Additions to the Genus *Arthrinium* (Apiosporaceae) From Bamboos in China

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Arthrinium has a widespread distribution occurring in various substrates (e.g., air, soil debris, plants, lichens, marine algae and even human tissues). It is characterized by the basauxic conidiogenesis in the asexual morph, with apiospores in the sexual morph. In this study, seventeen isolates of *Arthrinium* were collected in China. Based on their morphology and phylogenetic characterization, four new species (*A. biseriale*, *A. cyclobalanopsidis*, *A. gelatinosum*, and *A. septatum*) are described and seven known species (*A. arundinis*, *A. garethjonesii*, *A. guizhouense*, *A. hydei*, *A. neosubglobosa*, *A. phyllostachium* and *A. psedoparenchymaticum*) are identified, of which the sexual morph of three species (*A. guizhouense*, *A. phyllostachium* and *A. psedoparenchymaticum*) and asexual morph of *A. garethjonesii* are reported for the first time. The detailed descriptions, illustrations and comparisons with related taxa of these new collections are provided. Phylogenetic analyses of combined ITS, LSU, TUB2, and TEF sequence data support their placements in the genus *Arthrinium* and justify the new species establishments and identifications of known species.

Keywords: 4 new taxa, asexual-sexual morphs, multi-genes, phylogeny, taxonomy

INTRODUCTION

The genus *Arthrinium* Kunze belongs to the family Apiosporaceae, which was introduced by Hyde et al. (1998) and typified by the genus *Apiospora* (Ellis, 1971; Seifert et al., 2011; Hyde et al., 2020). *Arthrinium* is the largest genus within Apiosporaceae and it has a widespread distribution on variety of hosts, 77 species have been recorded by Species Fungrom (March, 2021). Classification of *Arthrinium* was primarily based on conidial shape, conidiophores, sterile cells, and the presence of setae. Some morphologically different taxa (genera) grouped with *Arthrinium* when use the molecular data (Crous and Groenewald, 2013). Thus, those characteristics could be not fully inferred about the phylogenetic relationships for *Arthrinium* (Crous and Groenewald, 2013; Wang et al., 2018; Pintos et al., 2019). Except for being reported as saprobes (Agut and Calvo, 2004; Crous and Groenewald, 2013; Dai et al., 2016, 2017; Jiang et al., 2018; Wang et al., 2018; Jiang et al., 2019, 2020; Luo et al., 2019; Pintos et al., 2019; Yan et al., 2019; Mapook et al., 2020; Senanayake et al., 2020a; Tang et al., 2020), the species of *Arthrinium* also includes phytopathogenic fungi, for instance, *A. arundinis* causing brown culm...
streak of *Phyllostachys praecox*, *A. phaeospermum* causing culm rot on *Phyllostachys viridis* and cutaneous infections of humans (Rai, 1989; Zhao et al., 1990; Martínez-Cano et al., 1992; Mavragani et al., 2007; Crous and Groenewald, 2013; Li et al., 2016; Wang et al., 2018). In this study, seventeen *Arthrinium*-like were collected in Guizhou and Guangdong province, China and can be recognized as eleven *Arthrinium* species based on morphological characters and phylogeny inferred from the multi-gene sequences data (ITS, LSU, TUB2, and TEF) analyses, which four new species (*A. biseriale*, *A. cyclobalanopsidis*, *A. gelatinosum*, and *A. septatum*) and seven known species (*A. arundinis*, *A. garethjonesii*, *A. guizhouense*, *A. hydei*, *A. neosubglobosa*, *A. phyllostachium* and *A. psedoparenchymaticum*) are introduced and identified, respectively. The aim of this study is to describe these new taxa with detailed descriptions and illustrations, and also provide their phylogenetic relationships within *Arthrinium* based on multi-gene analysis.

**MATERIALS AND METHODS**

**Sample Collection, Morphological Studies and Isolation**

Samples were collected from Guizhou and Guangdong Province in China. Fungal fruiting bodies were examined by using stereomicroscope (Motic SMZ 168). Free hand sections of fungal structures were mounted in water for microscopic studies and photomicrography. Images were taken by using a Nikon ECLIPSE Ni compound microscope fitted with a Canon EOS 70D digital camera. All measurements were taken by using Tarosoft Image Frame Work software (IFW) (Liu et al., 2010), and photo plates were processed with Adobe Photoshop CS6 software (Adobe Systems, United States).

The single spore isolation followed the method described in Senanayake et al. (2020b). Parts of morphological descriptions were based on sporulated cultures on WA (Water Agar) at room temperature (ca. 25°C). Type specimens were deposited in the herbarium of Cryptogams Kunming Institute of Botany Academia Sinica (HKAS), Kunming, China and Guizhou Academy of Agriculture sciences Herbarium (GZAAS). Pure cultures were deposited in China General Microbiological Culture Collection Center (CGMCC) and Guizhou Culture Collection (GZCC). Faces of Fungi¹ number is obtained as described in the paper by Jayasiri et al. (2015), and the new taxa are registered in Index Fungorum (2021).

**DNA Extraction, PCR Amplification and Sequencing**

Fungal mycelia were scraped from the pure culture which were growing on PDA (Potato Dextrose Agar) for one week at 25°C in dark. DNA was extracted by using Ezup Column Fungi Genomic DNA Purification Kit (Sangon Biotech, China) from fresh fungal mycelia, but some were extracted directly from fruiting bodies by using Forensic DNA Kit (Omega Bio-Tek, China). Four gene regions, large subunit rDNA (LSU), internal transcribed spacer (ITS), beta-tubulin (TUB2) and the translation elongation factor 1-alpha (TEF) gene were amplified by the primer pairs LR0R and LR5 (Vilgalys and Hester, 1990), ITS5 and ITS4, T1 (O’Donnell and Cigelnik, 1997) and Bt2b (Glass and Donaldson, 1995), EF1-728F and EF-2 (O’Donnell et al., 1998; Carbone and Kohn, 1999), respectively. Polymerase chain reaction (PCR) was carried out in 25 µL reaction volume containing 12.5 µL 2 × PCR Master Mix (Sangon Biotech, China), 9.5 µL ddH₂O, 1 µL of each primer and 1 µL DNA template. The annealing temperatures were adjusted to 56°C for ITS, LSU and TUB2, and 55°C for TEF. PCR products were sent to sequence at Sangon Biotech Co., Ltd., China. The PCR products were examined using 1.2% agarose electrophoresis gel stained with ethidium bromide. PCR products were purified and sequenced by Sangon Biotech (Shanghai) Co., Ltd., China. New generated nucleotide sequences were submitted in GenBank (Table 1).

