Invertebrate Systematics, 2020, **34**, 757–768
doi:10.1071/IS20004_AC

Supplementary material

Using multiple lines of evidence to delimit protogynes and deutogynes of four-legged mites: a case study on *Epitrimerus sabinae s.l.* (Acari : Eriophyidae)

Yue Yin[A], *Liang-Fei Yao*[A], *Qi Zhang*[A], *Paul D. N. Hebert*[B] *and Xiao-Feng Xue*[A,C]

[A]Department of Entomology, Nanjing Agricultural University, Nanjing,

Jiangsu, 210095, PR China.

[B]Centre for Biodiversity Genomics, University of Guelph, 50 Stone Road East,

Guelph, ON, N1G 2W1, Canada.

[C]Corresponding author. Email: xfxue@njau.edu.cn

Additional supporting information may be found in the online version of this article can be found on the following pages.

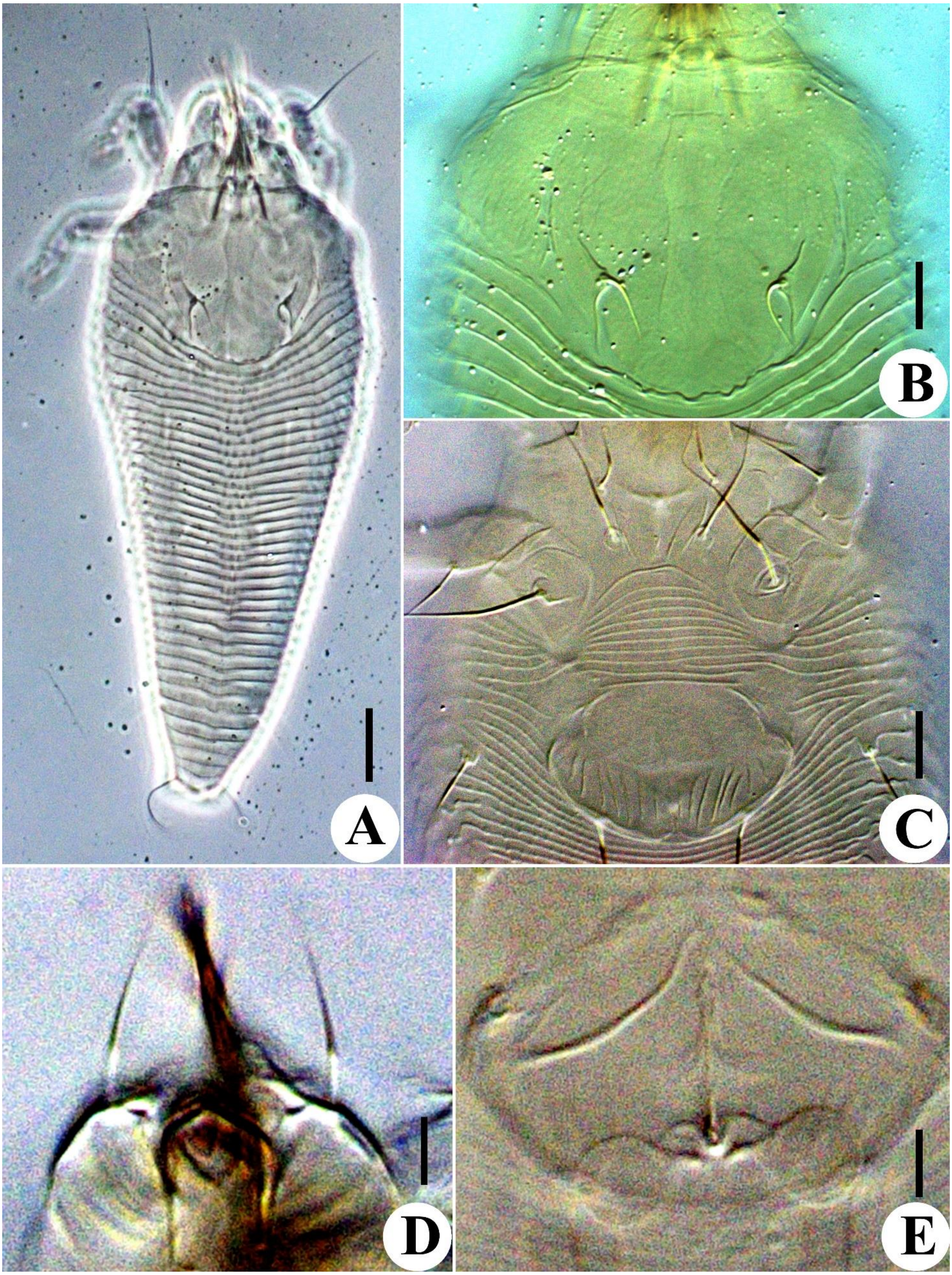

Fig. S1. *Epitrimerus sabinae s.s. A*, dorsal view of female; *B*, variable pattern of prodorsal shield; *C*, coxae and female genitalia; *D*, dorsal pedipalp genual setae *d*; *E*, internal genitalia of female. Scale bar: 20 μm for *A*; 10 μm for *B*, *C*; 3 μm for *D*, *E*.

