KM818932 – KM818813 – | J. Sinclair          |
| *Goniothalamus obtusatus*  | New Caledonia       | Veillon, J.M. 7591 (NOU) | 25 Nov 1992     | KM818545 KM818603 KM818660 KM818687 KM818883 KM818911 KM818981 KM818815 – | (Baill.) R.M.K. Saunders |
| *Goniothalamus palawanensis* | Philippines | Tang, C.C. TCC12 (HKU) | 31 May 2012     | – KM818604 – KM818716 KM818855 KM818925 KM818976 KM818793 – | C.C. Tang & R.M.K. Saunders |
| *Goniothalamus parallelivenius* | Borneo             | Tang, C.C. et al. TCC50 (HKU) | 16 May 2011    | KM818546 KM818605 KM818635 KM818683 KM818880 KM818941 – KM818801 KM818765 | Ridl.               |
|                           | Cultivated          | Saunders, R.M.K., Su, Y.C.F. & Chalermglin, P. 04/8 (HKU) | 25 Jul 2004     | KM818547 KM818606 KM818664 KM818723 KM818877 KM818936 – KM818795 KM818749 | Cultivated Saunders, R.M.K., Su, Y.C.F. & Chalermglin, P. 04/8 (HKU) |
| Species                                           | Location          | Authors & Collections | Date       | Accession Numbers |
|--------------------------------------------------|-------------------|-----------------------|------------|-------------------|
| Goniothalamus repevensis                        | Sri Lanka         | Pierre ex Finet & Gagnep. | 16 Jul 2000 | KM818548 KM818607 – KM818913 – KM818786 KM818742 |
| Goniothalamus reticulatus                       | Peninsular Malaysia | Thwaites | 16 Feb 1991 | KM818549 KM818608 – KM818739 KM818860 KM818951 KM818985 KM818830 – |
| Goniothalamus rotundisepalus                    | Thailand          | M.R. Hend.             | 2 Mar 1974  | KM818550 KM818609 KM818649 KM818693 KM818857 KM818908 – KM818794 KM818759 |
| Goniothalamus rufus                              | Borneo            | Keßler, P.J.A. et al. 2482 (L) | 10 Mar 1999 | KM818551 KM818610 – KM818727 KM818848 KM818943 – KM818819 – |
| Goniothalamus sawtehii                          | Cultivated        | E.C. Fisch.            | 21 Sep 1993 s.a. | KM818553 KM818612 KM818670 KM818712 KM818845 KM818929 KM818988 KM818781 KM818744 |
| Goniothalamus sesquipedalis                     | Peninsular Malaysia | India                 | 19 Jul 2005 s.a. | KM818554 KM818613 KM818667 KM818719 KM818904 KM818907 KM818984 KM818825 KM818740 |
| Goniothalamus sp. nov. tcc10                    | Philippines       | Tang, C.C. TCC10 (HKU) | 31 May 2012 | – KM818614 KM818675 KM818715 KM818864 KM818944 KM818980 KM818821 – |
| Goniothalamus suaveolens 1 Becc.                | Borneo            | Atkins, S. 466 (L)     | 14 Jul 1993 | – KM818615 – KM818681 KM818884 KM818968 KM818999 KM818818 – |
| Goniothalamus suaveolens 2 Becc.                |                  |                       |            | KM818556 KM818617 KM818662 KM818700 KM818866 KM818917 KM818990 KM818832 KM818761 |
| Goniothalamus tamirensis                        | Cultivated        | Saunders, R.M.K., Su, Y.C.F. & 25 Jul Chalerrmin, P. 04/23 (HKU) 2004 | 31 May 2012 | KM818557 KM818618 KM818641 KM818686 KM818899 KM818920 – KM818823 KM818771 |
| Goniothalamus tapioides                         | Borneo            | Tang, C.C. et al. TCC51 (HKU) | 16 May 2011 | KM818558 KM818619 KM818633 KM818690 KM818854 KM818961 – KM818841 KM818750 |
| Goniothalamus tavoyensis                        | Cultivated        | Saunders, R.M.K., Su, Y.C.F. & 25 Jul Chalerrmin, P. 04/11 (HKU) 2004 | 16 Aug 1974 s.a. | KM818559 KM818620 KM818669 KM818694 KM818889 KM818909 KM818974 KM818842 KM818741 |
| Goniothalamus thomsoni                          | Sri Lanka         | Kostermans, A.J.G.H. 25485 (L) | 31 Aug 1974 | – KM818621 – KM818733 KM818875 KM818971 – KM818834 – |
| Goniothalamus thwaitesii                        | India             | Beddome, R.H. 299 (PDA) |           | KM818560 KM818622 KM818653 KM818703 KM818849 KM818922 – – KM818772 |
| Goniothalamus tomentosus                        | Peninsular Malaysia | T.C. FRI 3851 (L)    | 21 May 1967 | KM818561 KM818623 – KM818738 KM818846 KM818964 – KM818783 – |
| Goniothalamus tortilipetalus                    | Thailand          | Nakkundot, S. 58 (HKU) | 25 Nov 2005 | – KM818624 KM818642 KM818708 KM818905 KM818948 – KM818828 – |
| Taxon name                  | Origin          | Voucher                          | Collection date | GenBank accession numbers                     |
|---------------------------|-----------------|----------------------------------|-----------------|-----------------------------------------------|
| Goniothalamus touranensis | Indochina       | Clemens, J. & Clemens, M.S. 4187 (NY) | May-Jul 1927    | KM818625 – KM818731 KM818870 KM818965 – KM818804 – |
| Goniothalamus undulatus   | Cultivated      | Saunders, R.M.K., Su, Y.C.F. & Chalermgilg, P. 04/25 (HKU) | 25 Jul 2004 – 24 May 1967 | KM818562 KM818626 KM818652 KM818679 KM818896 KM818921 KM818978 KM818820 KM818777 |
| Goniothalamus uvaroides   | Peninsular Malaysia | Kochummen, K.M. FR 2344 (L) | 24 May 1967 | – KM818627 KM818658 KM818685 KM818852 KM818966 KM818975 KM818827 – |
| Goniothalamus velutinus    | Borneo          | Tang, C.C. TCC 46 (HKU) | 16 May 2011 | KM818563 KM818628 KM818644 KM818705 KM818900 KM818953 KM818989 KM818812 KM818764 |
| Goniothalamus woodii      | Borneo          | Shea, G. SAN 75202 (L) | 18 Mar 1972 | KM818564 KM818629 KM818668 KM818720 KM818862 KM818972 – KM818824 KM818778 |
| Goniothalamus wrayi       | Peninsular Malaysia | Suppiah, T. FRI 28345 (L) | 18 Jan 1979 | KM818565 KM818630 KM818671 KM818721 KM818859 KM818957 – KM818803 KM818779 |
| Goniothalamus wynaadensis | India           | Kramer, K.U. 6248 (L) | 17 Dec 1977 | KM818566 KM818631 – KM818697 KM818863 KM818970 KM818991 KM818816 KM818768 |
| Neostenanthera myristicifolia (Oliv.) Exell | Gabon | Wieringa, J. et al. 3566 (WAG) | – | EF179271 AC743860 EF179306 AC743448 AC743467 EF179348 – AC743448 – |
Boerlage (1899) Sections  
- sect. Eu-Goniothalamus  
- sect. Beccariodendron  