**Phylogenetic Analyses**

Phylogenetic analyses were performed based on ITS, LSU, TUB2 and TEF sequence data. The related strains of Apiosporaceae (Table 1) used for analysis were referred to BLAST² results and relevant publications (Wang et al., 2018; Jiang et al., 2019, 2020; Pintos et al., 2019; Tang et al., 2020). Sequences were obtained from GenBank and aligned using MAFFT v. 7 (Katoh and Standley, 2013). Manual adjustment was also performed when it is necessary by using BioEdit v. 7.0 (Hall, 1999). The alignment of sequences data used in analyses is deposited in TreeBASE under the accession number S27728. The analyses of maximum parsimony (MP), maximum likelihood (ML) and Bayesian inference (BI) were carried out as detailed in Dissanayake et al. (2020a) and programs used including PAUP v.4.0b 10 (Hillis and Bull, 1993; Swoford, 2002), raxmlGUI v.4.0b 10 (Hillis and Bull, 1993; Swofford, 2002), MrBayes v.3.1.2 (Rannala and Yang, 1996; Huelsenbeck and Ronquist, 2001; Zhaxybayeva and Gogarten, 2002; Nylander, 2004). Trees were visualized with FigTree v1.4.2 (Rambaut, 2012) and the layout was edited using Adobe Illustrator CS6.

**RESULTS**

**Phylogeny**

To determine the phylogenetic placement of the new collections in this study, the combined ITS, LSU, TUB2 and TEF data set comprised 119 taxa with *Seiridium phylicae* (CPC 19962 and CPC 19965) as the outgroup taxa. The concatenated alignment comprises 2,770 characters (ITS: 1–635; LSU: 636–1,454; TUB2: 1,455–2,300; TEF: 2,301–2,770) including gaps, of which 1,361 characters were constant, and 1,279 characters are parsimony informative and 130 are parsimony uninformative. Maximum

1http://www.facesoffungi.org/

2https://blast.ncbi.nlm.nih.gov/Blast.cgi
TABLE 1 | GenBank accession numbers of species included in the phylogenetic study.

| Species                  | Strain no. | LSU    | ITS Accession Numbers | TEF Accession Numbers | TUB2 Accession Numbers |
|--------------------------|------------|--------|------------------------|-----------------------|------------------------|
| Arthrinium acutiapicum   | KUMCC 20–0209 | MT946338 | MT946342               | MT947359             | MT947365               |
| A. acutiapicum           | KUMCC 20–0210 | MT946339 | MT946343               | MT947360             | MT947366               |
| A. aquaticum             | MLFU 18–1628 | MK83806 | MK828608               | N/A                  | N/A                    |
| A. arundinis             | CBS 106.12  | KF144927 | KF144883               | KF145015             | KF144973               |
| A. arundinis             | CBS 11416   | KF144928 | KF144884               | KF145016             | KF144974               |
| A. arundinis             | GZCC 20–0116 | MW478989 | MW481720               | MW522952             | MW522968               |
| A. aureum                | CBS 244.83  | KF144905 | AB220251               | KF145023             | KF144981               |
| A. balericum             | CBS 145129  | MK014836 | MK014869               | MK017946             | MK017975               |
| A. bambusae              | LC7107      | N/A     | KY494719               | KY705117             | KY705167               |
| A. bambusae              | LC7106      | KY494734 | KY494718               | KY806204             | KY705186               |
| A. bambusicola           | MFLUCC 20–0144 | MV173087 | MV173030               | MV183262             | N/A                    |
| A. biseriale             | GZCC 20–0099 | MW478885 | MW481708               | MW522938             | MW522955               |
| A. biseriale             | GZCC 20–0100 | MW478887 | MW481710               | MW522940             | MW522957               |
| A. camarilla-sinensis    | LC8181      | KY494837 | KY494761               | KY705157             | KY705229               |
| A. camarilla-sinensis    | LC5007      | KY494780 | KY494704               | KY705103             | KY705173               |
| A. caricaica             | CBS 145127  | MK014838 | MK014871               | MK017948             | MK017977               |
| A. chinense              | CFCSC3026   | N/A     | MK819291               | MK818545             | MK818547               |
| A. chinense              | CFCSC3027   | N/A     | MK819292               | MK818546             | MK818548               |
| A. chromolaenae          | MFLUCC 17–1505 | MT214346 | MT214342               | N/A                  | N/A                    |
| A. cyclobalanopsideis    | GZCC 3.20136 | MW478892 | MW481713               | MW522945             | MW522962               |
| A. cyclobalanopsideis    | GZCC 20–0103 | MW478893 | MW481714               | MW522946             | MW522963               |
| A. descalsii             | CBS 145130  | MK014837 | MK014870               | MK017947             | MK017976               |
| A. dichotomanthi         | LC8175      | KY494831 | KY494755               | KY705151             | KY705223               |
| A. dichotomanthi         | LC4950      | KY494773 | KY494697               | KY705096             | KY705167               |
| A. esporlense            | CBS 145136  | MK014845 | MK014878               | MK017954             | MK017983               |
| A. euphorbiae            | IMI 285688b | AB220335 | AB220241               | N/A                  | AB220288               |
| A. gayouense             | CFCC 52301  | N/A     | MH197124               | MH236793             | MH236789               |
| A. gayouense             | CFCC 52302  | N/A     | MH197125               | MH236794             | MH236790               |
| A. garethjonesii         | KUMCC16–0202 | KY356091 | KY356086               | N/A                  | N/A                    |
| A. garethjonesii         | GZCC 20–0115 | MW478994 | MW481715               | MW522947             | N/A                    |
| A. gelatinosum           | KHAS 11962  | MW478888 | MW481706               | MW522941             | MW522958               |
| A. gelatinosum           | GZAAS 20–0107 | MW478889 | MW481707               | MW522942             | MW522959               |
| A. guizhouense           | LS5318      | KY494784 | KY494708               | KY705107             | KY705177               |
| A. guizhouense           | LS5322      | KY494785 | KY494709               | KY705108             | KY705178               |
| A. guizhouense           | GZCC 20–0114 | MW478895 | MW481716               | MW522948             | MW522964               |
| A. gutiae                | CBS 135835  | KR149063 | KR011352               | KR011351             | KR011350               |
| A. hispanicum            | IMI 326877  | AB220336 | AB220242               | N/A                  | AB220289               |
| A. hydei                 | CBS 114990  | KF144936 | KF144890               | KF145024             | KF144982               |
| A. hydei                 | KUMCC 16–0204 | KY356092 | KY356087               | N/A                  | N/A                    |
| A. hydei                 | GZCC 20–0113 | MW478900 | MW481721               | MW522953             | N/A                    |
| A. hyphopodi             | KUMCC 16–0201 | KY356093 | KY356088               | N/A                  | N/A                    |
| A. hyphopodi             | MFLUCC15–0003 | N/A     | KR069110               | N/A                  | N/A                    |
| A. hysterinum            | CBS 145134  | MK014843 | MK014876               | MK017951             | MK017980               |
| A. hysterinum            | ICMP 6889   | MK014841 | MK014874               | MK017956             | MK017984               |
| A. ibericum              | CBS 145137  | MK014846 | MK014879               | MK017955             | MK017984               |
| A. italicum              | CBS 145138  | MK014847 | MK014880               | MK017956             | MK017985               |
| A. japonicum             | IFO 30500   | AB220356 | AB220262               | N/A                  | AB220309               |
| A. japonicum             | IFO 31098   | AB220358 | AB220264               | N/A                  | AB220311               |
| A. jatrophae             | MMI 00052   | N/A     | JQ246355               | N/A                  | N/A                    |
| A. jatrophae             | AMH–9557    | N/A     | JQ246355               | N/A                  | N/A                    |