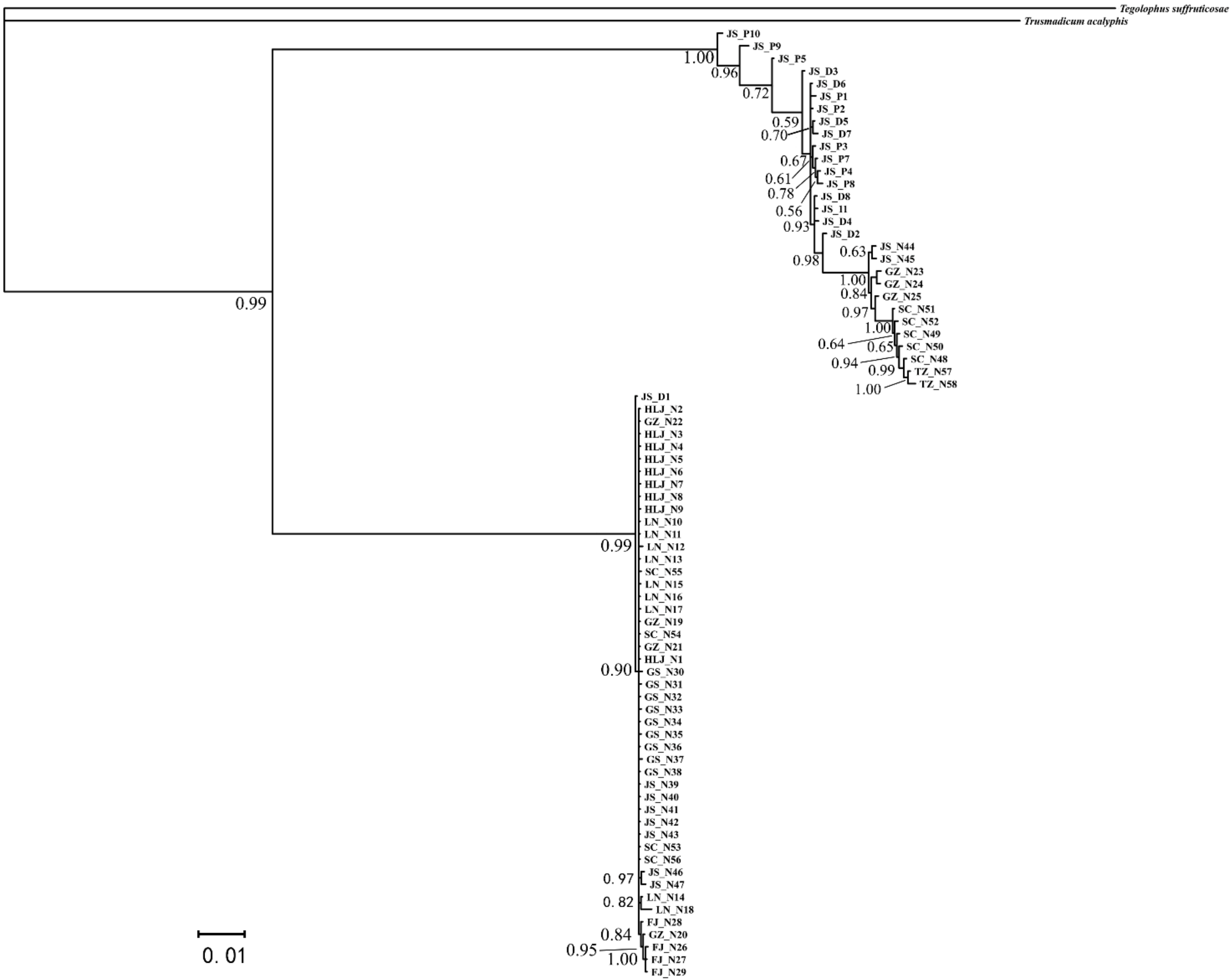

Fig. S2. Phylogenetic trees inferred from the nucleotide sequences of two mitochondrial (*COI* and *12S*) and two nuclear (*18S* and *28S*) gene fragments using the Bayesian method. Node numbers indicate Bayesian posterior probabilities (BPP).

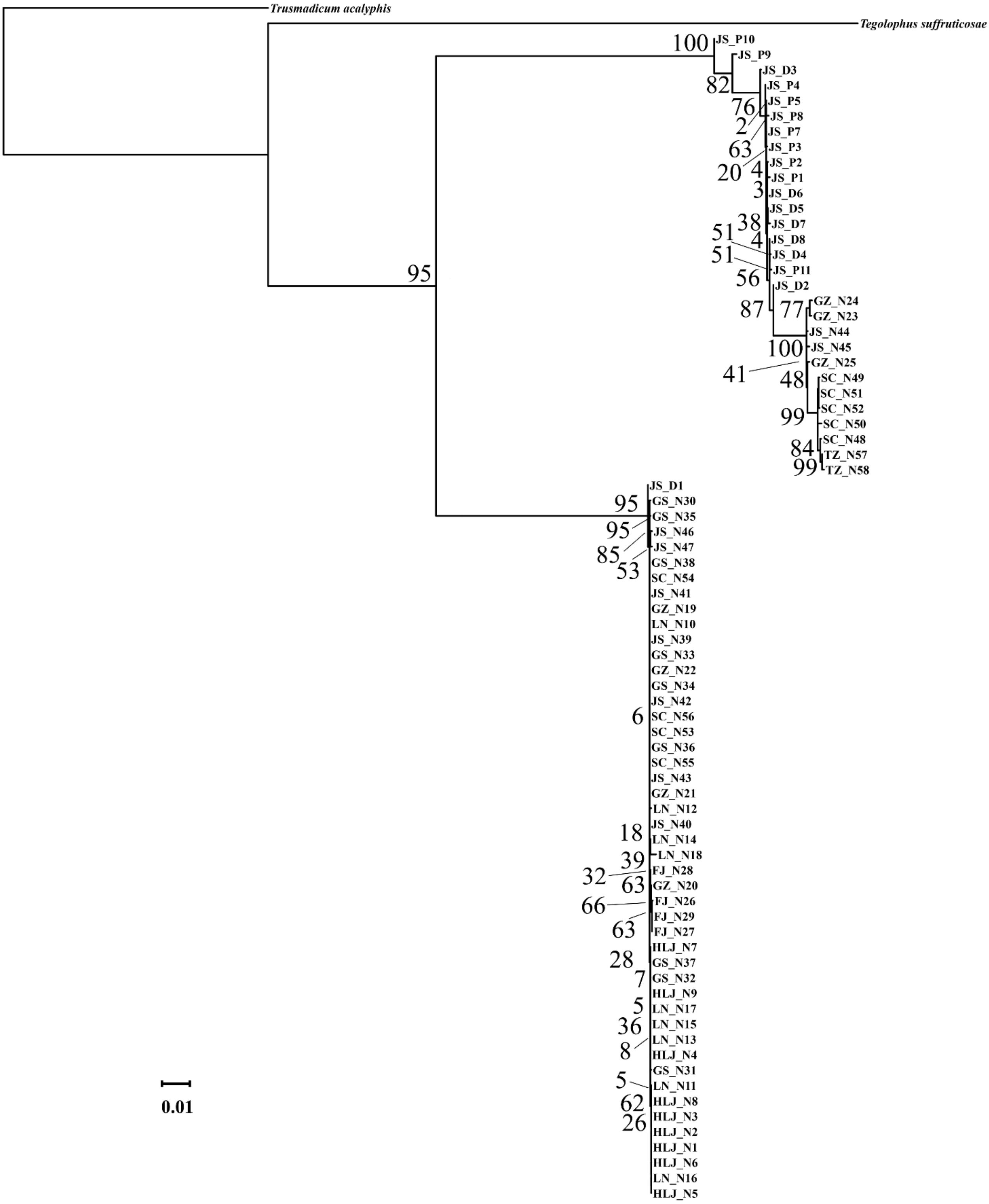

Fig. S3. Phylogenetic trees inferred from the nucleotide sequences of two mitochondrial (*COI* and *12S*) and two nuclear (*18S* and *28S*) gene fragments using the maximum likelihood method. Node numbers indicate maximum likelihood bootstrap proportion (BSP).

