J. Entomol. Res. Soc., 27(2): 219-234, 2025 *Research Article*
Doi: 10.51963/jers.v27i2.2737 *Online ISSN:2651-3579*

Molecular Phylogeny Confirms the Monophyly of *Neoceratobaeus* Rajmohana, 2014 (Hymenoptera: Scelionidae), a Rare and Endemic Genus from India

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ABSTRACT

The members of tribe Baeini (Hymenoptera: Scelionidae) are predominantly parasitoids of spider eggs. In India, baeine wasps are represented by five genera- *Baeus* Haliday, 1833, *Idris* Förster, 1856, *Ceratobaeus* Ashmead, 1893, *Odontacolus* Kieffer, 1910 and *Neoceratobaeus* Rajmohana, 2014. Of the above, *Neoceratobaeus* is comparatively rare, lesser-known and endemic to India. This study is the maiden attempt to assess *Neoceratobaeus* as a distinct genus under the tribe Baeini using DNA barcode data. Phylogenetic analysis of mitochondrial COI and nuclear 28S rRNA genes supports its prior classification as a new genus based on morphology.

Keywords: Baeini, DNA barcodes, mt COI, 28S rRNA, Parasitoids.

Debnath, R., Rajmohana, K., Sushama, V., Patra, S., & Dinesh, K. P. (2025). Molecular phylogeny confirms the monophyly of *Neoceratobaeus* Rajmohana, 2014 (Hymenoptera: Scelionidae), a rare and endemic genus from India. *Journal of the Entomological Research Society*, 27(2), 219-234.

Received: October 01, 2024 *Accepted: April 11, 2025*

INTRODUCTION

The primary ecological significance of spiders lies in their role as arthropod predators within terrestrial ecosystems, exerting a crucial impact on insect populations (Nyffeler & Benz, 1987). While spiders are known for regulating arthropod populations, it is noteworthy that certain parasitic hymenopteran families, such as Scelionidae (Platygastroidea), Encyrtidae, Eulophidae, Eurytomidae, Eupelmidae, Pteromalidae (Chalcidoidea), and Ichneumonidae (Ichneumonoidea), target the eggs and developing stages of spiders (Austin, 1985). After a comprehensive examination of various morphological characters, including the ovipositor system as well as the host data, all genera of scelionids that engaged in parasitism of spider eggs were reclassified under the unified nominal tribe Baeini (Austin, 1986; Austin & Field, 1997). As of now, the tribe Baeini encompasses 11 valid genera globally viz. *Baeus* Haliday, 1833, *Idris* Förster, 1856, *Ceratobaeus* Ashmead, 1893, *Odontacolus* Kieffer, 1910, *Aneurobaeus* Kieffer, 1912, *Mirobaeoides* Dodd, 1914, *Mirobaeus* Dodd, 1914, *Apobaeus* Masner, 1964, *Hickmanella* Austin, 1981, *Neobaeus* Austin, 1988 and *Neoceratobaeus* Rajmohana, 2014 (Austin & Field, 1997; Carey, Murphy, & Austin, 2006; Rajmohana, 2014). Of these, in India, only five genera viz. *Baeus, Idris, Ceratobaeus, Odontacolus and Neoceratobaeus* have been recorded.

Baeine wasps, with an average body length of less than 2 mm, are among the smallest in the subfamily Scelioninae (Iqbal & Austin, 2000a, 2000b) and possess various morphological adaptations that allow them to lay their eggs within spider eggs (Austin, 1986). The tribe Baeini comprises around 500 species globally (Johnson, Chen, & Huber, 2018), yet only 98 species have been documented in India, so far (Debnath, Rajmohana, Sen, Shabnam, Dinesh, 2024; Patra et al, 2024; Rameshkumar et al, 2024). Considering India's tropical climate and rich spider fauna, it is anticipated to host a wide array of baeine wasps. Occurrence of *Neoceratobaeus* is comparatively rare and it is the only genus of Baeini, which has been originally described from India. The establishment of *Neoceratobaeus* as a new genus (Rajmohana, 2014) was primarily based on a comparative analysis of morphological characters. The genus was monotypic with *Neoceratobaeus gibbus* Rajmohana, 2014 as the type species was described from Kerala (Rajmohana, 2014), until Sunita & Rajmohana (2019) described *N. dwitiyus* Sunita & Rajmohana, 2019 from West Bengal, documenting an extended distribution of the genus.

In the present study, the mitochondrial cytochrome c oxidase subunit I (mt COI) and nuclear 28S ribosomal RNA (rRNA) genes were sequenced for the Indian endemic genus *Neoceratobaeus.* The objective was to generate voucher-based DNA barcodes and also to elucidate the phylogenetic status of *Neoceratobaeus* within the tribe Baeini by constructing a phylogenetic tree, based on concatenated two genes, mt COI and 28S rRNA.

MATERIAL AND METHODS

Specimens studied

Specimens from all five genera of Baeini present in India were studied (Table 1). The samples were collected either by using Yellow Pan Traps (YPT) following Shweta & Rajmohana, 2018 or by rearing spider egg sacs. The YPT is based on the principle that insects are attracted to the color yellow (Shweta & Rajmohana, 2018). The specimens for morphological studies were card mounted, while the rest were preserved in absolute alcohol. Generic/species identifications followed Masner (1976), Valerio, Austin, Masner, & Johnson (2013), Rajmohana (2014), Sunita & Rajmohana (2019) and the morphological terminologies followed Mikó, Vilhelmsen, Johnson, Masner, & Penzes (2007). The voucher specimens have been deposited in the National Zoological Collections, Zoological Survey of India, Kolkata.

Table 1. The details of samples used in this study (YPT = yellow pan trap).

Sl.	Sample code	Species	Location	Collection method
1	RR25F	*Baeus* sp. 1	India: Odisha	Rearing
2	RR61F	*Ceratobaeus* sp. 1	India: Assam	YPT
3	RR24F	*Ceratobaeus* sp. 2	India: Odisha	YPT
4	RR13F	*Idris* sp. 1	India: West Bengal	Rearing
5	D671F	*Idris* sp. 2	India: Odisha	YPT
6	D692F	*Idris* sp. 4	India: Odisha	YPT
7	RR4F	*Idris* sp. 5	India: West Bengal	Rearing
8	RR20F	*Idris* sp. 6	India: West Bengal	Rearing
9	RR14F	*Neoceratobaeus dwitiyus* Sunita & Rajmohana, 2019	India: Odisha	YPT
10	RR14R	*Neoceratobaeus dwitiyus* Sunita & Rajmohana, 2019	India: Odisha	YPT
11	HM172	*Neoceratobaeus gibbus* Rajmohana, 2014	India: Kerala	YPT
12	HM188	*Neoceratobaeus gibbus* Rajmohana, 2014	India: Kerala	YPT
13	D684F	*Odontacolus markadicus* Veenakumari, 2011	India: West Bengal	Rearing

All morphological studies were carried out under a Leica M205A stereo zoom microscope, with a 1X objective. Images were taken using the integrated camera Leica DFC-500 and later processed using Leica Application Suite (LAS) software.

DNA extraction, amplification and sequencing

Genomic DNA was extracted from one or two adult female parasitoid specimens of each species (Table 1) using the DNeasy Blood and Tissue Kit (QIAGEN, Inc.) following the manufacturer's protocol. DNA quantification was carried out with a Qubit 2.0 fluorometer. Polymerase chain reactions (PCRs) were performed for one mitochondrial marker and one nuclear marker (28S rRNA). The primer set for each marker is listed in Table 2. The PCR reactions were set in a total volume of 25µL following Debnath, Rajmohana, Sen, Shabnam and Dinesh (2024) and the thermal cycling profiles are listed in Table 3. Positive PCR results were confirmed through agarose gel electrophoresis, followed by PCR product purification. The purified products were subjected to bidirectional Sanger sequencing using an ABI 377 sequencer (Applied Biosciences). Chromatogram files were manually assessed for

quality, and both the forward and reverse sequences generated in this study were meticulously reviewed for corrections. The sequences were submitted to the National Center for Biotechnology Information (NCBI) GenBank.

Table 2. The details of primers used in this study for PCR.]

Marker	Primer name	Direction	Primer sequence (5' to 3')	References
COI	LCO1490	Forward	GGTCAACAAATCATAAAGATATTGG	Folmer et al. (1994)
	HCO2198	Reverse	TAAACTTCAGGGTGACCAAAAAATCA	Folmer et al. (1994)
28S rRNA	28S C1	Forward	ACCCGCTGAATTTAAGCAT	Dayrat et al. (2001)
	28S D3	Reverse	GACGATCGATTTGCACGTCA	Vonnemann et al. (2005)

Table 3. Thermocycle conditions.