Bân (1974)  
- subgen. Truncatella  
  - sect. Infundibilistigma  
  - subsect. Polyspermi  
  - sect. Infundibiliformes  
  - sect. Truncatella  
  - subsect. Multiseminales  
  - subsect. Pauciseminales  
- subgen. Goniothalamus  
- sect. Goniothalamus  
  - subsect. Goniothalamomyctus  
  - subsect. Pleiospermi  
  - sect. Longistigma  
  - subsect. Longistigma

Fig. 1. Bayesian 50% majority-rule consensus tree of Goniothalamus species, generated from 9-partitioned dataset with all outgroups removed. Previous infrageneric classifications [2,3], published prior to the availability of molecular phylogenetic methods, are superimposed. Boerlage [2] recognized two sections, Eu-Goniothalamus (equivalent to the autonymic sect. Goniothalamus) and Beccariodendron, based on differences in ovule number per carpel. Bân [3] subsequently recognized two subgenera, Goniothalamus and Truncatella, based on differences in staminal connective shape; each of these subgenera were further divided into sections based on stigma and pseudostyle shape, and subsections based on the number of ovules per carpel. Branch length is proportional to the substitutions rate. Scale bar: 0.1 substitutions per site.
### 1.4. Taxon-character data matrix

Morphological characters including vegetative, floral, fruit and seed characters were assessed from living and herbarium material (BRUN, HKU, K, L, NY and US herbaria). A total of 14 vegetative, floral, fruit and seed characters were assessed from living and herbarium material, supplemented by species descriptions [31–53]. A summary of 14 characters of 66 *Goniothalamus* species and seven species in the tribe Annoneae are shown in Supplementary Table 1.

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### Appendix A. Supplementary Information

Supplementary data associated with this article can be found in the online version at http://dx.doi.org/10.1016/j.dib.2015.06.021.

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