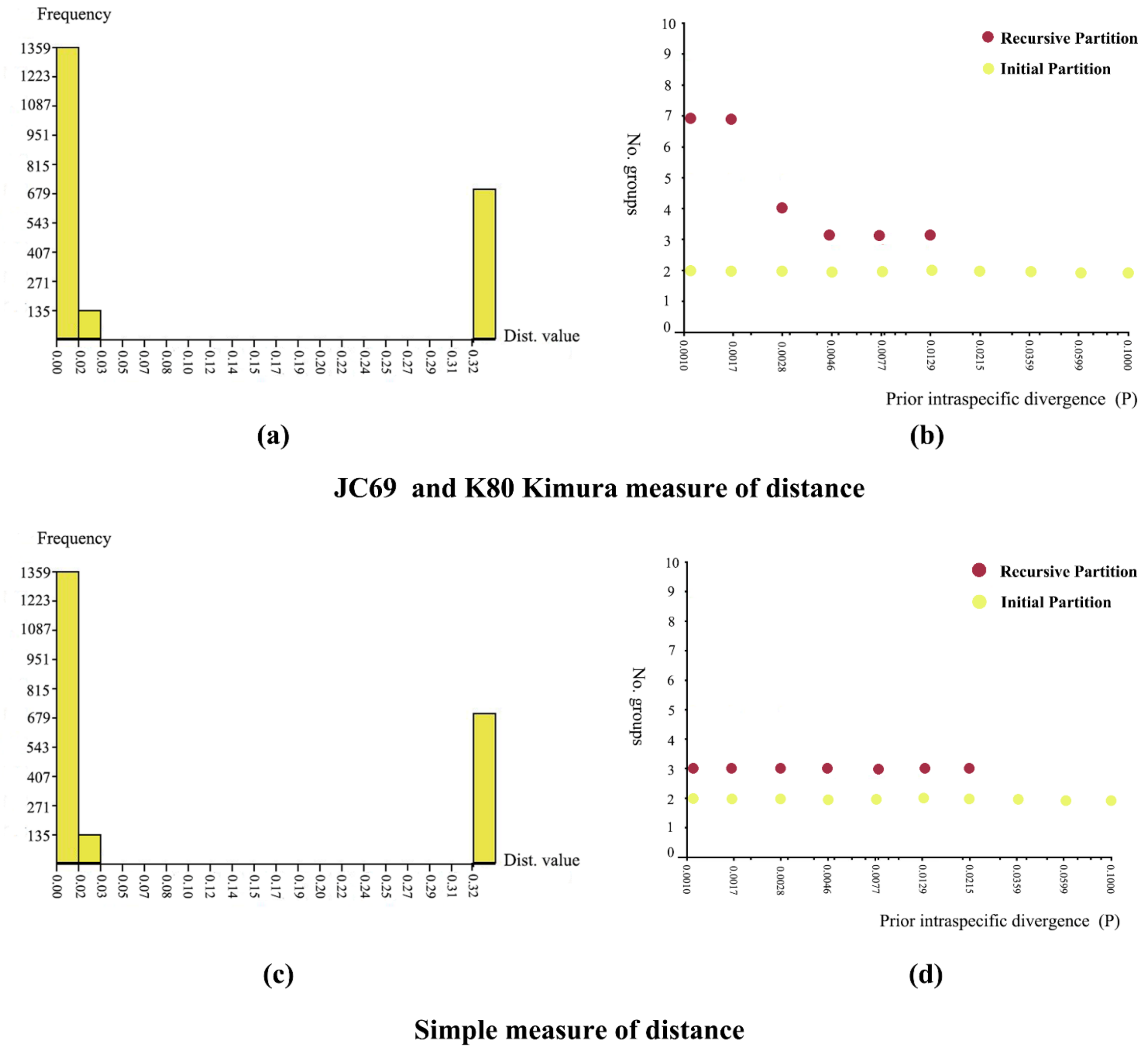

Fig. S4. Automatic Barcode Gap Discovery species delimitation. (a, c) Frequency histogram of Simple/JC69/K80 pairwise distances; (b, d) partitions under different prior intraspecific divergences.