Primers	Thermocycle conditions
LCO1490/HCO2198	2 min at 95°C; (30 sec at 94°C / 40 sec at 45°C / 1 min at 72°C) × 5 cycles; (30 sec at 94°C / 40 sec at 51°C / 1 min at 72°C) × 35 cycles; 5 min at 72°C; 4°C/∞
28S C1/ 28S D3	3 min at 98°C; (30 sec at 98°C / 45 sec at 56°C / 1 min at 72°C) × 40 cycles; 5 min at 72°C; 4°C/∞

Sequence alignment and phylogenetic analysis

For phylogenetic analyses of the members of tribe Baeini, a total of 845 mt COI and 32 28S rRNA sequences were downloaded from GenBank and Barcode of Life Data system (BOLD). Downloaded sequences were aligned with 13 sequences generated in the present study in MEGA X (Kumar, Stecher, Knyaz, & Tamura, 2018). In the final alignment set, duplicated, ambiguous, or unverified sequences that created gaps were removed for further analysis. The pairwise nucleotide sequence distances among and within taxa were estimated using the Kimura 2-parameter model (K2P) of substitution using MEGA X (Kumar *et al.*, 2018). The concatenated alignment of 1622 bp (671 bp of mt COI + 951 bp of 28S rRNA) was partitioned for each entire COI and 28S gene. Finally, a maximum likelihood tree was built using 602 sequences (Supplementary material- Table A1) inclusive of ours, eight genera of tribe Baeini in IQ-TREE multicore version 1.6.12 (Trifinopoulos, Nguyen, von Haeseler and Minh, 2016) web server for 1000 ultrafast bootstraps under GTR+F+I+G4 (for mt COI) and TVMe+G4 (for 28S rRNA) substitution models using ModelFinder. The consensus tree was visualised in FigTree v 1.4.4 to treat *Triteleia* sp. as outgroup following Chen *et al.*, 2021.

Abbreviations

T1–T3: metasomal tergites 1 to 3.

RESULTS AND DISCUSSION

Morphologically, members of the genera *Ceratobaeus*, *Odontacolus*, and a few species of *Idris* (Kamalanathan, Mohanraj, Khan, 2015), feature a hump or an elongated horn emerging dorsally from the first metasomal segment, serving as a recess for the long, hypodermic-like ovipositor when retracted internally (Austin, 1983; Austin & Field, 1997; Austin, Johnson, & Dowton, 2005). In the identification key to genera of Baeini from India presented here, *Neoceratobaeus* (Figs. 1-2) comes close to *Odontacolus* (Fig. 3). However, *Neoceratobaeus* has shorter spine-like lateral flanges on propodeum, and also differs in nature and shape of horn and fore wing (Figs. 1-2).

Key to the genera of Baeini in India (based on females)

1. Laterotergites free and wide, not incised into a submarginal groove along sternites (Fig. 4); apterous; T2 always largest of metasomal tergites; T1 not visible dorsally. ..... *Baeus* Haliday, 1833

- Laterotergites narrow, incised into submarginal groove; brachypterous or macropterous; T3 or rarely T2 largest of metasomal tergites; T1 visible dorsally. 2

2. T1 without horn (Fig. 5) or rarely with a horn, if horn present, then, both fore wing and hind wing with extremely long marginal cilia and hind wing curved inwards beyond submarginalis ('*adikeshavus*' species group). ..... *Idris* Förster, 1856

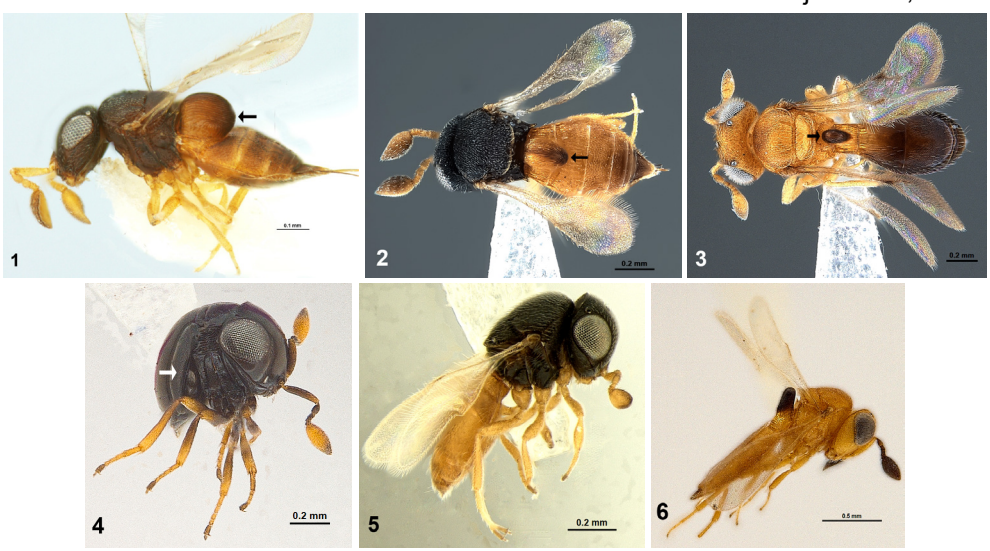
- T1 with a distinct hump or horn. 3

3. Metasomal horn not laterally compressed, circular in cross-section and vertical or directed forward (Fig. 6), propodeum with or without any spines to flank metasomal horn. ..... *Ceratobaeus* Ashmead, 1893

- Metasomal horn laterally compressed (at least in dorsal view), not circular in cross-section, propodeum always with spines to flank the metasomal horn. 4

4. Propodeum with a pair of broad, elongate spines flanking T1 horn; T1 horn not directed backward (Fig. 3); metasoma subpedunculate in dorsal view (Fig. 3). .... *Odontacolus* Kieffer, 1910

- Propodeum with a pair of comparatively short spines flanking T1 horn; T1 horn directed backward (Figs. 1-2); metasoma not subpedunculate in dorsal view (Fig. 2). ..... *Neoceratobaeus* Rajmohana, 2014



Figures 1-6. 1) *Neoceratobaeus gibbus* Rajmohana, ♀. The arrow indicates the backwards-directed T1 horn; 2) *Neoceratobaeus dwitiyus* Sunita and Rajmohana, ♀. The arrow indicates the laterally compressed T1 horn; 3) *Odontacolus markadicus* Veenakumari, ♀. The arrow indicates the laterally compressed T1 horn; 4) *Baeus* sp. 1, ♀. The arrow indicates the loose laterotergites; 5) *Idris* sp. 6, ♀; 6) *Ceratobaeus* sp. 2, ♀. The arrow indicates the T1 horn.

In the present study, multigene DNA barcodes were generated for the genus *Neoceratobaeus* for the first time. Understanding the shortfalls of single gene mt COI trees for phylogenetic inferences, here multigene (COI and 28S) tree is used to ascertain the monophyly of the genus *Neoceratobaeus*. In the multigene phylogenetic tree (Fig. 7), *Neoceratobaeus* was recovered as monophyletic, with high bootstrap support substantiating the morphological studies in Rajmohana (2014) erecting *Neoceratobaeus* as a new genus. The members of the genus *Neoceratobaeus* showed 15.7% to 23.6% genetic distance for mt COI among the two-sister species. High interspecific genetic distance in scelionids has been reported in *Idris* from India (Rajmohana, Debnath, Sushama, Sen & Dinesh, 2025) and *Oxyscelio* Kieffer, 1907 from China (Mo, Chen, Pang & Liu, 2021), highlighting substantial genetic diversity and potential species richness. In this context, the high genetic distance between the sister species of *Neoceratobaeus* could be due to the lack of sampling between the southwestern and northeastern coast of India (Kerala and West Bengal). Indirectly it also reflects the possibility of new taxa between the current distribution range of the genus. However, given their rarity in collections, further faunistic explorations are necessary to explore the species richness. Additionally, the members of *Neoceratobaeus* are exhibiting sister relationships to the sub-clade representing the genus *Ceratobaeus*, *Baeus* and *Idris*. Among these, only *Baeus* is monophyletic, the other two are paraphyletic. The multigene tree generated for the tribe Baeini suggests the requirement of taxonomic revisions, as a few of the current genera are paraphyletic within their geographical range.

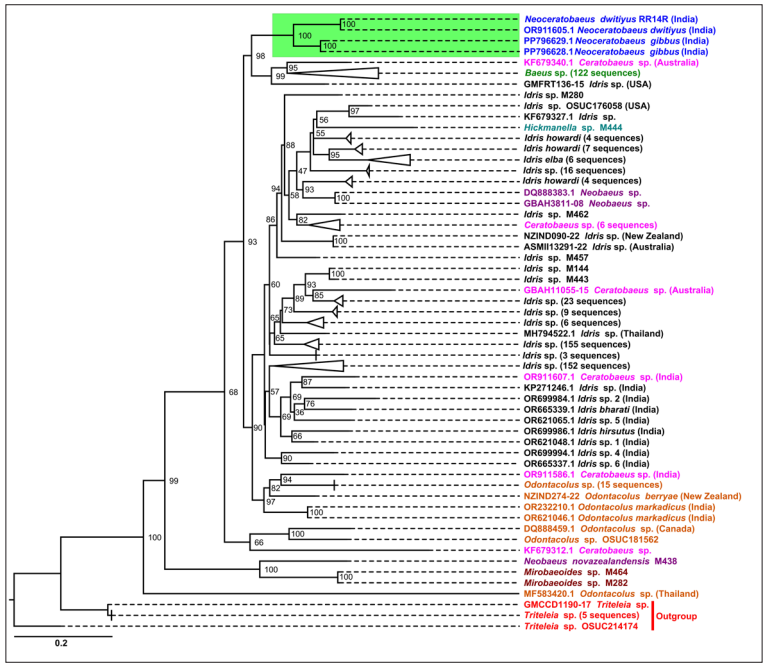


Figure 7. Maximum likelihood tree for the species of Baeini based on 1622 bp mt COI + 28S rRNA sequence.