(Continued)
| Species                  | Strain no. | LSU    | ITS    | TEF    | TUB2    |
|--------------------------|------------|--------|--------|--------|---------|
| *A. jiangxiense*         | LC4577     | KY494789 | KY494893 | KY705092 | KY705163 |
| *A. jiangxiense*         | LC4578     | KY494770 | KY494894 | KY705093 | KY705164 |
| *A. kogelbergense*       | CBS 113332 | KF144937 | KF144891 | KF145025 | KF144883 |
| *A. kogelbergense*       | CBS 113333 | KF144938 | KF144892 | KF145026 | KF144884 |
| *A. locuta-pollinis*     | LC11683    | N/A    | MF939695 | MF939616 | MF939622 |
| *A. longistromum*        | MFLUCC 11–0481 | KU863129 | KU840141 | N/A    | N/A     |
| *A. longistromum*        | MFLUCC 11–0479 | KU863130 | KU840142 | N/A    | N/A     |
| *A. malaysianum*         | CBS 102053 | KF144942 | KF144901 | KF145037 | KF144995 |
| *A. malaysianum*         | CBS 251.29 | KF144943 | KF144902 | KF145036 | KF144996 |
| *A. marii*               | CBS 145131 | MK014839 | MK014872 | N/A    | N/A     |
| *A. mediterranei*        | IMI 326875 | AB220337 | AB220243 | N/A    | AB220290 |
| *A. minus*               | CBS 145131 | MK014839 | MK014872 | MK017949 | MK017978 |
| *A. mycophoromorphum*    | DAOM 214595 | N/A    | KY494885 | N/A    | N/A     |
| *A. garethiopsis*        | KUMCC 18–0192 | MK014839 | MK014872 | N/A    | N/A     |
| *A. neosubglobosa*       | KUMCC 16–0203 | KY356095 | KY356090 | N/A    | N/A     |
| *A. neosubglobosa*       | JHB006     | KY356094 | KY356097 | N/A    | N/A     |
| *A. neosubglobosa*       | GZCC 20–0111 | MW478901 | MW481705 | MW522954 | MW522969 |
| *A. neosubglobosa*       | GZCC 20–0112 | MW478902 | MW481705 | MW522954 | MW522969 |
| *A. neosubglobosa*       | GZCC 20–0117 | MW478903 | MW481705 | MW522954 | MW522969 |
| *A. phyllostachium*      | GZCC 20–0111 | MW478901 | MW481716 | MW522949 | MW522965 |
| *A. phyllostachium*      | GZCC 20–0112 | MW478902 | MW481716 | MW522950 | MW522966 |
| *A. piptatheri*          | CBS 145149 | MK014839 | MK014872 | MK017949 | MK017978 |
| *A. pseudoparenchymaticum* | LC7234 | KY494819 | KY494743 | KY705129 | KY705211 |
| *A. pseudoparenchymaticum* | LC8173 | KY494829 | KY494753 | KY705149 | KY705221 |
| *A. pseudoparenchymaticum* | GZCC 20–0117 | MW478909 | MW481719 | MW522951 | MW522967 |
| *A. pseudorasikravindrae* | KUMCC 20–0208 | N/A | MT946344 | MT947361 | MT947367 |
| *A. pseudorasikravindrae* | KUMCC 20–0211 | N/A | MT946345 | MT947522 | MT947568 |
| *A. pseudosinense*       | CPC 21548  | KF144957 | KF144910 | KF145044 | N/A     |
| *A. pseudosinense*       | CBS 135459 | N/A    | KF144910 | KF145044 | N/A     |
| *A. pseudosinense*       | CBS 102052 | KF144958 | KF144911 | KF145045 | KF145002 |
| *A. pterospermum*        | CBS 123185 | KF144959 | KF144912 | N/A    | KF145003 |
| *A. pterospermum*        | CPC 20193  | KF144960 | KF144913 | KF145046 | KF145004 |
| *A. puccinioides*        | CBS 145150 | MK014861 | MK014894 | MK017970 | MK017998 |
| *A. puccinioides*        | CBS 549.86 | AB220347 | AB220253 | N/A    | AB220300 |
| *A. qinglingense*        | OFCC 52030 | N/A    | MH197120 | MH236795 | MH236791 |
| *A. qinglingense*        | OFCC 52031 | N/A    | MH197121 | MH236796 | MH236792 |
| *A. raskravindrae*       | CBS 145152 | MK014863 | MK014896 | MK017971 | MK017999 |
| *A. raskravindrae*       | LC7115     | KY494797 | KY494721 | KY705118 | KY705189 |
| *A. raskravindrae*       | NFCC 2144  | N/A    | JF326454 | N/A    | N/A     |
| *A. sacchari*            | CBS 212.30 | KF144963 | KF144917 | KF145048 | KF145006 |
| *A. sacchari*            | CBS 301.49 | KF144962 | KF144916 | KF145047 | KF145005 |
| *A. saccharicola*        | CBS 191.73 | KF144966 | KF144920 | KF145051 | KF145009 |
| *A. saccharicola*        | CBS 463.83 | KF144968 | KF144921 | KF145053 | KF145011 |
| *A. septatum*            | CGMCC 3.20134 | MW478890 | MW481711 | MW522943 | MW522960 |
| *A. septatum*            | GZCC 20–0109 | MW478891 | MW481712 | MW522944 | MW522961 |

(Continued)
TABLE 1 | Continued

| Species | Strain no. | GenBank Accession Numbers |
|---------|------------|---------------------------|
| A. serenense | IMI 326889 | AB220344 AB220250 N/A AB220297 |
| A. setosum | KUMCC 19–0027 | MN528011 MN528012 MN527357 N/A |
| A. sporophleum | CBS 145154 | MK014865 MK014898 MK017973 MK018001 |
| A. subglobosum | MFLUCC 11–0397 | KR069113 KR069112 N/A N/A |
| A. subrosatum | LC7292 | KJ494752 KY051418 KY052200 |
| A. thailandicum | MFLUCC 15–0199 | KJ840114 N/A N/A |
| A. thailandicum | MFLUCC 15–0202 | KJ863133 KJ840145 N/A N/A |
| A. trachycarpum | CFCC 53038 | N/A MK30199 MK30349 N/A |
| A. trachycarpum | CFCC 53039 | N/A MK30199 MK30349 N/A |
| A. urticae | IMI 326344 | AB220339 AB220245 N/A N/A |
| A. vietnamensis | IMI 326344 | KX986111 KX986096 N/A KY019466 |
| A. xenocordella | CBS478.86 | KF144970 KF144925 KF145055 KF145013 |
| A. xieirsanum | MFLUCC 15–0002 | KX986111 KU940146 N/A N/A |
| A. xieirsanum | MFLUCC 15–0002 | KU863133 KU940145 N/A N/A |
| Swiridium phylicae | CPC 19962 | N/A MK301098 MK30339 N/A |
| Swiridium phylicae | CPC 19965 | N/A MK301098 MK30339 N/A |