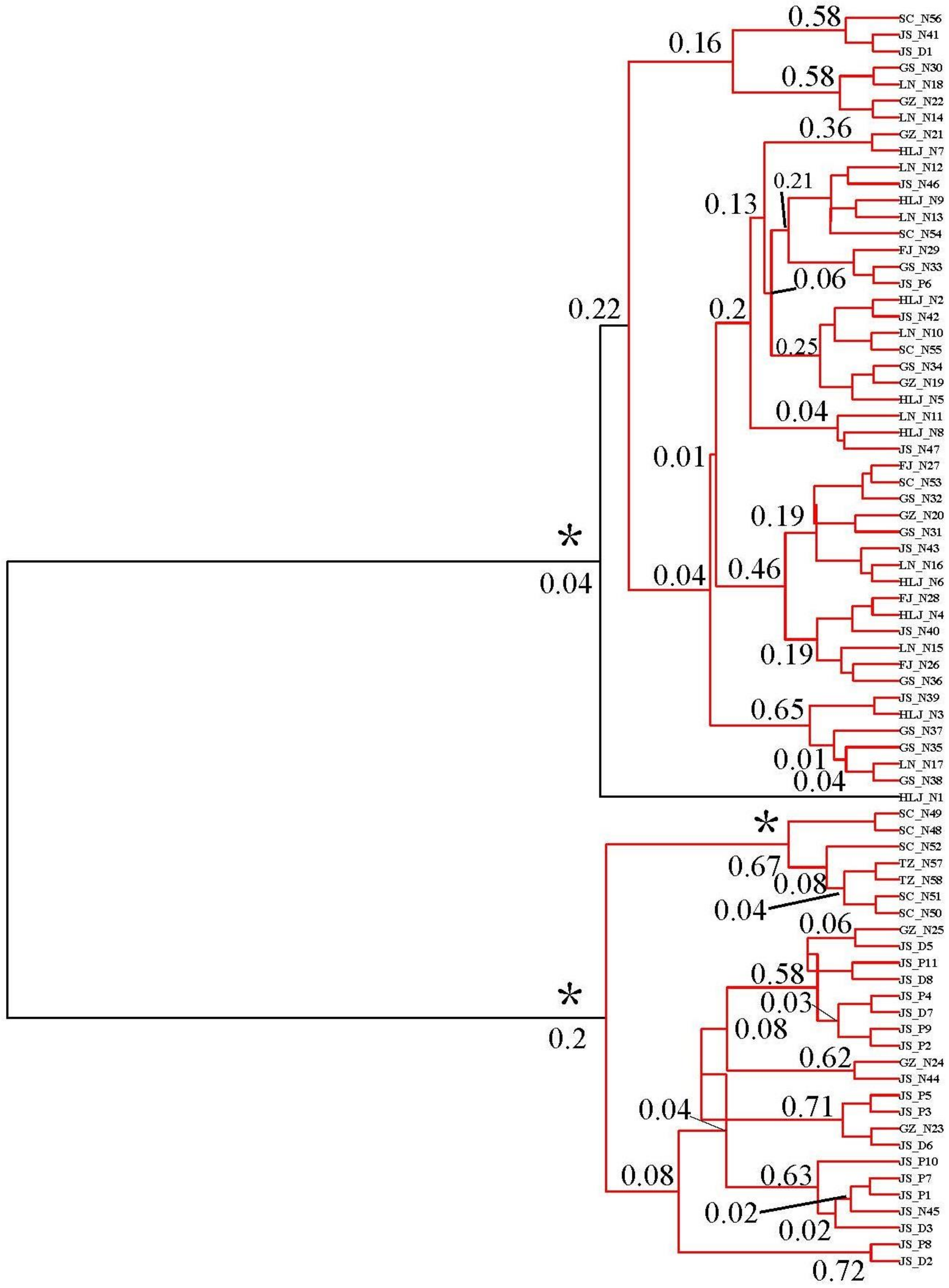

Fig. S5. Species delimitation under the single-threshold GMYC model based on the *COI* ultrametric tree. Asterisks indicate posterior probabilities greater than 0.95. Node values represent GMYC support. Cluster branches are shown in red.

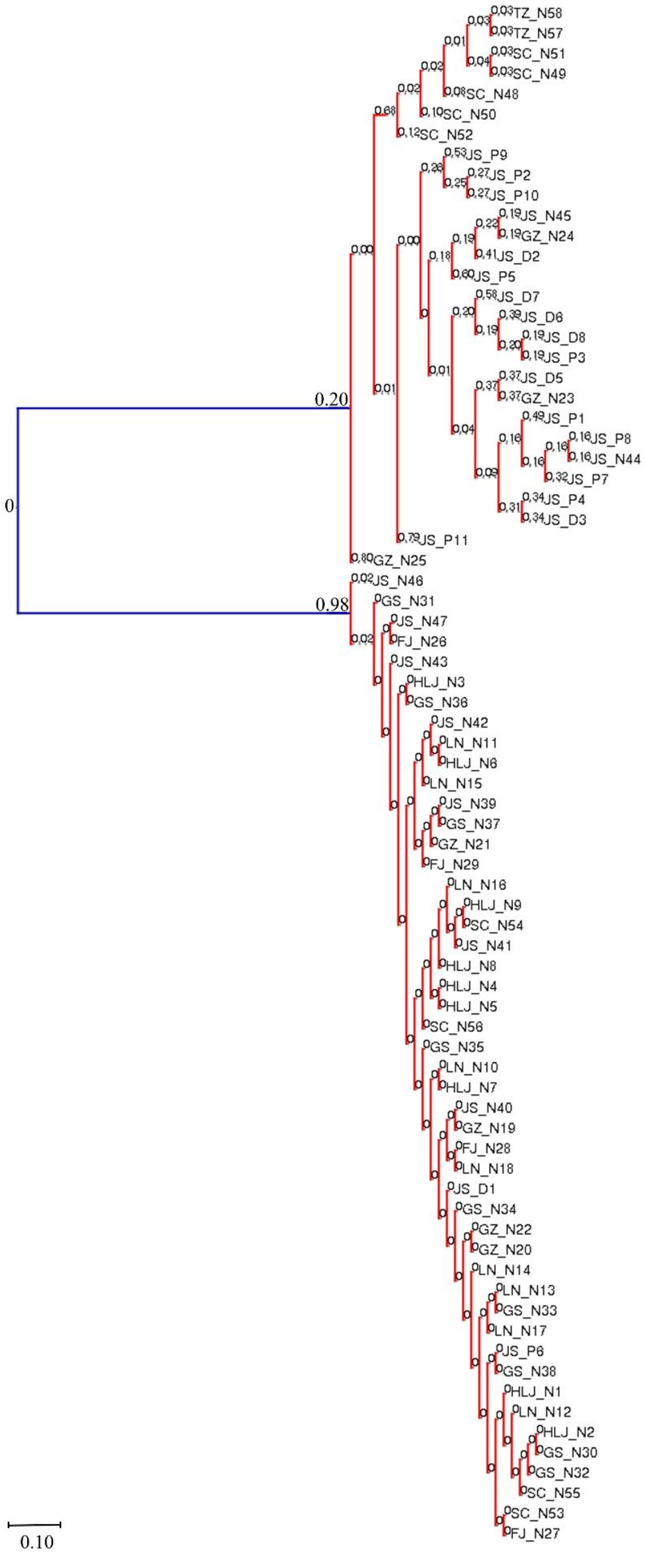

Fig. S6. Species delimitation under the PTP model. Cluster branches are shown in red; bPTP approach is based on a single ML tree.