Earlier studies suggested that *Idris* and *Ceratobaeus* are polyphyletic (Iqbal & Austin, 2000b; Carey *et al.*, 2006). As per the present phylogenetic tree too, *Idris* and *Ceratobaeus* are not monophyletic, and so also are *Odontacolus* and *Neobaeus*, reflecting either poor sampling across the distribution range or suggesting generic-level taxonomic revisions. Although *Idris* and *Ceratobaeus* are currently recognized as valid genera, they have frequently undergone generic transfers and synonymizations (Masner 1976; Huggert 1979; Johnson 1992). *Idris* lacks any distinctive apomorphic characters and serves as a taxonomic 'dumping ground' for numerous nondescript baeine wasps that do not readily fit into any other established genera (Carey *et al.*, 2006). This practice has, in turn, generated substantial ambiguity in the accurate identification of GenBank sequences. However, the members of the genus *Hickmanella* and *Mirobaeoides* were singletons (with single species) on the tree. On a finer scale, there is a clear geographic grouping (clade) within a few genera in the tree (Fig. 7). For example, all the subclades of *Idris* show clear groups either at the country scale India or southeast Asia- Malaysia, Philippines or USA (Fig. 7, Table A1).

CONCLUSIONS

In this study, DNA barcoding corroborates morphological evidence supporting the recognition of *Neoceratobaeus* as a distinct genus. In emerging taxonomic frameworks, DNA barcode data not only facilitates species identification but also contributes to the development of meaningful classification systems.

ACKNOWLEDGEMENTS

The authors are grateful to the Director, Zoological Survey of India (ZSI) for providing necessary facilities. KPD is thankful to the Officer-in-Charge, Western Regional Center, ZSI for support and encouragement. KR and KPD greatly indebted to Department of Science and Technology and Science and Engineering Research Board (DST-SERB) (Project: CRG/2021/005047) for funding this work. Authors are thankful to Drs. Vikas Kumar, Kaomud Tyagi and Mrs. A. Shabnam for the wet lab support and initial analysis. RD and VS are thankful to DST for providing Senior Research Fellowships. SP is thankful to ZSI for providing a Senior Research Fellowship. RD, VS and SP are grateful to their lab mates for the encouragement.

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Supplementary material

Table A1. Details of mt COI and 28S rRNA sequences used in phylogenetic analysis for Baeini.

Sl.	Species	mt COI	28S rRNA	Location	References
1	*Neoceratobaeus dwitiyus*	OR911606.1	PP738136.1	India	This study
2	*Neoceratobaeus dwitiyus*	OR911605.1	-	India	This study
3	*Neoceratobaeus gibbus*	PP796629.1	-	India	This study
4	*Neoceratobaeus gibbus*	PP796628.1	-	India	This study
5	*Ceratobaeus* sp.	-	KF679340.1	Australia	Unpublished
6	*Baeus* sp.	DQ888382.1	DQ888430.1	Australia	Murphy et al. 2007
7	*Baeus* sp.	KF679310.1	KF679339.1	French Guiana	Murphy et al. 2007
8	*Baeus* sp.	KF679315.1	KF679333.1	French Guiana	Murphy et al. 2007
9	*Baeus* sp.	OQ561913.1	-	USA	Moore et al. 2023
10	*Baeus* sp.	KM566887.1	-	Canada	Unpublished
11	*Baeus* sp.	KM561780.1	-	Canada	Unpublished
12	*Baeus* sp.	JN801182.1	-	USA	Unpublished
13	*Baeus* sp.	KF679319.1	KF679337.1	-	Unpublished
14	*Baeus* sp.	ASMII11105-22	-	Australia	Unpublished
15	*Baeus* sp.	ASMII5106-22	-	Australia	Unpublished
16	*Baeus* sp.	ASMII5276-22	-	Australia	Unpublished
17	*Baeus* sp.	GMNZO1207-18	-	New Zealand	Unpublished
18	*Baeus* sp.	GMNZM1031-14	-	New Zealand	Unpublished
19	*Baeus* sp.	GMNZP1064-18	-	New Zealand	Unpublished
20	*Baeus* sp.	NZIND270-22	-	New Zealand	Unpublished
21	*Baeus* sp.	GMNZO960-14	-	New Zealand	Unpublished
22	*Baeus* sp.	GMNZP358-14	-	New Zealand	Unpublished
23	*Baeus* sp.	GMNZU236-14	-	New Zealand	Unpublished
24	*Baeus* sp.	GMNZP490-14	-	New Zealand	Unpublished
25	*Baeus* sp.	GMNZS235-14	-	New Zealand	Unpublished
26	*Baeus* sp.	GMNZS952-14	-	New Zealand	Unpublished
27	*Baeus* sp.	GMNZR133-14	-	New Zealand	Unpublished
28	*Baeus* sp.	GMNZQ220-14	-	New Zealand	Unpublished
29	*Baeus* sp.	GMNZR132-14	-	New Zealand	Unpublished
30	*Baeus* sp.	GMNZS1021-14	-	New Zealand	Unpublished
31	*Baeus* sp.	GMNZP069-14	-	New Zealand	Unpublished
32	*Baeus* sp.	GMNZT168-14	-	New Zealand	Unpublished
33	*Baeus* sp.	GMNZQ312-14	-	New Zealand	Unpublished
34	*Baeus* sp.	GMNZS250-14	-	New Zealand	Unpublished
35	*Baeus* sp.	GMNZS362-14	-	New Zealand	Unpublished
36	*Baeus* sp.	GMNZS244-14	-	New Zealand	Unpublished
37	*Baeus* sp.	GMNZR141-14	-	New Zealand	Unpublished
38	*Baeus* sp.	GMNZP365-14	-	New Zealand	Unpublished
39	*Baeus* sp.	GMNZQ194-14	-	New Zealand	Unpublished
40	*Baeus* sp.	GMNZR108-14	-	New Zealand	Unpublished
41	*Baeus* sp.	GMNZR118-14	-	New Zealand	Unpublished
42	*Baeus* sp.	GMNZS248-14	-	New Zealand	Unpublished
43	*Baeus* sp.	GMNZT165-14	-	New Zealand	Unpublished
44	*Baeus* sp.	GMNZO616-14	-	New Zealand	Unpublished
45	*Baeus* sp.	GMNZV196-14	-	New Zealand	Unpublished
46	*Baeus* sp.	GMNZW372-14	-	New Zealand	Unpublished
47	*Baeus* sp.	GMNZR142-14	-	New Zealand	Unpublished
48	*Baeus* sp.	GMNZR153-14	-	New Zealand	Unpublished
49	*Baeus* sp.	GMNZO584-14	-	New Zealand	Unpublished
50	*Baeus* sp.	GMNZR143-14	-	New Zealand	Unpublished
51	*Baeus* sp.	GMNZQ199-14	-	New Zealand	Unpublished
52	*Baeus* sp.	GMNZQ235-14	-	New Zealand	Unpublished
53	*Baeus* sp.	GMNZS267-14	-	New Zealand	Unpublished
54	*Baeus* sp.	GMNZS218-14	-	New Zealand	Unpublished
55	*Baeus* sp.	GMNZV201-14	-	New Zealand	Unpublished
56	*Baeus* sp.	GMNZR258-14	-	New Zealand	Unpublished
57	*Baeus* sp.	GMNZV166-14	-	New Zealand	Unpublished
58	*Baeus* sp.	GMNZT197-14	-	New Zealand	Unpublished
59	*Baeus* sp.	GMNZO574-14	-	New Zealand	Unpublished
60	*Baeus* sp.	GMNZO617-14	-	New Zealand	Unpublished
61	*Baeus* sp.	GMNZP1066-18	-	New Zealand	Unpublished
62	*Baeus* sp.	GMNZV154-14	-	New Zealand	Unpublished