The newly generated sequence is shown in bold. AMH: Ajrekar Mycological herbarium, Pune, Maharashtra, India; CBS: Westerdijk Fungal Biodiversity Institute, Utrecht, Netherlands; CFCC: China Forestry Culture Collection Center, Beijing, China; GOMCC: China General Microbiological Culture Collection Center, Beijing, China; CPC: Culture collection of Pedro Crous, housed at the Westerdijk Fungal Biodiversity Institute; DAOM: Canadian Collection of Fungal Cultures, Ottawa, Canada; DQ: D.Q. Dai; GZAAS: Guizhou Academy of Agricultural Sciences herbarium, China; GZCC: Guizhou Culture Collection, China; HKAS: Herbarium of Cryptogams Kunming Institute of Botany Academia Sinica; ICMP: International Collection of Microorganisms from Plants, New Zealand; IFO: Institute for Fermentation, Osaka, Japan; IMI: Culture collection of CABI Europe UK Centre, Egham, UK; JHB: H.B. Jiang; KUMCC: Culture collection of Kunming Institute of Botany, Yunnan, China; LC: Working collection of Lei Cai, Botany Academia Sinica; IMI: Culture collection of the Smithsonian Institution, Washington, DC; NFCCI: National Fungal Culture Collection of India; NRT: military herbarium of the USDA, USDA Forest Service; NZ: National Herbarium of New Zealand; RMNH: Richard M. Van Nr. 1909; NAS: National Agricultural Sciences herbarium, China; IA: Agricultural Herbarium, IL; GHA: Guizhou Academy of Agricultural Sciences herbarium, China; GZ: Guizhou, China; HKAS: Herbarium of Cryptogams, Kunming Institute, Yunnan, China; IFO: Institute for Fermentation, Osaka, Japan; IMI: Centraalbureau voor Schimmelcultures, Utrecht, the Netherlands; KUBH: K. L. Burt, herbarium, University of British Columbia, Canada; KU: King Herbarium, University of Copenhagen, Denmark; LACM: Los Angeles County Museum of Natural History; LACIS: LSU: Louisiana State University; and the rest in the footnotes.

likelyhood, maximum parsimony and Bayesian analyses were performed, respectively, and presented consistent topologies. The best scoring RAxML tree (Figure 1) is obtained with a final likelihood value of -27544.434044. Estimated base frequencies were as follows: A = 0.236829, C = 0.253015, G = 0.251523, T = 0.258634; substitution rates AC = 1.154254, AG = 2.738844, AT = 1.073582, CG = 0.896658, CT = 4.134885, GT = 1.000000; and the gamma distribution shape parameter alpha is equal to 0.332641 and the Tree-Length equal to 3.795226.

Phylogenetic analyses showed that our newly collected seventeen taxa clustered into eleven clades and can be recognized as seven known species (Arthrinium arundinis, A. gelatinosum, A. septatum, A. garethjonesii, A. phyllostachium, A. guizhouense) and four new species (A. biseriale, A. cyclobalanopsidis, A. psedoparenchymaticum, A. neosubglobosa) (Figure 1).

Taxonomy

**Arthrinium biseriale** Y. Feng and Z.Y. Liu, sp. nov.

Figure 2

Index Fungorum number: IF558136

Facesoffungi number: FoF 09569

Etymology: The epithet refers to the ascospores are arranged in two rows in the ascus.

Holotype: HKAS 111961

Saprobic on dead bamboo culms, forming black, lenticular spots on the host surface, with stromata breaking through raised cracks with black center, and merge with each other with age, forming an erumpent black mass visible at the naked eye. **Sexual morph:** Stromata scattered to gregarious, immersed to erumpent, later becoming superficial, dark brown to black, fusiform, forming a slit-like opening at the apex, multi-loculate, membranous, with a periphysate ostiole. Ascomata 122–153 µm high, 138–207 µm diam, arranged in rows, dark brown to black. Peridium 11–19 µm wide, composed of several layers of dark brown to hyaline cells of textura angularis. Hamathecium 3–4 µm wide, comprising dense, hyaline, septa paraphyses. Asci 84–116 µm × 18–25 µm (x = 97 µm × 21 µm, n = 20), 8-spored, unitunicate, clavate, apically rounded, with an indistinct pedicel. Ascospores 22–28 µm × 7–11 µm (x = 25 µm × 9 µm, n = 30), biseriate, fusiform, curved at the bottom, obtuse at both ends, slightly wider in the middle, hyaline, 1-septate, constricted at the septum, mostly curved at the lower cell, rarely straight, with a large upper cell and a small lower cell, smoothwalled. The lower cell has 1–3 giant guttules in the middle surrounded by multiple small guttules with a shallow 4–7 µm thick gelatinous sheath in the early. Growing to a later stage, the guttules filled the entire spore, and the gelatinous sheath dissolves easily. **Asexual morph:** On WA, Hyphae 2.5–6.0 µm diam, hyaline, branched, septate, some curled in a ring structure. Conidiophores 12.0–44.0 µm × 2.5–5.0 µm (x = 20.0 µm × 3.5 µm, n = 20), straight or flexuous, smooth, thin-walled, unbranched, hyaline to pale brown, cylindrical, cyathiform, having transverse septa, often reduced to conidiogenous cells. Conidiogenous cells 5.0–22.0 µm × 2.5–5.0 µm (x = 10.0 µm × 3.5 µm, n = 20), integrated, hyaline to pale brown, doliiform to ampulliform, or lageniform.
Conidia 7–9 μm long (n = 30), brown, smooth in surface view, and 7–11 μm long (n = 30), lenticular, with a paler equatorial slit in side view, globose to ellipsoid with many guttules.

**Culture characters**
Ascospores germinated on WA within 24 h and germ tubes produced from middle and lower end. Colonies fast...
FIGURE 1 | RAxML tree of representatives based on a combined dataset of ITS, LSU, TUB2 and TEF sequences. Bootstrap support values for ML, MP (≥75%) and Bayesian (≥0.95) are given at the nodes (ML/MP/BI). Branches with ML, MP and BI equal 100, 100 and 1 are in bold. The tree is rooted with Seiridium phylicae (CPC 19962 and CPC 19965). New strains are shown in red.
grown on PDA at 25°C, reached 7 cm in 7 days at 25°C. Colonies evenly tiled, with a large number of aerial hyphae, white, velvety, thin, gray-white on the reverse side and dirty white in the center.

**Materials examined**

China, Guizhou Province, Chishui City, Zhuhai National Forest Park, on dead culms of bamboo, 10 July 2019, Yao Feng, CS19-17 (HKAS 111961, holotype; GZAAS 20–0102, isotype), ex-type living cultures, CGMCC 3.20135 = GZCC 20–0101. *Ibid.*, on dead base of the bamboo stem, 10 July 2019, Yao Feng, CS 19-25 (GZAAS 20–0101), living culture, GZCC 20–0100. *Ibid.*, on dead branch of bamboo, 11 July 2019, Ya-Ya Chen, CS 013 (GZAAS 20–0100), living culture, GZCC 20–099.

**Notes**

Three strains representing *Arthrinium biseriale* clustered in a well-supported clade which are closely related to *A. gelatinosum*, but phylogenetically distinct and can be recognized as two different species (99% sequence similarity in ITS; 99% in TEF; 98% in TUB2). Morphologically, *Arthrinium biseriale* has smaller stromata (122–153 µm × 138–207 µm vs. 144–199
μm × 184–214 μm) and the spores of A. biseriale are more curved than those of A. gelatinosum.