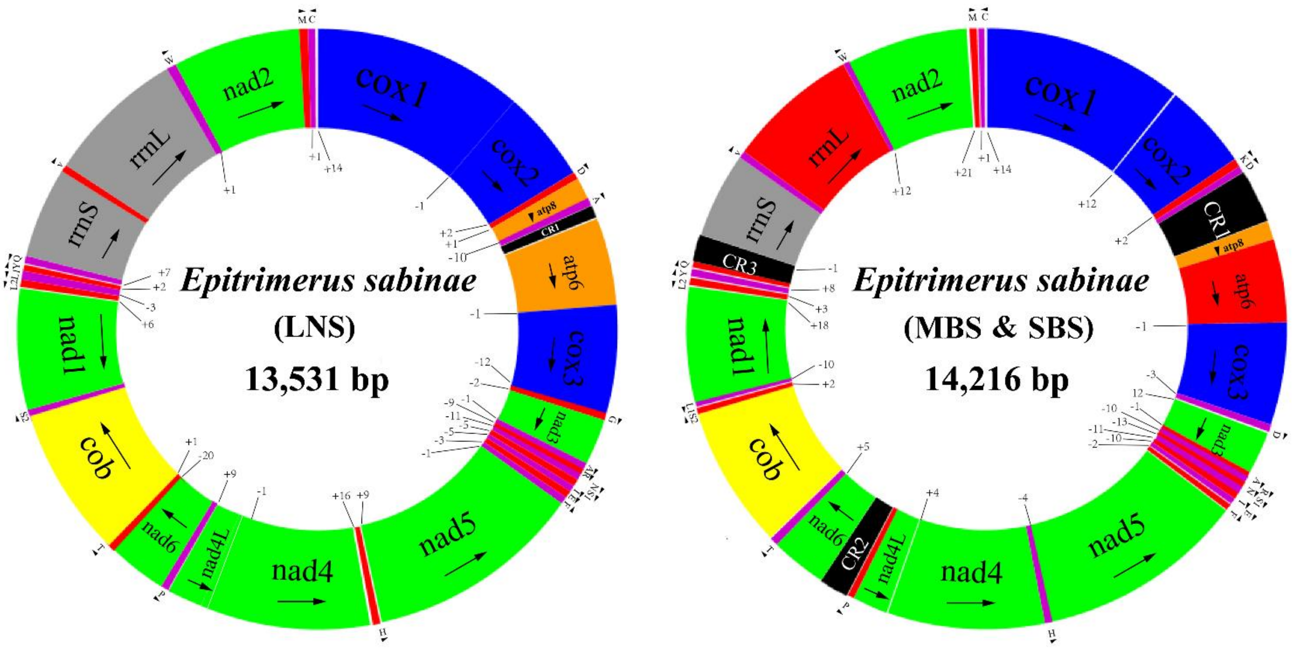

Fig. S7. Map of the mitochondrial genomes of (*A*) *Leipothrix junipernesis*, sp. nov., and (*B*) *Epitrimerus sabinae*. Protein-coding genes are colour-coded (cox: blue; nad: green; atp: orange; cytb: yellow); rRNA genes are in grey; control regions are in black; tRNA genes are in red or purple. Abbreviations of protein-coding genes are: atp6 and atp8 for ATP synthase subunits 6 and 8, *cox1–3* for cytochrome oxidase subunits 1–3, cytb for Cytochrome *b, nad1–6* and *nad4L* for NADH dehydrogenase subunits 1–6 and 4 L, *rrnL* and *rrnS* for large and small rRNA subunits. Transfer RNA genes are indicated by the single-letter IUPAC-IUB abbreviations for their corresponding amino acid(s). Arrows and arrowheads show the direction of gene transcription. Numbers at gene junctions indicate the length of non-coding sequences; negative numbers indicate overlap between genes.

Table S1. Sampling location, date, and number of individuals for each population inspected in this study

LNS, *Epitrimerus sabinae s.l.* with long body size and normal seta *d*; MBS, *E. sabinae s.l.* with medium body size and bifurcated seta *d*; SBS, *E. sabinae s.l.* with short body size and bifurcated seta *d*

Serial numbers in Fig. 1	Voucher number	Locality (city, province)	Longitude (N)	Latitude (E)	Collection date	Total number of LNS (males)	Total number of MBS (males)	Total number of SBS (males)
1	NJAUAcariGHT	Nanjing, Jiangsu	118°5012″	32°23′23″	23 May 2019	26 (5♂)	105 (47♂)	22 (0♂)
2	NJAUAcariJS_tz	Taizhou, Jiangsu	119°54′52″	32°27′47″	22 July 2018	10 (6♂)	5 (0♂)	5 (0♂)
3	NJAUAcari144	Luanchuan, Henan	111°45′37″	33°42′53″	13 July 2013	26 (2♂)	10 (0♂)	1 (0♂)
4	NJAUAcari225	Zhouzhi, Shaanxi	108°19′22″	34°03′54″	31 August 2004	10 (2♂)	0	0
5	NJAUAcari396	Xi’an, Shaanxi	109°00′04″	34°59′04″	14 August 2005	43 (10♂)	0	1 (0♂)
6	NJAUAcariG5	Gaotai, Gansu	99°81′26″	39°37′99″	13 August 2018	51 (4♂)	6 (1♂)	1 (0♂)
7	NJAUAcariG3	Jingning, Gansu	105°73′03″	35°51′00″	13 August 2010	39 (13♂)	1 (0♂)	0
8	NJAUAcari433	Wenxian, Gansu	104°40′27″	32°56′43″	6 September 2005	44 (9♂)	1 (0♂)	0
9	NJAUAcari453	Longnan, Gansu	104°55′48″	33°23′43″	11 September 2005	48 (7♂)	1 (0♂)	1(0♂)
10	NJAUAcariH100	Ning’an, Heilongjiang	128°56′35″	44°02′33″	27 July 2018	24 (12♂)	0	0
11	NJAUAcari602	Harbin, Heilongjiang	126°57′21″	43°87′02″	29 June 2006	57 (8♂)	0	0
12	NJAUAcari9	Taian, Shandong	117°06′15″	36°15′17″	19 July 2004	175 (21♂)	6 (0♂)	5 (0♂)
13	NJAUAcariSD_zz	Zaozhuang, Shandong	116°48′00″	37°42′12″	21 July 2017	21 (16♂)	2 (0♂)	2 (0♂)
14	NJAUAcariL10	Shenyang, Liaoning	123°43′32″	41°08′12″	24 July 2018	21 (5♂)	0	0
15	NJAUAcari660	Changchun, Jiling	125°42′01″	44°04′12″	11 July 2006	20 (1♂)	0	0
16	NJAUAcari506	Fuzhou, Fujian	119°17′09″	26°06′04″	27 October 2005	3 (0♂)	4 (0♂)	0
17	NJAUAcari542	Wuyishan, Fujian	117°40′49″	27°44′55″	31 October 2005	61 (42♂)	2 (0♂)	1 (0♂)
18	NJAUAcariZ136	Lin’an, Zhejiang	119°26′44″	30°20′37″	25 July 2011	3 (0♂)	3 (1♂)	0
19	NJAUAcariGz29	Guiyang, Guizhou	106°70′91″	26°62′99″	21 July 2014	25 (3♂)	0	0
20	NJAUAcariSc6	Chendu, Sichuan	104°06′00″	30°67′45″	17 September 2018	27 (9♂)	2 (0♂)	5 (0♂)
21	NJAUAcari154	Changsha, Hunan	112°58′42″	28°11′49″	21 July 2004	27 (8♂)	0	0
22	NJAUAcari69	Kunming, Yunnan	100°25′12″	26°86′22″	8 August 2009	38 (12♂)	0	0