table continued

Sl.	Species	mt COI	28S rRNA	Location	References
63	*Baeus* sp.	GMNZP063-14	-	New Zealand	Unpublished
64	*Baeus* sp.	GMNZV186-14	-	New Zealand	Unpublished
65	*Baeus* sp.	GMNZO601-14	-	New Zealand	Unpublished
66	*Baeus* sp.	GMNZS255-14	-	New Zealand	Unpublished
67	*Baeus* sp.	GMNZP493-14	-	New Zealand	Unpublished
68	*Baeus* sp.	GMNZP367-14	-	New Zealand	Unpublished
69	*Baeus* sp.	GMNZS251-14	-	New Zealand	Unpublished
70	*Baeus* sp.	GMNZP370-14	-	New Zealand	Unpublished
71	*Baeus* sp.	GMNZQ217-14	-	New Zealand	Unpublished
72	*Baeus* sp.	GMNZP084-14	-	New Zealand	Unpublished
73	*Baeus* sp.	GMNZW334-14	-	New Zealand	Unpublished
74	*Baeus* sp.	GMNZT138-14	-	New Zealand	Unpublished
75	*Baeus* sp.	GMNZQ212-14	-	New Zealand	Unpublished
76	*Baeus* sp.	GMNZQ227-14	-	New Zealand	Unpublished
77	*Baeus* sp.	GMNZR110-14	-	New Zealand	Unpublished
78	*Baeus* sp.	GMNZU216-14	-	New Zealand	Unpublished
79	*Baeus* sp.	GMNZU241-14	-	New Zealand	Unpublished
80	*Baeus* sp.	GMNZS226-14	-	New Zealand	Unpublished
81	*Baeus* sp.	GMNZS271-14	-	New Zealand	Unpublished
82	*Baeus* sp.	GMNZP489-14	-	New Zealand	Unpublished
83	*Baeus* sp.	GMNZS252-14	-	New Zealand	Unpublished
84	*Baeus* sp.	GMNZQ187-14	-	New Zealand	Unpublished
85	*Baeus* sp.	GMNZQ231-14	-	New Zealand	Unpublished
86	*Baeus* sp.	GMNZP369-14	-	New Zealand	Unpublished
87	*Baeus* sp.	GMNZS270-14	-	New Zealand	Unpublished
88	*Baeus* sp.	GMNZS247-14	-	New Zealand	Unpublished
89	*Baeus* sp.	GMNZS236-14	-	New Zealand	Unpublished
90	*Baeus* sp.	GMNZP080-14	-	New Zealand	Unpublished
91	*Baeus* sp.	GMNZQ192-14	-	New Zealand	Unpublished
92	*Baeus* sp.	GMNZQ218-14	-	New Zealand	Unpublished
93	*Baeus* sp.	GMNZQ216-14	-	New Zealand	Unpublished
94	*Baeus* sp.	GMNZS230-14	-	New Zealand	Unpublished
95	*Baeus* sp.	GMNZS1308-14	-	New Zealand	Unpublished
96	*Baeus* sp.	ASMII13201-22	-	Australia	Unpublished
97	*Baeus* sp.	OR909050.1	-	India	This study
98	*Baeus* sp.	KF679308.1	KF679321.1	-	Unpublished
99	*Baeus* sp.	CRBOA17855-23	-	Costa Rica	Unpublished
100	*Baeus* sp.	CRBOA22983-23	-	Costa Rica	Unpublished
101	*Baeus* sp.	CRBOA4237-23	-	Costa Rica	Unpublished
102	*Baeus* sp.	CRBOA18442-23	-	Costa Rica	Unpublished
103	*Baeus* sp.	GMADK072-16	-	Costa Rica	Unpublished
104	*Baeus* sp.	GMAAY145-16	-	Costa Rica	Unpublished
105	*Baeus* sp.	CRBOA4102-23	-	Costa Rica	Unpublished
106	*Baeus* sp.	GMABE125-16	-	Costa Rica	Unpublished
107	*Baeus* sp.	GMACT447-15	-	Costa Rica	Unpublished
108	*Baeus* sp.	GMACZ206-15	-	Costa Rica	Unpublished
109	*Baeus* sp.	GMAAR144-16	-	Costa Rica	Unpublished
110	*Baeus* sp.	GMACY666-15	-	Costa Rica	Unpublished
111	*Baeus* sp.	GMACZ203-15	-	Costa Rica	Unpublished
112	*Baeus* sp.	GMAAS480-16	-	Costa Rica	Unpublished
113	*Baeus* sp.	GMACU814-15	-	Costa Rica	Unpublished
114	*Baeus* sp.	GMADL055-16	-	Costa Rica	Unpublished
115	*Baeus* sp.	GMAAT539-16	-	Costa Rica	Unpublished
116	*Baeus* sp.	CRBOA18441-23	-	Costa Rica	Unpublished
117	*Baeus* sp.	GMHML181-16	-	Honduras	Unpublished
118	*Baeus* sp.	GMHML262-16	-	Honduras	Unpublished
119	*Baeus* sp.	GMHMP140-15	-	Honduras	Unpublished
120	*Baeus* sp.	GMADM087-16	-	Costa Rica	Unpublished
121	*Baeus* sp.	CRCEB37435-22	-	Costa Rica	Unpublished
122	*Baeus* sp.	GMADR043-16	-	Costa Rica	Unpublished
123	*Baeus* sp.	GMADZ077-16	-	Costa Rica	Unpublished
124	*Baeus* sp.	GMADL098-16	-	Costa Rica	Unpublished
125	*Baeus* sp.	GMAAL596-16	-	Costa Rica	Unpublished
126	*Baeus* sp.	GMADM094-16	-	Costa Rica	Unpublished
127	*Baeus* sp.	GMADR039-16	-	Costa Rica	Unpublished
128	*Idris* sp.	GMFRT136-15	-	USA	Unpublished
129	*Idris* sp.	KF679298.1	DQ888451.1	-	Unpublished
130	*Idris* sp.	KF679302.1	MF583398.1	USA	Unpublished
131	*Idris* sp.	-	KF679327.1	-	Unpublished
132	*Hickmanella* sp.	KF679311.1	KF679332.1	-	Unpublished
133	*Idris howardi*	GMPQW132-19	-	Pakistan	Unpublished
134	*Idris howardi*	GMGMV1553-20	-	Germany	Unpublished
135	*Idris howardi*	KUGLA260-22	-	Canada	Unpublished
136	*Idris howardi*	GMEGO131-14	-	Egypt	Unpublished
137	*Idris howardi*	BARSC518-16	-	Canada	Unpublished
138	*Idris howardi*	OPPQQ706-17	-	Canada	Unpublished
139	*Idris howardi*	OPPUE926-17	-	Canada	Unpublished
140	*Idris howardi*	GMGSC027-12	-	USA	Unpublished
141	*Idris howardi*	GMGSG073-12	-	USA	Unpublished
142	*Idris howardi*	OPPFQ4037-17	-	Canada	Unpublished
143	*Idris howardi*	OPPDS1542-17	-	Canada	Unpublished
144	*Idris elba*	MN135850.1	-	USA	Johnson et al. 2018
145	*Idris elba*	MN135849.1	-	Mexico	Johnson et al. 2018
146	*Idris elba*	MN135848.1	-	Mexico	Johnson et al. 2018
147	*Idris elba*	MN135847.1	-	Mexico	Johnson et al. 2018
148	*Idris elba*	MN135845.1	-	Mexico	Johnson et al. 2018
149	*Idris elba*	MN135846.1	-	Mexico	Johnson et al. 2018
150	*Idris* sp.	OPPEG1427-17	-	Canada	Unpublished
151	*Idris* sp.	MG499732.1	-	Canada	deWaard et al. 2019
152	*Idris* sp.	KM568582.1	-	Canada	Unpublished
153	*Idris* sp.	KR788961.1	-	Canada	Hebert et al. 2016
154	*Idris* sp.	KM567519.1	-	Canada	Unpublished
155	*Idris* sp.	KR790488.1	-	Canada	Hebert et al. 2016
156	*Idris* sp.	KR794787.1	-	Canada	Hebert et al. 2016
157	*Idris* sp.	KR808297.1	-	Canada	Hebert et al. 2016
158	*Idris* sp.	KR931352.1	-	Canada	Hebert et al. 2016