**Arthrinium gelatinosum** Y. Feng and Z.Y. Liu, sp. nov.

**Figure 3**

Index Fungorum number: IF558137

Facesoffungi number: FoF 09570

Etymology: The epithet refers to the ascospore surrounded by gelatinous sheath.

Holotype: HKAS 111962

*Saprobic* on dead bamboo culms, forming black, lenticular spots on the host surface, with stromata breaking through raised cracks with black center. **Sexual morph:** *Stromata* solitary to gregarious, immersed to erumpent, fusiform, with long axis broken at the top by one cracks. *Ascomata* 144–199 μm high μm × 184–214 μm wide, uniseriate or irregularly arranged beneath stromata, pseudothecial, black, globose to subglobose with a flattened base. *Peridium* composed of 5 or 6 layers of
brown cells arranged in *textura angularis*, with a conspicuous perforate ostiole. *Hamathecium paraphyses* hyphae-like. *Asci* 85–121 μm × 15–24 μm (x = 100 μm × 17 μm, n = 20), 8-spored, unitunicate, clavate, apically rounded, broadly cylindrical, with an indistinct pedicel. *Ascospores* (27–) 28–31 (–32) μm × 6–8 μm (x = 30 μm × 7 μm, n = 30), apiosporic, clavate to fusiform with narrowly rounded ends, composed of a large guttate and small guttate, hyaline, smooth-walled, surrounded by a gelatinous sheath. Growing to a later stage, the guttate filled the entire spore, and the gelatinous sheath dissolves easily. 

**Asexual morph:** undetermined.

**Materials examined**

*China*, Guizhou Province, Chishui City, Zhuhai National Forest Park, on dead culms of bamboo, 10 July 2019, Yao Feng, CS19–29 (GZAAS 20–0107, CS19–32 (HKAS 111962, holotype; GZAAS 20–0108, isotype). *Ibid.*, Chishui National Scenic Area, on dead branch of bamboo, 10 July 2019, Yao Feng, CS 19–29 (GZAAS 20–0107).

**Notes**

Two taxa representing *Arthrinium gelatinosum* cluster in a well-supported lineage (ML/MP/BI = 93/98/1, Figure 1), which is a sister to *A. biseriale*, and they are phylogenetically distinct species.

**Arthrinium septatum** Y. Feng and Jian K. Liu, sp. nov.

*Index Fungorum number:* IF558138

*Facesoffungi number:* FoF 09571

*Etymology:* The epithet refers to the septate conidiophore.

*Holotype:* HKAS 111960

*Saprobic* on dead bamboo culms. **Sexual morph:** *Stromata* scattered to gregarious, immersed to erumpent, initially breaks through a black spot on the host, later visible as black, raised, lenticular or dome-shaped, and will grow into a linear shape at the later stage of growth. Ostiolate, with the long axis broken at the top revealing the ostioles of pseudothecia. *Ascomata* 88–195 μm high × 160–185 μm wide (x = 140 μm × 173 μm, n = 10), arranged in rows, brown to dark brown, subglobose with a flattened base. *Peridium* with several layers of cells arranged in *textura angularis*, with a conspicuous ostiole 50–90 μm in diameter, periphysate. *Hamathecium paraphyses* hyphae-like, septate, hyaline. *Asci* 75–104 μm × 17–26 μm (x = 91 μm × 20 μm, n = 20), 8-spored, clavate, cylindrical, apically rounded, with distinct pedicel. *Ascospores* (24–) 25–30 (–32) μm × (6–) 8–10 (–11) μm (x = 29 μm × 9 μm, n = 30), biseriate, broad fusiform to cylindrical, with a large upper cell and a small lower cell, hyaline, 1-septate, constricted at septum, slightly curved, smooth-walled, with many guttules, with a large guttule at the center of large upper cell, with a distinct gelatinous sheath. **Asexual morph:** On PDA, *Hyphae* 2–4 μm in diameter, hyaline, branched, septate. **Conidiophores** 12.0–63.0 × 2–5 (x = 313 μm × 3 μm, n = 20), straight or flexuous, smooth, thin-walled, septate, hyaline to light brown, cylindrical, sometimes reduced to conidiogenous cells. **Conidiogenous cells** 4.0–18.0 × 1.5–4.0 (x = 10.0 μm × 2.5 μm, n = 20), solitary on hyphae, integrated, branched, ampulliform, cylindrical, hyaline to brown. **Conidia** 8–11 (–13) μm long (n = 30), brown, smooth, guttulate, globose to ellipsoid in surface view. and (8–) 9–13 (–14) μm long (n = 30), lenticular with a paler equatorial slit in side view. *Sterile cells* (13–) 14–21 (–27) μm × 5–7 (–9) μm elongated, mixed among conidia.

**Culture characteristics**

Ascospores germinated on WA within 24 h. Colonies on PDA reached 8 cm in 7 days at 25 °C, flat, aerial mycelium white. The hyphae in the center are cottony, dense, and there is a thin circle of hyphae at the edge. Reverse grayish white with a dirty white patch.

**Materials examined**

*China*, Guizhou Province, Chishui City, Zhuhai National Forest Park, on dead culms of bamboo, 10 July 2019, Yao Feng, CS19–8 (HKAS 111960, holotype; GZAAS 20–0109, isotype), ex-type living culture CGMCC 3.20134 = GZCC20–0108. *Ibid.*, on dead branch of bamboo, 11 July 2019, Ya-Ya Chen, CS 025 (GZAAS 20–0111), living culture GZCC 20–0109.

**Notes**

Two isolates, representing *Arthrinium septatum*, grouped in a well-supported clade and appear to be distinct from other *Arthrinium* species phylogenetically (Figure 1). *Arthrinium septatum* resembles to *A. biseriale* in having biseriate, broad fusiform to cylindrical ascospores and cylindrical, clavate asci. However, *Arthrinium septatum* differs from *A. biseriale* by having smaller stromata (160–185 μm diam vs. 138–207 μm diam) and asci (75–104 × 17–26 μm vs. 84–116 μm × 18–25 μm).

**Arthrinium cyclobalanopsidis** Y. Feng and Jian K. Liu, sp. nov. Figure 4

*Index Fungorum number:* IF558139

*Facesoffungi number:* FoF 09572

*Etymology:* The epithet “cyclobalanopsidis” refers to the host plant, *Cyclobalanopsidis glauca* (Thunb.) Oerst.

*Holotype:* HKAS 111963

*Saprobic* on *Cyclobalanopsidis glauca* (Thunb.). **Sexual morph:** Undetermined. **Asexual morph:** On PDA, *Hyphae* 2.5–5.5 μm in diameter, hyaline, septate, branched with chain structure. **Conidiophores** reduced to the conidiogenous cells. **Conidiogenous cells** 6.0–19.0 μm × 2.5–7.0 μm (x = 11.0 μm × 4.5 μm, n = 20), aggregated in clusters on hypha, pale brown, ampulliform or cylindrical. **Conidia** 8–12 μm long (n = 30), brown, smooth, globose to ellipsoid in surface view, and 10–14 μm long (n = 30), lenticular, with a paler equatorial slit in side view. *Sterile cells* elongated, rolled up, sometimes mixed among conidia.