Serial numbers in Fig. 1	Voucher number	Locality (city, province)	Longitude (N)	Latitude (E)	Collection date	Total number of LNS (males)	Total number of MBS (males)	Total number of SBS (males)
23	NJAUAcari161	Dali, Yunnan	98°48′10″	25°17′44″	24 May 2011	20 (4♂)	10 (4♂)	0
24	NJAUAcariQ105	Haikou, Hainan	110°18′47″	20°58′34″	1 October 2008	6 (2♂)	26 (6♂)	5 (0♂)
25	NJAUAcari885	Lingzhi, Xizang	94°42′00″	29°37′01″	14 August 2007	32 (7♂)	1 (0♂)	2 (0♂)
26	NJAUAcari694	Yili, Xinjiang	80°19′12″	43°55′12″	3 August 2006	40 (5♂)	2 (1♂)	2 (0♂)

Table S2. Morphometric characters used in the principal component analysis

Variables	Morphological characters
S1	Body length
S2	Body width
S3	Body height
S4	The length of dorsal pedipalp genual seta *d*
S5	The length of prodorsal shield
S6	The width of prodorsal shield
S7	Distance between dorsal tubercles
S8	The length of scapular seta *sc*
S9	The length of seta *1b*
S10	Distance between setae *1b*
S11	The length of seta *1a*
S12	Distance between setae *1a*
S13	The length of seta *2a*
S14	Distance between setae *2a*
S15	Distance from seta *1b* to seta *1a*
S16	Distance from seta *1a* to seta *2a*
S17	The number of coxigentital annuli
S18	The length of seta *c2*
S19	Distance between setae *c2*
S20	The length of seta *d*
S21	Distance between setae *d*
S22	The length of seta *e*
S23	Distance between setae *e*
S24	The length of seta *f*
S25	Distance between setae *f*
S26	The length of female genitalia
S27	The width of female genitalia
S28	The number of longitudinal ridges on female coverflap
S29	The length of seta *3a*
S30	Distance between setae *3a*
S31	The number of dorsal annuli
S32	The number of ventral annuli

Table S3. PCR primers used in this study

Fragment	Primer	Sequence (5′–3′)	Annealing temperature	Source
18S (a)	18Sfw	CTTGTCTCAAAGATTAAGCCATGCA	50°C	Dabert *et al*. (2010)
	rev480R	GTTATTTTTCTTCACTACAT		Liu *et al*. (2019)
18S (b)	fw390R	AGTTAGGGCTCGACTCCGGAGA	52°C	Liu *et al*. (2019)
	rev960R	ATCGGTCTAAGAATTTCAC		Liu *et al*. (2019)
18S (b1)	fw390R	AGTTAGGGCTCGACTCCGGAGA	55°C	Liu *et al*. (2019)
	rev771	AGCACTCTAATTTTCTCAAGG		Liu *et al*. (2019)
18S (b2)	fw770R	ACCTTGAGAAAATTAGAGTGC	47°C	Liu *et al*. (2019)
	rev960R	ATCGGTCTAAGAATTTCAC		Liu *et al*. (2019)
18S (c)	fw961	TGAAATTCTTAGACCGATGC	50°C	Liu *et al*. (2019)
	rev1460	CATCACAGACCTGTTATTGC		Dabert *et al*. (2010)
18S (d)	fw1462	AATAACAGGTCTGTGATGC	55°C	Liu *et al*. (2019)
	rev18S	TGATCCTTCCGCAGGTTCACCT		Dabert *et al*. (2010)
28S D2–5 (1)	ND2f	AGTACCGTGAGGGAAAGTTG	55°C	Campbell *et al*. (1994)
	D2R	TTGGTCCGTGTTTCAAGACGGG		Campbell *et al*. (1994)
28S D2–5 (2)	28S3F	GACCCGTCTTGAAACACGGA	55°C	Whiting *et al*. (1997)
	28S3R	TCGGAAGGAACCAGCTACTA		Whiting *et al*. (1997)
28S D9–10	28S9F	GTAGCCAAATGCCTCGTCA	52°C	Hillis and Dixon (1991)
	28S9R	CACAATGATAGGAAGAGCC		Hillis and Dixon (1991)
COI	LCO1490	GGTCAACAAATCATAAAGATATTGG	46°C	Folmer *et al*. (1994)
	HCO2198	TAAACTTCAGGGTGACCAAAAAATCA		Folmer *et al*. (1994)
12S	SR1–14199	TACTATGTTACGACTTAT	42°C	Kambhampati and Smith (1995)
	SR2–14594	AAACTAGGATTAGATACCC		Kambhampati and Smith (1995)

Table S4. Samples of the *Epitrimerus sabinae s.l.* and outgroups used in this study