table continued

Sl.	Species	mt COI	28S rRNA	Location	References
159	*Idris* sp.	KR783452.1	-	Canada	Hebert et al. 2016
160	*Idris* sp.	KM557169.1	-	Canada	Unpublished
161	*Idris* sp.	KM568466.1	-	Canada	Unpublished
162	*Idris* sp.	KR926010.1	-	Canada	Hebert et al. 2016
163	*Idris* sp.	KM569072.1	-	Canada	Unpublished
164	*Idris* sp.	KM560556.1	-	Canada	Unpublished
165	*Idris* sp.	KM561854.1	-	Canada	Unpublished
166	*Ceratobaeus* sp.	DQ888380.1	DQ888437.1	-	Murphy et al. 2007
167	*Ceratobaeus* sp.	KF679300.1	KF679322.1	-	Unpublished
168	*Ceratobaeus* sp.	AACTA3622-20	-	Australia	Unpublished
169	*Ceratobaeus* sp.	GMAEA2655-22	-	Australia	Unpublished
170	*Ceratobaeus* sp.	GMAEA6701-22	-	Australia	Unpublished
171	*Ceratobaeus* sp.	GMAEA6790-22	-	Australia	Unpublished
172	*Ceratobaeus* sp.	GMAEA6752-22	-	Australia	Unpublished
173	*Ceratobaeus* sp.	MCCAA8820-20	-	Australia	Unpublished
174	*Ceratobaeus* sp.	MCCAA8663-20	-	Australia	Unpublished
175	*Ceratobaeus* sp.	ASMII1466-22	-	Australia	Unpublished
176	*Ceratobaeus* sp.	AUSBC1029-12	-	Australia	Unpublished
177	*Ceratobaeus* sp.	ASMII9041-22	-	Australia	Unpublished
178	*Ceratobaeus* sp.	MCCAA8773-20	-	Australia	Unpublished
179	*Ceratobaeus* sp.	GMAEA4663-22	-	Australia	Unpublished
180	*Ceratobaeus* sp.	ASMII7648-22	-	Australia	Unpublished
181	*Ceratobaeus* sp.	ASMII3157-22	-	Australia	Unpublished
182	*Ceratobaeus* sp.	GMAEA2048-22	-	Australia	Unpublished
183	*Ceratobaeus* sp.	GMAEA2730-22	-	Australia	Unpublished
184	*Ceratobaeus* sp.	AACTA5047-20	-	Australia	Unpublished
185	*Ceratobaeus* sp.	GMAEA1235-22	-	Australia	Unpublished
186	*Ceratobaeus* sp.	GMAEA1361-22	-	Australia	Unpublished
187	*Ceratobaeus* sp.	GMAEA3362-22	-	Australia	Unpublished
188	*Ceratobaeus* sp.	GMAEA6768-22	-	Australia	Unpublished
189	*Ceratobaeus* sp.	GMAEA3352-22	-	Australia	Unpublished
190	*Ceratobaeus* sp.	GMAEA5905-22	-	Australia	Unpublished
191	*Ceratobaeus* sp.	ASMII3136-22	-	Australia	Unpublished
192	*Ceratobaeus* sp.	ASMII10396-22	-	Australia	Unpublished
193	*Ceratobaeus* sp.	ASMII6981-22	-	Australia	Unpublished
194	*Ceratobaeus* sp.	ASMII3036-22	-	Australia	Unpublished
195	*Ceratobaeus* sp.	ASMII1465-22	-	Australia	Unpublished
196	*Ceratobaeus* sp.	ASMII1649-22	-	Australia	Unpublished
197	*Neobaeus* sp.	DQ888383.1	-	-	Murphy et al. 2007
198	*Neobaeus* sp.	GBAH3811-08	-	-	Murphy et al. 2007
199	*Idris* sp.	KF679314.1	KF679325.1	-	Unpublished
200	*Ceratobaeus masneri*	KF679303.1	KF679330.1	-	Unpublished
201	*Ceratobaeus* sp.	KF679318.1	KF679328.1	-	Unpublished
202	*Ceratobaeus* sp.	KF679317.1	KF679324.1	-	Unpublished
203	*Ceratobaeus* sp.	GMNZC336-14	-	New Zealand	Unpublished
204	*Ceratobaeus* sp.	NZIND072-22	-	New Zealand	Unpublished
205	*Ceratobaeus* sp.	MCCAA329-12	-	Australia	Unpublished
206	*Idris* sp.	NZIND090-22	-	New Zealand	Unpublished
207	*Idris* sp.	ASMII13291-22	-	Australia	Unpublished
208	*Idris* sp.	KF679299.1	KF679336.1	-	Unpublished
209	*Idris* sp.	KF679305.1	DQ888450.1	-	Murphy et al. 2007
210	*Idris* sp.	KF679301.1	KF679326.1	-	Unpublished
211	*Ceratobaeus* sp.	GBAH11055-15	-	Australia	Unpublished
212	*Idris* sp.	GMNZI842-14	-	New Zealand	Unpublished
213	*Idris* sp.	GMNZA277-14	-	New Zealand	Unpublished
214	*Idris* sp.	GMNZM518-14	-	New Zealand	Unpublished
215	*Idris* sp.	GMNZK880-14	-	New Zealand	Unpublished
216	*Idris* sp.	GMNZJ1090-14	-	New Zealand	Unpublished
217	*Idris* sp.	GMNZS1006-14	-	New Zealand	Unpublished
218	*Idris* sp.	GMNZI741-14	-	New Zealand	Unpublished
219	*Idris* sp.	GMNZA275-14	-	New Zealand	Unpublished
220	*Idris* sp.	NZHYM2007-13	-	New Zealand	Unpublished
221	*Idris* sp.	NZHYM2001-13	-	New Zealand	Unpublished
222	*Idris* sp.	GMNZV177-14	-	New Zealand	Unpublished
223	*Idris* sp.	GMNZS1060-14	-	New Zealand	Unpublished
224	*Idris* sp.	GMNZT160-14	-	New Zealand	Unpublished
225	*Idris* sp.	GMNZL602-14	-	New Zealand	Unpublished
226	*Idris* sp.	GMNZQ221-14	-	New Zealand	Unpublished
227	*Idris* sp.	GMNZJ1125-14	-	New Zealand	Unpublished
228	*Idris* sp.	GMNZS1079-14	-	New Zealand	Unpublished
229	*Idris* sp.	NZIND068-22	-	New Zealand	Unpublished
230	*Idris* sp.	GMNZI830-14	-	New Zealand	Unpublished
231	*Idris* sp.	GMNZI843-14	-	New Zealand	Unpublished
232	*Idris* sp.	GMNZX664-18	-	New Zealand	Unpublished
233	*Idris* sp.	GMNZX663-18	-	New Zealand	Unpublished
234	*Idris* sp.	NZHYM2670-18	-	New Zealand	Unpublished
235	*Idris* sp.	GMAEA7562-22	-	Australia	Unpublishd
236	*Idris* sp.	GMAEA8761-22	-	Australia	Unpublishd
237	*Idris* sp.	GMAEA7902-22	-	Australia	Unpublishd
238	*Idris* sp.	MCCAA1449-12	-	Australia	Unpublishd
239	*Idris* sp.	GMAEA2650-22	-	Australia	Unpublishd
240	*Idris* sp.	GMAEA8115-22	-	Australia	Unpublishd
241	*Idris* sp.	GMAEA4170-22	-	Australia	Unpublishd
242	*Idris* sp.	NZIND660-22	-	New Zealand	Unpublishd
243	*Idris* sp.	CNBAN639-13	-	Australia	Unpublishd
244	*Idris* sp.	MH794530.1	-	Phillipines	Johnson et al. 2018
245	*Idris* sp.	MH794529.1	-	Phillipines	Johnson et al. 2018
246	*Idris* sp.	MH794528.1	-	Phillipines	Johnson et al. 2018
247	*Idris* sp.	MH794527.1	-	Phillipines	Johnson et al. 2018
248	*Idris* sp.	MH794521.1	-	Malaysia	Johnson et al. 2018
249	*Idris* sp.	MH794520.1	-	Malaysia	Johnson et al. 2018
250	*Idris* sp.	MH794522.1	-	Thailand	Unpublished
251	*Idris* sp.	OPPCG1465-17	-	Canada	Unpublished
252	*Idris* sp.	KR364996.1	-	Canada	Unpublished
253	*Idris* sp.	KR878080.1	-	Canada	Hebert et al. 2016
254	*Idris* sp.	MG498976.1	-	Canada	deWaard et al. 2019