**Culture characteristics**

Conidia germinated on WA within 12 h. Sporulated on PDA, Colonies flat, margin circular, fluffy, sparse, white, with dirty white patches in center, reverse white, with sparse aerial mycelium, reached 8 cm in 7 days at 25°C.

**Material examined**

*China*, Guizhou Province, Qianxinan Buyi and Miao Autonomous Prefecture, Cengh County, on Leaf of *cyclobalanopsidis glauca* (Thunb.) Oerst., 13 May 2018, Yao Feng, G81 (HKAS 111963, holotype; GZAAS 20–0096, isotype),
**Arthrinium septatum** (HKAS 111960, holotype). (A) Appearance of stromata on bamboo host. (B) Vertical section of stroma. (C) Peridium. (D) Germinating ascospore. (E) Paraphyses. (F,G) Culture. (H–J) Asci. (K–P) Ascospore. (Q) Colony on PDA producing conidia masses. (R–T) Conidiophore and conidiogenous cells. (U–Z) Sterile cell. Scale bars: (B) = 50 µm. (C,D) = 25 µm. (E) = 10 µm. (H–J) = 20 µm. (K–P) = 10 µm. (R–T) = 10 µm. (U–Z) = 5 µm.

**Notes**

Two isolates, representing *Arthrinium cyclobalanopsidis*, cluster together with *A. camelliae-sinensis* which was introduced by Wang et al. (2018) from *Camellia sinensis* (Figure 1). *Arthrinium cyclobalanopsidis* can be distinguished from *A. camelliae-sinensis* (567/572 in ITS; 390/414 in TEF; 715/748 in TUB2). Morphologically, *Arthrinium cyclobalanopsidis* resembles to *A. camelliae-sinensis* in having similar conidia (8–12 µm × 10–14 µm vs. 9.0–13.5 µm × 7.0–12.0 µm), but can be distinguished by its relatively longer conidiogenous cells (6.0–19.0 µm vs. 4.0–9.5 µm).

*Arthrinium garethjonesii* D.Q. Dai and H.B. Jiang, Mycosphere 7 (9): 1337 (2017). Figure 6

Saprobic on dead bamboo branch. **Sexual morph:** See Dai et al. (2016). **Asexual morph:** Sporodochia on host with hair-like setae, also grow in the gaps of the perithecia and scatter on the surface of the perithecia, black. Conidiophores reduced to conidiogenous
cells. Conidiogenous cells (5–) 6–19 (–20) µm × (2–) 3–5 (–7) µm (x = 11 µm × 4 µm, n = 20), aggregated in black sporodochia, hyaline to pale brown, smooth, ampulliform. Conidia (14–) 16–19 (–20) µm diam, brown, smooth, granular, globose to subglobose in surface view, and (16–) 17–22 (–23) µm diam, with pale equatorial slit in side view.

Culture characteristics
Conidia germinated on WA within 12 h, colonies fast growing on PDA, reached 8 cm in 7 days at 25°C, fluffy, circular, dense, raised at center, white, reverse reddish. Hyphae 2–4 µm diam, hyaline to pale brown, branched, septate.

Material examined
China, Guizhou Province, Chishui City, Zhuhai National Forest Park, on dead branches of bamboo, 10 July 2019, Yao Feng, CS19-9 (GZAAS 20-0117); living culture GZCC 20-0115.

Notes
Arthrinium garethjonesii was originally described by Dai et al. (2016) based on the sexual morph from dead bamboo culms (HKAS 96289) collected from Yunnan Province, China. Our phylogenetic result (Figure 1) indicates that our collection is identical to Arthrinium garethjonesii and we report its asexual morph for the first time in this study.
**Arthrinium guizhouense** M. Wang and L. Cai, Mycokeys 34: 13 (2018). Figure 7

Saprobic on dead bamboo culms, forming black, lenticular spots on the host surface, stromata breaking through raised cracks with black center. **Sexual morph:** Stromata solitary to gregarious, immersed to erumpent, fusiform, with long axis broken at the top by one cracks. *Ascomata* 188–220 µm high × 170–200 µm wide, uniseriate or irregularly arranged beneath stromata, pseudothecial, black, globose to subglobose. *Peridium* composed of 5 or 6 layers of brown cells arranged in *textura angularis*, *Hamathecium paraphyses* 3–5 µm, hyaline, hyphae-like, septate. *Asci* (80−) 94–106 (−107) µm × (20−) 21–23 (−24) µm, 8-spored, clavate, apically rounded, broadly cylindrical, with an indistinct pedicel. *Ascospores* (24−) 25–32 (−33) µm × (6−) 7–9 (−10) µm (x = 31 µm × 8 µm, n = 30), apiosporic, clavate to fusiform.
FIGURE 7 | *Arthrinium guizhouense* (GZAAS 20–0114). (A) Appearance of stromata on bamboo host. (B) Vertical section of stroma. (C) Peridium. (D–F) Asci. (G) Germinating ascospore. (H,I) Culture. (J–O) Ascospore. (P) Colony on WA producing conidia masses. (Q,R) Conidiogenous cells giving rise to conidia. (S–V) Conidia. (W) Sterile cell. Scale bars: (B,C) = 50 μm. (D–F) = 30 μm. (G) = 50 μm. (J–O) = 20 μm. (Q,R) = 10 μm. (S–W) = 5 μm.

with narrowly rounded ends, composed of a large upper cell and small lower cell, hyaline, smooth-walled, surrounded an inconspicuous gelatinous sheath. **Asexual morph:** *Hyphae* 2.5–7.5 μm diam, hyaline, branched, septate. *Conidiophores* reduced to conidiogenous cells. *Conidiogenous cells* 4–12 μm × 2–5 μm (μ = 8 μm × 3 μm, n = 20), erect, aggregated in clusters on hyphae, pale brown, smooth, subglobose, ampulliform or doliform. *Conidia* 5–8 μm long (n = 30), dark brown to black, smooth, globose or subglobose, and 6–8 μm long (n = 30), lenticular, with a paler equatorial slit in side view. Sterile cells elongated, rolled up, sometimes mixed among conidia.

**Culture characteristics**

On PDA, colonies very fast, reached 8 cm in 8 days at 25°C, velvety, circular, with regular edge, middle densely and raised white, dense at above the from margin, aerial mycelia, surface initially white, became grayish and reverse white.
Material examined

China, Guangdong Province, Guangzhou City, on decaying bamboo culms, 03 Sep. 2019, Yao Feng, GZ 23 (GZAAS 20–0114); living culture GZCC 20–0114.

Notes

Arthrinium guizhouense was introduced from air in a karst cave (asexual morph was provided from the culture) in Guizhou province, China by Wang et al. (2018). In this study, one collection was found as saprobe on bamboo in Guangzhou, China and it is identified as A. guizhouense based on the phylogeny and morphology evidences. In addition, our new collection provides the sexual morph which only the asexual morph was illustrated by Wang et al. (2018) and Senanayake et al. (2020a).