Vouchers	Species	Host plant	Locality	GPS coordinates		GenBank Acc.				
				Latitude (N)	Longitude (E)	*COI*	*18S*	*28S* D2–5	*28S* D9–10	*12S*
HLJ_N1			Harbin, Heilongjiang	128°56′35″	44°02′33″	MN520569	MN128778	MN335731	MN335657	MN122726
HLJ_N2_			Harbin, Heilongjiang	128°56′35″	44°02′33″	MN520568	MN128779	MN335732	MN335658	MN122727
HLJ_N3			Harbin, Heilongjiang	128°56′35″	44°02′33″	MN520567	MN128780	MN335733	MN335659	MN122728
HLJ_N4			Harbin, Heilongjiang	128°56′35″	44°02′33″	MN520566	MN128781	MN335734	MN335660	MN122729
HLJ_N5			Harbin, Heilongjiang	128°56′35″	44°02′33″	MN520565	MN128782	MN335735	MN335661	MN122730
HLJ_N6			Harbin, Heilongjiang	128°56′35″	44°02′33″	MN520564	MN128783	MN335736	MN335662	MN122731
HLJ_N7			Harbin, Heilongjiang	128°56′35″	44°02′33″	MN520563	MN128784	MN335806	MN335663	MN122732
HLJ_N8			Harbin, Heilongjiang	128°56′35″	44°02′33″	MN520562	MN128785	MN335737	MN335664	MN122733
HLJ_N9			Harbin, Heilongjiang	128°56′35″	44°02′33″	MN520561	MN128786	MN335807	MN335665	MN122734
LN_N10			Shenyang, Liaoning	123°43′32″	41°08′12″	MN520560	MN128787	MN335738	MN335666	MN122735
LN_N11			Shenyang, Liaoning	123°43′32″	41°08′12″	MN520559	MN128788	MN335739	MN335667	MN122736
LN_N12			Shenyang, Liaoning	123°43′32″	41°08′12″	MN520558	MN128789	MN335740	MN335668	–
LN_N13			Shenyang, Liaoning	123°43′32″	41°08′12″	MN520557	MN128790	MN335741	MN335669	MN122737
LN_N14			Shenyang, Liaoning	123°43′32″	41°08′12″	MN520556	MN128791	MN335742	MN335670	MN122738
LN_N15			Shenyang, Liaoning	123°43′32″	41°08′12″	MN520555	MN128792	MN335743	MN335671	MN122739
LN_N16			Shenyang, Liaoning	123°43′32″	41°08′12″	MN520554	MN128793	MN335744	MN335672	MN122740
LN_N17			Shenyang, Liaoning	123°43′32″	41°08′12″	MN520553	–	MN335745	MN335673	MN122741
LN_N18			Shenyang, Liaoning	123°43′32″	41°08′12″	MN520552	–	MN335746	–	–
GZ_N19			Guiyang, Guizhou	106°70′91″	26°62′99″	MN520551	MN128794	MN335747	MN335674	MN122742
GZ_N20			Guiyang, Guizhou	106°70′91″	26°62′99″	MN520550	MN128795	MN335748	MN335675	MN122743
GZ_N21			Guiyang, Guizhou	106°70′91″	26°62′99″	MN520549	MN128796	MN335749	MN335676	MN122744
GZ_N22			Guiyang, Guizhou	106°70′91″	26°62′99″	MN520548	MN128797	MN335750	MN335677	MN122745
GZ_N23			Guiyang, Guizhou	106°70′91″	26°62′99″	MN520547	MN128798	MN335751	MN335678	MN122746
GZ_N24			Guiyang, Guizhou	106°70′91″	26°62′99″	MN520546	MN128799	MN335752	–	MN122747
GZ_N25			Guiyang, Guizhou	106°70′91″	26°62′99″	MN520545	MN128800	MN335753	MN335679	–

Vouchers	Species	Host plant	Locality	GPS coordinates		GenBank Acc.				
				Latitude (N)	Longitude (E)	*COI*	*18S*	*28S* D2–5	*28S* D9–10	*12S*
FJ_N26			Fuzhou, Fujain	117°40′49″	27°44′55″	MN520544	MN128801	MN335754	MN335680	MN122748
FJ_N27			Fuzhou, Fujain	117°40′49″	27°44′55″	MN520543	MN128802	MN335755	MN335681	MN122749
FJ_N28			Fuzhou, Fujain	117°40′49″	27°44′55″	MN520542	MN128803	MN335808	MN335682	MN122750
FJ_N29			Fuzhou, Fujain	117°40′49″	27°44′55″	MN520541	MN128804	MN335756	MN335683	MN122751
GS_N30			Guiyang, Guizhou	99°81′26″	39°37′99″	MN520540	MN128805	MN335757	MN335684	MN122752
GS_N31			Guiyang, Guizhou	99°81′26″	39°37′99″	MN520539	MN128806	MN335758	MN335685	MN122753
GS_N32			Guiyang, Guizhou	99°81′26″	39°37′99″	MN520538	MN128807	MN335809	MN335686	MN122754
GS_N33			Guiyang, Guizhou	99°81′26″	39°37′99″	MN520537	MN128808	MN335759	MN335687	MN122755
GS_N34			Guiyang, Guizhou	99°81′26″	39°37′99″	MN520536	MN128809	MN335760	MN335688	MN122756
GS_N35			Guiyang, Guizhou	99°81′26″	39°37′99″	MN520535	MN128810	MN335761	MN335689	MN122757
GS_N36			Guiyang, Guizhou	99°81′26″	39°37′99″	MN520534	MN128811	MN335762	MN335690	MN122758
GS_N37			Guiyang, Guizhou	99°81′26″	39°37′99″	MN520533	MN128812	MN335810	–	–
GS_N38			Guiyang, Guizhou	99°81′26″	39°37′99″	MN520532	MN128813	MN335763	MN335691	MN122759
JS_N39			Nanjing, Jiangsu	118°50′12″	32°23′23″	MN520531	MN128814	MN335764	MN335692	MN122760
JS_N40			Nanjing, Jiangsu	118°50′12″	32°23′23″	MN520530	MN128815	MN335765	MN335693	MN122761
JS_N41			Nanjing, Jiangsu	118°50′12″	32°23′23″	MN520529	MN128816	MN335766	MN335694	MN122762
JS_N42			Nanjing, Jiangsu	118°50′12″	32°23′23″	MN520528	MN128817	MN335767	MN335695	MN122763
JS_N43			Nanjing, Jiangsu	118°50′12″	32°23′23″	MN520527	MN128818	MN335768	MN335696	MN122764
JS_N44			Nanjing, Jiangsu	118°50′12″	32°23′23″	MN520526	MN128819	MN335769	–	MN122765
JS_N45			Nanjing, Jiangsu	118°50′12″	32°23′23″	MN520525	MN128820	MN335770	MN335697	MN122766
JS_N46			Nanjing, Jiangsu	118°50′12″	32°23′23″	MN520524	MN128821	MN335771	MN335698	–
JS_N47			Nanjing, Jiangsu	118°50′12″	32°23′23″	MN520523	MN128822	MN335772	MN335699	MN122767
SC_N48			Chengdu, Sichuan	104°06′00″	30°67′45″	MN520522	MN128823	MN335773	MN335700	MN122768
SC_N49			Chengdu, Sichuan	104°06′00″	30°67′45″	MN520521	MN128824	MN335774	MN335701	MN122769
SC_N50			Chengdu, Sichuan	104°06′00″	30°67′45″	MN520520	MN128825	MN335775	MN335702	MN122770
SC_N51			Chengdu, Sichuan	104°06′00″	30°67′45″	MN520519	MN128826	MN335776	MN335703	MN122771