table continued

Sl.	Species	mt COI	28S rRNA	Location	References
255	*Idris* sp.	KR368403.1	-	Canada	Unpublished
256	*Idris* sp.	KR802533.1	-	Canada	Hebert et al. 2016
257	*Idris* sp.	KR796963.1	-	Canada	Hebert et al. 2016
258	*Idris* sp.	KR889031.1	-	Canada	Hebert et al. 2016
259	*Idris* sp.	KR372630.1	-	Canada	Unpublished
260	*Idris* sp.	MG380766.1	-	Canada	Unpublished
261	*Idris* sp.	BARSA234-15	-	Canada	Unpublished
262	*Idris* sp.	OPPQE2561-17	-	Canada	Unpublished
263	*Idris* sp.	KM562074.1	-	Canada	Unpublished
264	*Idris* sp.	KR371155.1	-	Canada	Unpublished
265	*Idris* sp.	KR368089.1	-	Canada	Unpublished
266	*Idris* sp.	KR368460.1	-	Canada	Unpublished
267	*Idris* sp.	KR374638.1	-	Canada	Unpublished
268	*Idris* sp.	KR365223.1	-	Canada	Unpublished
269	*Idris* sp.	KR366058.1	-	Canada	Unpublished
270	*Idris* sp.	KR365634.1	-	Canada	Unpublished
271	*Idris* sp.	KR373094.1	-	Canada	Unpublished
272	*Idris* sp.	KR372359.1	-	Canada	Unpublished
273	*Idris* sp.	KR368133.1	-	Canada	Unpublished
274	*Idris* sp.	KR374425.1	-	Canada	Unpublished
275	*Idris* sp.	KR371123.1	-	Canada	Unpublished
276	*Idris* sp.	KR889626.1	-	Canada	Hebert et al. 2016
277	*Idris* sp.	OPPOG601-17	-	Canada	Unpublished
278	*Idris* sp.	KR370117.1	-	Canada	Unpublished
279	*Idris* sp.	KR375574.1	-	Canada	Unpublished
280	*Idris* sp.	MG376377.1	-	Canada	deWaard et al. 2019
281	*Idris* sp.	MG381111.1	-	Canada	Unpublished
282	*Idris* sp.	KR801270.1	-	Canada	Hebert et al. 2016
283	*Idris* sp.	KR786454.1	-	Canada	Hebert et al. 2016
284	*Idris* sp.	KR801020.1	-	Canada	Hebert et al. 2016
285	*Idris* sp.	KR809267.1	-	Canada	Hebert et al. 2016
286	*Idris* sp.	KR897060.1	-	Canada	Hebert et al. 2016
287	*Idris* sp.	SSWBA533-21	-	Canada	Unpublished
288	*Idris* sp.	KM564732.1	-	Canada	Unpublished
289	*Idris* sp.	KM557803.1	-	Canada	Unpublished
290	*Idris* sp.	KM560839.1	-	Canada	Unpublished
291	*Idris* sp.	SSWBA527-21	-	Canada	Unpublished
292	*Idris* sp.	KM562872.1	-	Canada	Unpublished
293	*Idris* sp.	KR883817.1	-	Canada	Hebert et al. 2016
294	*Idris* sp.	MG514562.1	-	Canada	deWaard et al. 2019
295	*Idris* sp.	KR792678.1	-	Canada	Hebert et al. 2016
296	*Idris* sp.	KM567577.1	-	Canada	Unpublished
297	*Idris* sp.	KM555993.1	-	Canada	Unpublished
298	*Idris* sp.	KR890404.1	-	Canada	Hebert et al. 2016
299	*Idris* sp.	MG374651.1	-	Canada	Unpublished
300	*Idris* sp.	KR879606.1	-	Canada	Hebert et al. 2016
301	*Idris* sp.	KR873956.1	-	Canada	Hebert et al. 2016
302	*Idris* sp.	KR373875.1	-	Canada	Unpublished
303	*Idris* sp.	KR373109.1	-	Canada	Unpublished
304	*Idris* sp.	KR371283.1	-	Canada	Unpublished
305	*Idris* sp.	KR371244.1	-	Canada	Unpublished
306	*Idris* sp.	KR369018.1	-	Canada	Unpublished
307	*Idris* sp.	KR365121.1	-	Canada	Unpublished
308	*Idris* sp.	KR368574.1	-	Canada	Unpublished
309	*Idris* sp.	KR367538.1	-	Canada	Unpublished
310	*Idris* sp.	KR370772.1	-	Canada	Unpublished
311	*Idris* sp.	KR368444.1	-	Canada	Unpublished
312	*Idris* sp.	KR368330.1	-	Canada	Unpublished
313	*Idris* sp.	KR371670.1	-	Canada	Unpublished
314	*Idris* sp.	KR369422.1	-	Canada	Unpublished
315	*Idris* sp.	KR367173.1	-	Canada	Unpublished
316	*Idris* sp.	KR372469.1	-	Canada	Unpublished
317	*Idris* sp.	KR372714.1	-	Canada	Unpublished
318	*Idris* sp.	KR370909.1	-	Canada	Unpublished
319	*Idris* sp.	KR896617.1	-	Canada	Hebert et al. 2016
320	*Idris* sp.	KR881848.1	-	Canada	Hebert et al. 2016
321	*Idris* sp.	KR894355.1	-	Canada	Hebert et al. 2016
322	*Idris* sp.	KR895770.1	-	Canada	Hebert et al. 2016
323	*Idris* sp.	KR878951.1	-	Canada	Hebert et al. 2016
324	*Idris* sp.	KR881527.1	-	Canada	Hebert et al. 2016
325	*Idris* sp.	KR879860.1	-	Canada	Hebert et al. 2016
326	*Idris* sp.	KR896819.1	-	Canada	Hebert et al. 2016
327	*Idris* sp.	KR900193.1	-	Canada	Hebert et al. 2016
328	*Idris* sp.	KR901384.1	-	Canada	Hebert et al. 2016
329	*Idris* sp.	KR895467.1	-	Canada	Hebert et al. 2016
330	*Idris* sp.	KR886532.1	-	Canada	Hebert et al. 2016
331	*Idris* sp.	KR887883.1	-	Canada	Hebert et al. 2016
332	*Idris* sp.	KR892742.1	-	Canada	Hebert et al. 2016
333	*Idris* sp.	KR887499.1	-	Canada	Hebert et al. 2016
334	*Idris* sp.	KR896325.1	-	Canada	Hebert et al. 2016
335	*Idris* sp.	KR896159.1	-	Canada	Hebert et al. 2016
336	*Idris* sp.	KR892581.1	-	Canada	Hebert et al. 2016
337	*Idris* sp.	KR879726.1	-	Canada	Hebert et al. 2016
338	*Idris* sp.	KR883244.1	-	Canada	Hebert et al. 2016
339	*Idris* sp.	KR897405.1	-	Canada	Hebert et al. 2016
340	*Idris* sp.	KR887210.1	-	Canada	Hebert et al. 2017
341	*Idris* sp.	KR887976.1	-	Canada	Hebert et al. 2016
342	*Idris* sp.	KR885139.1	-	Canada	Hebert et al. 2016
343	*Idris* sp.	KR893541.1	-	Canada	Hebert et al. 2016
344	*Idris* sp.	KR886546.1	-	Canada	Hebert et al. 2016
345	*Idris* sp.	KR899463.1	-	Canada	Hebert et al. 2016
346	*Idris* sp.	KR895557.1	-	Canada	Hebert et al. 2016
347	*Idris* sp.	KR900248.1	-	Canada	Hebert et al. 2016
348	*Idris* sp.	KR895648.1	-	Canada	Hebert et al. 2016
349	*Idris* sp.	KR874839.1	-	Canada	Hebert et al. 2016
350	*Idris* sp.	KR899457.1	-	Canada	Hebert et al. 2016