Arthrinium phyllostachium C.L. Yang, X.L. Xu and K.D. Hyde, Phytotaxa 406 (2): 102 (2019), Figure 8

Saprobic on dead bamboo culms, Sexual morph: Stromata scattered to gregarious, immersed to erumpent, later becoming superficial, dark brown to black, fusiform, forming a slit-like opening at the apex, with stromata breaking through raised cracks with black center. Ascomata 135–185 μm high, 157–215 μm diam, multi-loculate, with a periphysate ostiole, arranged in rows, clustered, gregarious, ampulliform, dark brown to black. Peridium 20–25 μm wide, composed of several layers of dark brown to black cells of textura angularis. Hamathecium 3–5 μm wide, comprising dense, hyaline, septate paraphyses, hymenial-like. Ascii 66–98 × 17–27 (x = 85 μm × 21 μm, n = 20), 8-spored, unitunicate, clavate, apiculate, apically rounded. Ascospores 29–34 μm × 7–10 μm (x = 32 μm × 9 μm, n = 30), biseriate, elliptical, hyaline, 1-septate, constricted at the septum, mostly curved at the lower cell, rarely straight, with a large upper cell and a small lower cell, smooth-walled, with a shallow gelatinous sheath. Asexual morph: On WA, Hyphae 1.5–4.0 μm in diameter, hyaline, septate, branched. Conidiophores reduced to the conidiogenous cells. Conidiogenous cells (8–) 9–28 (–31.5) μm × (1.5–) 2–4 (–6) μm (x = 20 μm × 3 μm, n = 20), aggregated in clusters on hypha or solitary, erect, ampulliform or cylindrical, arising holoblastically from vegetative hyphae, monoblastic, or polyblastic, sympodial, terminal, cylindrical to clavate, ampulliform, hyaline, smooth, thin-walled. Conidia 5–8 μm long (n = 30), brown, smooth, globose to ellipsoid in surface view, and 7–9 μm long (n = 30), lenticular, with a paler equatorial slit in side view. Sterile cells light brown, elongated, and occasionally irregularly angled.

Culture characteristics

Ascospores germinated on WA within 24 h and germ tubes produced from upper. Colonies fast growing on PDA at 25°C, under 12 h light/12 h dark, cottony, circular, sparse, raised, with irregular edge, white in center.

Material examined

China, Guangdong Province, Guangzhou City, on decaying bamboo culms, 3 Sep. 2019, Yao Feng, GZ18 (GZAAS 20–0117), living culture GZCC20–0117.

Notes

Arthrinium pseudoparenchymaticum was introduced by Wang et al. (2018) based on the asexual morph and phylogeny analyses. It was originally collected from bamboo in China (Wang et al., 2018). In this study, a fresh specimen was collected and it

Materials examined

China, Guangdong Province, Chishui City, Zhuhai National Forest Park, on dead culms of bamboo, 10 July 2019, Yao Feng, CS19-23 (GZAAS 20–0112), living culture GZCC 20–0111; Ibid., Chishui National Scenic Area, on dead culms of bamboo, 10 July 2019, Ya-Ya Chen, CS004 (GZAAS 20–0113), living culture GZCC 20–0112.

Notes

Arthrinium phyllostachium was introduced by Yang et al. (2019) based on the asexual morph and phylogeny analyses. It was collected from culms of Phyllostachys heterocloada (Poaceae) in China (Yang et al., 2019). The phylogenetic results showed that our new collections are identical to A. phyllostachium, Yang et al. (2019) only provided the asexual morph and the sexual morph is given in this study.

Arthrinium pseudoparenchymaticum M. Wang and L. Cai, Mycokeys 34 (1): 17 (2018), Figure 9

Saprobic on dead bamboo culms, forming black, lenticular spots on the host surface, with stromata breaking through raised cracks with black center. Sexual morph: Ascomata 187–242 μm high × 242–373 μm wide, uniseriate, or irregularly arranged beneath stromata, black, globose to subglobose with a flattened base. Peridium composed of 5–7 layers of brown cells arranged in textura angularis, with a conspicuous perisporus ostiole. Hamathecium paraphyses 4–8 μm, hymenial-like, septa hyaline. Ascii (95–) 107–110 (–133) μm × 23–25 (–27) μm, 8-spored, broadly cylindrical, clavate or subglobose, apically rounded, with an indistinct pedicel. Ascospores (35–) 35–43 (–44) × (10–) 11–13 μm (x = 41 × 12, n = 30), apiosporic, clavate to fusiform with narrowly rounded ends, composed of a large upper cell and small lower cell, hyaline, smooth-walled, surrounded by a gelatinous sheath. Asexual morph: On WA, Hyphae 1.5–4 μm diam, hyaline to pale brown, branched, septate. Conidiophore extends from the vegetative hypha, up to 60 μm long. Conidiogenous cells 10.0–40.0 μm × 3.0–6.0 μm, scattered in clusters on hyphae, smooth, unbranched, hyaline to pale yellow, smooth, erect, subcylindrical. Conidia 17–27 μm × 17–21 μm (x = 23 μm × 19 μm, n = 30), pale to light brown, smooth, globose to subglobose, sometimes lobed or dentate, polygonal or irregular in surface view.

Culture characteristics

Ascospores germinated on WA within 24 h and germ tubes produced from upper. Colonies fast growing on PDA at 25°C, under 12 h light/12 h dark, cottony, circular, sparse, raised, with irregular edge, white in center.

Material examined

China, Guangdong Province, Guangzhou City, on decaying bamboo culms, 3 Sep. 2019, Yao Feng, GZ18 (GZAAS 20–0115), living culture GZCC20–0117.
is identical to *A. pseudoparenchymaticum* (Figure 1), both sexual and asexual morphs were described and illustrated (Figure 9).

**Arthrinium arundinis** (Corda) Dyko and B. Sutton, *Mycotaxon* 8: 119 (1979), Figure 10.

Saprobic on dead bamboo culms. **Asexual morph:** On PDA, *Hyphae* 2–3 μm diam, consisting of smooth, hyaline, branched, septate. *Conidiophores* reduced to conidiogenous cells. *Conidiogenous cells* 3–8 μm × 2–5 μm, aggregated in clusters on hyphae, pale brown, smooth, ampulliform. *Conidia* (4–) 5–6 (–7) μm, brown, smooth, globose in surface view, and (4–) 5–7 (–8) μm diam, lenticular with pale equatorial slit in side view. **Sterile cells** at times intermingled among conidia. **Sexual morph:** Undetermined.

**Culture characteristics**
The colony is flat, cotton-like, thick and dense, with sparse aerial mycelia. The surface of PDA is white and the reverse side is grayish white.
Materials examined

**China**, Guizhou Province, Chishui City, Zhuhai National Forest Park, on dead culms of bamboo, 10 July 2019, Yao Feng, CS 19-7 (GZAAS 20–0116), living culture GZCC 20–0116.

Notes

Our collection clusters together with the isolates of *Arthrinium arundinis* (Figure 1) and its morphology lines up with the type species. Therefore we identify it as *Arthrinium arundinis*.