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Sl.	Species	mt COI	28S rRNA	Location	References
351	*Idris* sp.	KR877218.1	-	Canada	Hebert et al. 2016
352	*Idris* sp.	KR890325.1	-	Canada	Hebert et al. 2016
353	*Idris* sp.	MG378664.1	-	Canada	Unpublished
354	*Idris* sp.	KR889851.1	-	Canada	Hebert et al. 2016
355	*Idris* sp.	KR892817.1	-	Canada	Hebert et al. 2016
356	*Idris* sp.	KR877995.1	-	Canada	Hebert et al. 2016
357	*Idris* sp.	KR886518.1	-	Canada	Hebert et al. 2016
358	*Idris* sp.	KR880300.1	-	Canada	Hebert et al. 2016
359	*Idris* sp.	KR883369.1	-	Canada	Hebert et al. 2016
360	*Idris* sp.	KR879830.1	-	Canada	Hebert et al. 2016
361	*Idris* sp.	KR876908.1	-	Canada	Hebert et al. 2016
362	*Idris* sp.	KR898586.1	-	Canada	Hebert et al. 2016
363	*Idris* sp.	KR877442.1	-	Canada	Hebert et al. 2016
364	*Idris* sp.	KR892529.1	-	Canada	Hebert et al. 2016
365	*Idris* sp.	KR901933.1	-	Canada	Hebert et al. 2016
366	*Idris* sp.	KR880643.1	-	Canada	Hebert et al. 2016
367	*Idris* sp.	KR880645.1	-	Canada	Hebert et al. 2016
368	*Idris* sp.	KR880448.1	-	Canada	Hebert et al. 2016
369	*Idris* sp.	KR878621.1	-	Canada	Hebert et al. 2016
370	*Idris* sp.	KR885394.1	-	Canada	Hebert et al. 2016
371	*Idris* sp.	KR889517.1	-	Canada	Hebert et al. 2016
372	*Idris* sp.	KR879423.1	-	Canada	Hebert et al. 2016
373	*Idris* sp.	KR876451.1	-	Canada	Hebert et al. 2016
374	*Idris* sp.	KR895390.1	-	Canada	Hebert et al. 2016
375	*Idris* sp.	KR876748.1	-	Canada	Hebert et al. 2016
376	*Idris* sp.	KR886223.1	-	Canada	Hebert et al. 2016
377	*Idris* sp.	KR886378.1	-	Canada	Hebert et al. 2016
378	*Idris* sp.	KR886636.1	-	Canada	Hebert et al. 2016
379	*Idris* sp.	KR886360.1	-	Canada	Hebert et al. 2016
380	*Idris* sp.	KR880873.1	-	Canada	Hebert et al. 2016
381	*Idris* sp.	KR898421.1	-	Canada	Hebert et al. 2016
382	*Idris* sp.	KR897789.1	-	Canada	Hebert et al. 2016
383	*Idris* sp.	KR887841.1	-	Canada	Hebert et al. 2016
384	*Idris* sp.	KR873564.1	-	Canada	Hebert et al. 2016
385	*Idris* sp.	KR875128.1	-	Canada	Hebert et al. 2016
386	*Idris* sp.	KR888700.1	-	Canada	Hebert et al. 2016
387	*Idris* sp.	KR876161.1	-	Canada	Hebert et al. 2016
388	*Idris* sp.	KR885741.1	-	Canada	Hebert et al. 2016
389	*Idris* sp.	KR896167.1	-	Canada	Hebert et al. 2016
390	*Idris* sp.	KR893253.1	-	Canada	Hebert et al. 2016
391	*Idris* sp.	KR877316.1	-	Canada	Hebert et al. 2016
392	*Idris* sp.	KR876582.1	-	Canada	Hebert et al. 2016
393	*Idris* sp.	KR897354.1	-	Canada	Hebert et al. 2016
394	*Idris* sp.	KR892855.1	-	Canada	Hebert et al. 2016
395	*Idris* sp.	KR892193.1	-	Canada	Hebert et al. 2016
396	*Idris* sp.	KR874335.1	-	Canada	Hebert et al. 2016
397	*Idris* sp.	KR881315.1	-	Canada	Hebert et al. 2016
398	*Idris* sp.	KR887211.1	-	Canada	Hebert et al. 2016
399	*Idris* sp.	KR929293.1	-	Canada	Hebert et al. 2016
400	*Idris* sp.	KR886702.1	-	Canada	Hebert et al. 2016
401	*Idris* sp.	KR899397.1	-	Canada	Hebert et al. 2016
402	*Idris* sp.	KR885876.1	-	Canada	Hebert et al. 2016
403	*Idris* sp.	KR895840.1	-	Canada	Hebert et al. 2016
404	*Idris* sp.	KR891008.1	-	Canada	Hebert et al. 2016
405	*Idris* sp.	KR901816.1	-	Canada	Hebert et al. 2016
406	*Idris* sp.	KU064691.1	-	Republic of Korea	Unpublished
407	*Idris* sp.	KU064689.1	-	Republic of Korea	Unpublished
408	*Idris* sp.	KU064690.1	-	Republic of Korea	Unpublished
409	*Idris* sp.	GMIAE739-17	-	Indonesia	Unpublished
410	*Idris* sp.	GMIAK7502-18	-	Indonesia	Unpublished
411	*Idris* sp.	GMIAK7618-18	-	Indonesia	Unpublished
412	*Idris* sp.	GMIAC364-17	-	Indonesia	Unpublished
413	*Idris* sp.	GMIAI481-17	-	Indonesia	Unpublished
414	*Idris* sp.	GMIAG518-17	-	Indonesia	Unpublished
415	*Idris* sp.	GMIAH1461-18	-	Indonesia	Unpublished
416	*Idris* sp.	GMIAJ334-17	-	Indonesia	Unpublished
417	*Idris* sp.	GMIBB177-17	-	Indonesia	Unpublished
418	*Idris* sp.	GMMBZ093-17	-	Malaysia	Unpublished
419	*Idris* sp.	MH794518.1	-	Singapore	Johnson et al. 2018
420	*Idris* sp.	MH794517.1	-	Singapore	Johnson et al. 2018
421	*Idris* sp.	MH794532.1	-	Philippines	Johnson et al. 2018
422	*Idris* sp.	MH794515.1	-	Singapore	Johnson et al. 2018
423	*Idris* sp.	MH794523.1	-	Philippines	Johnson et al. 2018
424	*Idris* sp.	MH794514.1	-	Singapore	Johnson et al. 2018
425	*Idris* sp.	MH794513.1	-	Singapore	Johnson et al. 2018
426	*Idris* sp.	MH794516.1	-	Singapore	Johnson et al. 2018
427	*Idris* sp.	MH794526.1	-	Philippines	Johnson et al. 2018
428	*Idris* sp.	MH794524.1	-	Philippines	Johnson et al. 2018
429	*Idris* sp.	MH794531.1	-	Philippines	Johnson et al. 2018
430	*Idris* sp.	MH794519.1	-	Malaysia	Johnson et al. 2018
431	*Idris* sp.	MH794525.1	-	Philippines	Johnson et al. 2018
432	*Idris* sp.	PLAAY2048-18	-	Costa Rica	Unpublished
433	*Idris* sp.	PLLAZ1246-20	-	Costa Rica	Unpublished
434	*Idris* sp.	PLECY2359-20	-	Costa Rica	Unpublished
435	*Idris* sp.	PLUAX697-20	-	Costa Rica	Unpublished
436	*Idris* sp.	PLUBK414-20	-	Costa Rica	Unpublished
437	*Idris* sp.	PLXDI2396-21	-	Costa Rica	Unpublished
438	*Idris* sp.	GMCRJ307-13	-	Costa Rica	Unpublished
439	*Idris* sp.	PLAEL538-21	-	Costa Rica	Unpublished
440	*Idris* sp.	PLECK3889-20	-	Costa Rica	Unpublished
441	*Idris* sp.	PLXDL2241-21	-	Costa Rica	Unpublished
442	*Idris* sp.	PLXCG1541-20	-	Costa Rica	Unpublished
443	*Idris* sp.	PLABG4096-18	-	Costa Rica	Unpublished
444	*Idris* sp.	PLXDB2885-20	-	Costa Rica	Unpublished
445	*Idris* sp.	PLZAM174-20	-	Costa Rica	Unpublished
446	*Idris* sp.	PLSAJ456-20	-	Costa Rica	Unpublished

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Sl.	Species	mt COI	28S rRNA	Location	References
447	*Idris* sp.	PLTCU329-20	-	Costa Rica	Unpublished
448	*Idris* sp.	PLECQ1157-20	-	Costa Rica	Unpublished
449	*Idris* sp.	PLSBE1573-20	-	Costa Rica	Unpublished
450	*Idris* sp.	PLKDE391-20	-	Costa Rica	Unpublished
451	*Idris* sp.	PLVDE3530-20	-	Costa Rica	Unpublished
452	*Idris* sp.	PLACL379-20	-	Costa Rica	Unpublished
453	*Idris* sp.	PLECJ4491-20	-	Costa Rica	Unpublished
454	*Idris* sp.	PLXCQ733-20	-	Costa Rica	Unpublished
455	*Idris* sp.	PLRDE370-20	-	Costa Rica	Unpublished
456	*Idris* sp.	PLPDB1572-20	-	Costa Rica	Unpublished
457	*Idris* sp.	PLXDK1851-21	-	Costa Rica	Unpublished
458	*Idris* sp.	PLZBV317-20	-	Costa Rica	Unpublished
459	*Idris* sp.	PLSAN163-20	-	Costa Rica	Unpublished
460	*Idris* sp.	PLXDI2273-21	-	Costa Rica	Unpublished
461	*Idris* sp.	PLABJ1627-19	-	Costa Rica	Unpublished
462	*Idris* sp.	PLXDC3319-20	-	Costa Rica	Unpublished
463	*Idris* sp.	PLFET323-21	-	Costa Rica	Unpublished
464	*Idris* sp.	PLAAS743-18	-	Costa Rica	Unpublished
465	*Idris* sp.	PLXDF2639-20	-	Costa Rica	Unpublished
466	*Idris* sp.	PLADB821-20	-	Costa Rica	Unpublished
467	*Idris* sp.	PLZAX469-20	-	Costa Rica	Unpublished
468	*Idris* sp.	PLFBT909-19	-	Costa Rica	Unpublished
469	*Idris* sp.	PLUAY1003-20	-	Costa Rica	Unpublished
470	*Idris* sp.	PLXDG2168-21	-	Costa Rica	Unpublished
471	*Idris* sp.	PLXDJ2159-21	-	Costa Rica	Unpublished
472	*Idris* sp.	PLFAC1430-19	-	Costa Rica	Unpublished
473	*Idris* sp.	PLABG3307-18	-	Costa Rica	Unpublished
474	*Idris* sp.	PLXCQ661-20	-	Costa Rica	Unpublished
475	*Idris* sp.	PLXDJ2032-21	-	Costa Rica	Unpublished
476	*Idris* sp.	PLAAC4903-18	-	Costa Rica	Unpublished
477	*Idris* sp.	PLXDH2134-21	-	Costa Rica	Unpublished
478	*Idris* sp.	PLECX909-20	-	Costa Rica	Unpublished
479	*Idris* sp.	PLECJ3173-20	-	Costa Rica	Unpublished
480	*Idris* sp.	PLXDB2976-20	-	Costa Rica	Unpublished
481	*Idris* sp.	PLXDD3860-20	-	Costa Rica	Unpublished
482	*Idris* sp.	PLEBI149-19	-	Costa Rica	Unpublished
483	*Idris* sp.	PLECZ3432-20	-	Costa Rica	Unpublished
484	*Idris* sp.	PLZAY388-20	-	Costa Rica	Unpublished
485	*Idris* sp.	PLXCM157-20	-	Costa Rica	Unpublished
486	*Idris* sp.	PLABC3590-18	-	Costa Rica	Unpublished
487	*Idris* sp.	PLXDD2587-20	-	Costa Rica	Unpublished
488	*Idris* sp.	PLECR928-20	-	Costa Rica	Unpublished
489	*Idris* sp.	PLXDF2181-20	-	Costa Rica	Unpublished
490	*Idris* sp.	PLXDI2321-21	-	Costa Rica	Unpublished
491	*Idris* sp.	PLABK2060-19	-	Costa Rica	Unpublished
492	*Idris* sp.	PLEDF3489-20	-	Costa Rica	Unpublished
493	*Idris* sp.	PLXCP1265-20	-	Costa Rica	Unpublished
494	*Idris* sp.	PLSAM321-20	-	Costa Rica	Unpublished
495	*Idris* sp.	PLTDD811-20	-	Costa Rica	Unpublished
496	*Idris* sp.	PLFCI694-20	-	Costa Rica	Unpublished
497	*Idris* sp.	PLHAJ097-19	-	Costa Rica	Unpublished
498	*Idris* sp.	PLFEM256-21	-	Costa Rica	Unpublished
499	*Idris* sp.	PLXCP1262-20	-	Costa Rica	Unpublished
500	*Idris* sp.	PLAEG1064-21	-	Costa Rica	Unpublished
501	*Idris* sp.	PLACH401-20	-	Costa Rica	Unpublished
502	*Idris* sp.	PLLAJ1067-20	-	Costa Rica	Unpublished
503	*Idris* sp.	KM996909.1	-	USA	Unpublished
504	*Idris* sp.	PLABE7699-18	-	Costa Rica	Unpublished
505	*Idris* sp.	PLKDH164-20	-	Costa Rica	Unpublished
506	*Idris* sp.	PLFFB719-21	-	Costa Rica	Unpublished
507	*Idris* sp.	PLUAY880-20	-	Costa Rica	Unpublished
508	*Idris* sp.	JCCCR642-16	-	Costa Rica	Unpublished
509	*Idris* sp.	JCCCC1934-16	-	Costa Rica	Unpublished
510	*Idris* sp.	JCCCH685-16	-	Costa Rica	Unpublished
511	*Idris* sp.	PLIDE278-20	-	Costa Rica	Unpublished
512	*Idris* sp.	PLLAY2506-20	-	Costa Rica	Unpublished
513	*Idris* sp.	PLPCR482-20	-	Costa Rica	Unpublished
514	*Idris* sp.	PLABF6009-19	-	Costa Rica	Unpublished
515	*Idris* sp.	JCCCG128-16	-	Costa Rica	Unpublished
516	*Idris* sp.	JCCCJ450-16	-	Costa Rica	Unpublished
517	*Idris* sp.	JCCCJ153-16	-	Costa Rica	Unpublished
518	*Idris* sp.	JCCCI436-16	-	Costa Rica	Unpublished
519	*Idris* sp.	JCCCC2266-16	-	Costa Rica	Unpublished
520	*Idris* sp.	JICCX763-16	-	Costa Rica	Unpublished
521	*Idris* sp.	PLPCN334-20	-	Costa Rica	Unpublished
522	*Idris* sp.	PLXDH1715-21	-	Costa Rica	Unpublished
523	*Idris* sp.	JCCCH691-16	-	Costa Rica	Unpublished
524	*Idris* sp.	PLXDI2397-21	-	Costa Rica	Unpublished
525	*Idris* sp.	PLXCD1094-20	-	Costa Rica	Unpublished
526	*Idris* sp.	PLXDF2287-20	-	Costa Rica	Unpublished
527	*Idris* sp.	PLLAW1316-20	-	Costa Rica	Unpublished
528	*Idris* sp.	PLABV681-19	-	Costa Rica	Unpublished
529	*Idris* sp.	PLADI262-20	-	Costa Rica	Unpublished
530	*Idris* sp.	PLXDC4019-20	-	Costa Rica	Unpublished
531	*Idris* sp.	PLWCZ355-21	-	Costa Rica	Unpublished
532	*Idris* sp.	PLXDH2081-21	-	Costa Rica	Unpublished
533	*Idris* sp.	PLQBQ444-20	-	Costa Rica	Unpublished
534	*Idris* sp.	PLXDP1204-21	-	Costa Rica	Unpublished
535	*Idris* sp.	PLSAL224-20	-	Costa Rica	Unpublished
536	*Idris* sp.	PLCFA559-21	-	Costa Rica	Unpublished
537	*Idris* sp.	PLTCO151-20	-	Costa Rica	Unpublished
538	*Idris* sp.	PLWDD447-21	-	Costa Rica	Unpublished
539	*Idris* sp.	PLNDF1180-20	-	Costa Rica	Unpublished
540	*Idris* sp.	PLABH3327-19	-	Costa Rica	Unpublished
541	*Idris* sp.	PLUAZ1140-20	-	Costa Rica	Unpublished
542	*Idris* sp.	PLCDC157-20	-	Costa Rica	Unpublished