**Figure 9**

*Arthrinium pseudoparenchymaticum* (GZAAS 20–0115) (A,B) Appearance of stromata on bamboo host. (C) Vertical section of stroma. (D) Paraphyses. (E) Peridium. (F) Germinating ascospore. (G) Culture. (H–J) Asci. (K–O) Ascospore. (P) Ascospore in Indian ink and present clear gelatinous sheath. (Q) Colony on WA producing conidia masses. (R) Dentate conidia. (S–U) Conidiogenous cells giving rise to conidia. Scale bars: (C) = 50 μm, (D–F) = 20 μm, (H–J) = 30 μm, (K–P) = 15 μm, (R–U) = 15 μm.

**Arthrinium hydei** Crous, IMA Fungus 4 (1): 142 (2013).

**Figure 11**

*Saprobic* on bamboo leaves. **Asexual morph:** Colonies on the host punctiform, pulvinate, blackish brown. **Conidiophores** pale brown, smooth, transversely septate, subcylindrical. **Conidiogenous cells** 5–15 × 3–6 μm, brown, smooth, subcylindrical to doliiform to lageniform. **Conidia** (13–) 14–19 (–20) μm diam in surface view, brown, roughened, globose, and 15–20 μm diam.
lenticular with pale equatorial slit in side view. Sexual morph: Undetermined.

**Culture characteristics**
Colonies flat, spreading, with sparse aerial mycelium. On PDA surface and reverse pale luteous. Mycelium consisting of smooth, hyaline to pale brown, branched, septate, 2.0–4.5 μm diam hyphae.

**Materials examined**
China, Guizhou Province, Guiyang City, Baihua Lake, on bamboo leaves, 20 April 2018, Yao Feng, 67 (GZAAS 20–0098), living culture GZCC20–0113.

**Notes**
This collection is identified as *Arthrinium hydei* based on both morphological characters and molecular data. Crous and Groenewald (2013) originally described *A. hydei*.
based on the asexual morph from a culture (CBS 114990) which was isolated from bamboo culms in Hong Kong, China; we found this species in Guizhou from the substrate in nature with its asexual morph.

**Arthrinium neosubglobosa** D.Q. Dai and H.B. Jiang, *Mycosphere* 7 (9): 1337 (2017) Figure 12.

*Saprobic* on dead bamboo culms. **Sexual morph:** Stromata scattered to gregarious, superficial to raised, with a slit-like opening, dark brown to black, naviculate, with black papillate ostiole, multi-loculate. *Ascomata* 205–328 µm high, 168–345 µm, perithecial, arranged in a row, immersed in stromata, later becoming erumpent through host surface to superficial, obpyriform to ampulliform, dark brown, membranous. Ostiole raised from center of *Ascomata*, internally lined with periphyses. *Peridium* 4 layers, outer layer composed of dark brown, cells of *textura prismatica*, inner layer thin, with hyaline cells of *textura angularis*. *Hamathecium* 4.0–5.5 µm wide, comprising dense...
Paraphyses, indistinctly aseptate, unbranched, not anastomosing, filamentous, clustered embedded in gelatinous matrix. *Asci* 80–119 μm × 20–37 μm (\( \bar{x} = 97 \mu m \times 28 \mu m, n = 20 \)), 8-spored, unitunicate, clavate, with a short pedicel, apically rounded. *Ascospores* 25–36 μm × 11–15 μm (\( \bar{x} = 29 \mu m \times 13 \mu m, n = 30 \)), 2-seriate, elliptical, hyaline, 1-septate, constricted at the septum, mostly curved at the lower cell, rarely straight, with a large upper cell and a small lower cell, smoothwalled, 1-guttulate, with a shallow 8–12 μm thick gelatinous sheath. **Asexual morph:** Undetermined.

**Materials examined**

*China.* Guizhou Province, Zunyi City, Daozhen County, on dead culms of bamboo, 15 August 2018, Yao Feng, DZ22 (GZAAS 20–0099).

**Notes**

*Arthrinium neosubglobosa* was introduced by Dai et al. (2016) based on the sexual morph characters and phylogeny analyses. The pure culture was attempted by single spore isolation and the DNA was extracted directly from the fruiting body, the
new collection is identified as *A. neoseglobosa* based on the phylogeny (Figure 1) and morphology evidences.

**DISCUSSION**

*Arthrinium* species have been reported from many hosts, includes hive-stored pollen lichens, marine algae, soil debris, gut of insects and nodules of human skin (Sharma et al., 2014; Crous et al., 2015, Senanayake et al., 2015; Wijayawardene et al., 2017, Zhao et al., 2018), it can be concluded that *Arthrinium* is ecologically diverse. Bamboo, as one of the most reported host, is a gramineous plant integrating economy and ornamental value (Gratani et al., 2008; Kelchner and Bamboo Phylogeny Group, 2013; Dai et al., 2016, 2017; Jiang et al., 2018, 2019, 2020; Wang et al., 2018; Yang et al., 2019), there is more than 115 genera with approximately 1,450 species. According to incomplete statistics, more than 1,100 species of fungi on bamboo were reported (Hyde et al., 2002a,b; Dai et al., 2016, 2017; Senanayake et al., 2020a; Tang et al., 2020; Wijesinghe et al., 2020). It is of great significance to excavate and identify the fungi on bamboo.

Several studies have shown (Crous and Groenewald, 2013; Dai et al., 2016, Dai et al., 2017; Wang et al., 2018; Yang et al., 2019) that it is difficult to identify the *Arthrinium* species solely rely on morphology and the multi-gene phylogenetic analyses are needed in the identification and classification of *Arthrinium*. The morphology of conidia is variable which can be depending on the period of incubation on different habitats, for example, *A. biserialae*, *A. gelatinosum* and *A. septatum*, are very similar in morphology, but molecular data distinguish them into different species; Our collection *A. pseudoparenchymaticum* differs from the type specimen (LC 8173) in the morphology of conidiophores, the size of conidiogenous cells is also different, while the molecular data supported them as the same species. These results are in agreement with the previous observations and publications (Crous and Groenewald, 2013; Dai et al., 2016, Dai et al., 2017; Wang et al., 2018, Yang et al., 2019). In addition, as a high diverse group, it is also difficult to distinguish species within *Arthrinium* by only using ITS and LSU gene regions, and the protein genes (TEF and TUB2) are not available for many species in the genus which bring potential problem once the new or existing taxa are introduced and identified, respectively. For example the absent of the protein genes (TEF and TUB2) of *Arthrinium garethjonesii* would bring the troubles in identification of *Arthrinium setostromum* as it is hard to confirm whether they are same species or not as they are identical in ITS and LSU gene regions, as well as the close phylogenetic relationship (Figure 1). It would be necessary to provide protein genes when new taxa are introduced in these well-study and diverse groups.

**DATA AVAILABILITY STATEMENT**

The data presented in the study can be found in the Genbank. The accession numbers of the sequences deposited in GenBank are ITS: MW481705—MW481721; LSU: MW478885—MW478901; TEF: MW522938—MW522954; and TUB: MW522955—MW522969.

**AUTHOR CONTRIBUTIONS**

YF and J-KL: conceptualization. YF and Y-YC: methodology. YF, C-GL, and J-KL: formal analysis. YF, Y-YC, M-MX, and J-KL: resources. YF: writing—original draft preparation. C-GL, Z-YL, and J-KL: writing—review and editing. Z-YL and J-KL: supervision. All authors approved to publish the version of final manuscript.

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**Conflict of Interest:** The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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