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Sl.	Species	mt COI	28S rRNA	Location	References
543	*Idris* sp.	PLPCF3221-20	-	Costa Rica	Unpublished
544	*Idris* sp.	PLSAD416-20	-	Costa Rica	Unpublished
545	*Idris* sp.	PLUAT489-20	-	Costa Rica	Unpublished
546	*Idris* sp.	PLUAX710-20	-	Costa Rica	Unpublished
547	*Idris* sp.	PLFDE1525-20	-	Costa Rica	Unpublished
548	*Idris* sp.	PLXDF2172-20	-	Costa Rica	Unpublished
549	*Idris* sp.	PLTBB172-20	-	Costa Rica	Unpublished
550	*Idris* sp.	PLFCW557-20	-	Costa Rica	Unpublished
551	*Idris* sp.	PLUAZ2234-20	-	Costa Rica	Unpublished
552	*Idris* sp.	PLAFA428-21	-	Costa Rica	Unpublished
553	*Idris* sp.	PLEDB883-20	-	Costa Rica	Unpublished
554	*Idris* sp.	PLXDF2289-20	-	Costa Rica	Unpublished
555	*Idris* sp.	PLXDG1836-21	-	Costa Rica	Unpublished
556	*Idris* sp.	PLUAY941-20	-	Costa Rica	Unpublished
557	*Idris* sp.	PLLAU429-20	-	Costa Rica	Unpublished
558	*Idris* sp.	JCCCT1573-16	-	Costa Rica	Unpublished
559	*Idris* sp.	PLXDJ2236-21	-	Costa Rica	Unpublished
560	*Idris* sp.	PLZAZ686-20	-	Costa Rica	Unpublished
561	*Ceratobaeus* sp.	OR911607.1	-	India	Unpublished
562	*Idris* sp.	KP271246.1	-	India	Unpublished
563	*Idris* sp.	OR699984.1	-	India	This study
564	*Idris bharati*	OR665339.1	-	India	Debnath et al. 2024
565	*Idris sp5*	OR621065.1	-	India	This study
566	*Idris hirsutus*	OR699986.1	-	India	Patra et al. 2024
567	*Idris sp1*	OR621048.1	-	India	This study
568	*Idris sp4*	OR699994.1	-	India	This study
569	*Idris sp6*	OR665337.1	-	India	This study
570	*Ceratobaeus* sp.	OR911586.1	-	India	This study
571	*Odontacolus* sp.	PLACM275-20	-	Costa Rica	Unpublished
572	*Odontacolus* sp.	PLTBH196-20	-	Costa Rica	Unpublished
573	*Odontacolus* sp.	PLUAJ583-20	-	Costa Rica	Unpublished
574	*Odontacolus* sp.	PLUAN385-20	-	Costa Rica	Unpublished
575	*Odontacolus* sp.	PLUAG525-20	-	Costa Rica	Unpublished
576	*Odontacolus* sp.	PLUAF530-20	-	Costa Rica	Unpublished
577	*Odontacolus* sp.	PLUBV141-20	-	Costa Rica	Unpublished
578	*Odontacolus* sp.	PLQBI489-20	-	Costa Rica	Unpublished
579	*Odontacolus* sp.	PLUAV601-20	-	Costa Rica	Unpublished
580	*Odontacolus* sp.	PLICF172-20	-	Costa Rica	Unpublished
581	*Odontacolus* sp.	PLSBZ408-20	-	Costa Rica	Unpublished
582	*Odontacolus* sp.	PLUAD924-20	-	Costa Rica	Unpublished
583	*Odontacolus* sp.	PLFEI307-21	-	Costa Rica	Unpublished
584	*Odontacolus* sp.	PLECG2601-20	-	Costa Rica	Unpublished
585	*Odontacolus* sp.	PLEDZ850-20	-	Costa Rica	Unpublished
586	*Odontacolus berryae*	NZIND274-22	-	New Zealand	Unpublished
587	*Odontacolus markadicus*	OR232210.1	-	India	Debnath et al. 2024
588	*Odontacolus markadicus*	OR621046.1	-	India	This study
589	*Odontacolus* sp.	DQ888459.1	-	Canada	Hebert et al. 2016
590	*Odontacolus* sp.	KF679316.1	KF679320.1	-	Unpublished
591	*Ceratobaeus* sp.	KF679312.1	-	-	Unpublished
592	*Neobaeus novazealandensis*	KF679309.1	KF679341.1	-	Unpublished
593	*Mirobaeoides* sp.	KF679307.1	KF679334.1	-	Unpublished
594	*Mirobaeoides* sp.	DQ888375.1	DQ888429.1	-	Murphy et al. 2007
595	*Odontacolus* sp.	MF583420.1	-	Thailand	Unpublished
596	*Triteleia* sp.	GMCCD1190-17	-	Costa Rica	Unpublished
597	*Triteleia* sp.	DQ888427.1	DQ888502.1	-	Murphy et al. 2007
598	*Triteleia* sp.	GMABJ022-16	-	Costa Rica	Unpublished
599	*Triteleia* sp.	GMACF753-15	-	Costa Rica	Unpublished
600	*Triteleia* sp.	GMCDF1947-16	-	Costa Rica	Unpublished
601	*Triteleia* sp.	GMACC591-15	-	Costa Rica	Unpublished
602	*Triteleia* sp.	MF583517.1	MF583391.1	Fiji	Unpublished