Vouchers	Species	Host plant	Locality	GPS coordinates		GenBank Acc.				
				Latitude (N)	Longitude (E)	*COI*	*18S*	*28S* D2–5	*28S* D9–10	*12S*
SC_N52			Chengdu, Sichuan	104°06′00″	30°67′45″	MN520518	MN128827	MN335777	MN335704	–
SC_N53			Chengdu, Sichuan	104°06′00″	30°67′45″	MN520517	MN128828	MN335778	MN335705	MN122772
SC_N54			Chengdu, Sichuan	104°06′00″	30°67′45″	MN520516	MN128829	MN335779	MN335706	MN122773
SC_N55			Chengdu, Sichuan	104°06′00″	30°67′45″	MN520515	MN128830	MN335780	MN335707	MN122774
SC_N56			Chengdu, Sichuan	104°06′00″	30°67′45″	MN520514	MN128831	MN335781	MN335708	MN122775
TZ_N57			Taizhou, Jiangsu	119°54′52″	32°27′47″	MN520513	MN128832	MN335782	MN335709	–
TZ_N58			Taizhou, Jiangsu	119°54′52″	32°27′47″	MN520512	MN128833	MN335783	MN335710	–
JS_D1			Nanjing, Jiangsu	118°50′12″	32°23′23″	MN520511	MN416005	MN335784	MN335711	MN364663
JS_D2			Nanjing, Jiangsu	118°50′12″	32°23′23″	MN520510	–	MN335785	MN335712	MN364662
JS_D3			Nanjing, Jiangsu	118°50′12″	32°23′23″	MN520509	MN416006	MN335786	MN335713	MN364661
JS_D4			Nanjing, Jiangsu	118°50′12″	32°23′23″	MN520508	MN416007	MN335787	MN335714	MN364660
JS_D5			Nanjing, Jiangsu	118°50′12″	32°23′23″	MN520507	MN416008	MN335788	MN335715	MN364659
JS_K1			Nanjing, Jiangsu	118°50′12″	32°23′23″	MN520506	MN416009	MN335790	MN335716	–
JS_K2			Nanjing, Jiangsu	118°50′12″	32°23′23″	MN520505	MN416010	MN335791	MN335717	–
JS_K3			Nanjing, Jiangsu	118°50′12″	32°23′23″	MN520504	MN416011	MN335792	MN335718	–
JS_L1			Nanjing, Jiangsu	118°50′12″	32°23′23″	MN520492	MN416012	MN335794	MN335720	–
JS_P1			Nanjing, Jiangsu	118°50′12″	32°23′23″	MN520502	MN415995	MN335796	MN335722	MN364657
JS_P2			Nanjing, Jiangsu	118°50′12″	32°23′23″	MN520501	MN415996	MN335797	MN335723	MN364656
JS_P3			Nanjing, Jiangsu	118°50′12″	32°23′23″	MN520500	MN415997	MN335798	MN335724	MN364655
JS_P4			Nanjing, Jiangsu	118°50′12″	32°23′23″	MN520499	MN415998	MN335799	MN335725	MN364654
JS_P5			Nanjing, Jiangsu	118°50′12″	32°23′23″	MN520498	MN415999	MN335800	–	MN364653
JS_P6			Nanjing, Jiangsu	118°50′12″	32°23′23″	MN520497	MN416000	MN335801	MN335726	MN364652
JS_P7			Nanjing, Jiangsu	118°50′12″	32°23′23″	MN520496	MN416001	MN335802	MN335727	–
JS_P8			Nanjing, Jiangsu	118°50′12″	32°23′23″	MN520495	MN416002	MN335803	MN335728	MN364651
JS_P9			Nanjing, Jiangsu	118°50′12″	32°23′23″	MN520494	MN416003	MN335804	MN335729	–
JS_P10			Nanjing, Jiangsu	118°50′12″	32°23′23″	MN520493	MN416004	MN335805	MN335730	MN364650

Vouchers	Species	Host plant	Locality	GPS coordinates		GenBank Acc.				
				Latitude (N)	Longitude (E)	*COI*	*18S*	*28S* D2–5	*28S* D9–10	*12S*
	Outgroups									
KK14	*Trusmadius acalypher*	*Acalypha* sp. (Euphorbiaceae)	Sabah, Malaysia	5°47′59″	116°27′05″	MN520503	MN415993	MN335793	MN335719	–
L13	*Tegolophus suffruticosae*	*Flueggea suffruticosa* (Pall.) Baill.	Shenyang, Liaoning, China	123°43′32″	41°08′12″	MN527352	MN415994	MN335795	MN335721	MN364658

Table S5. Morphological measurements (µm) of *Leipotrix juniperensis*, sp. nov. (protogynes and deutogynes)

Abbreviations: L, length; W, width; D, distance

Characters	Protogyne						Deutogyne		
	Female (*n* = 11, incl. holotype)			Male (*n* = 7)			Female (*n* = 8)		
	Holotype	Mean ± s.d.	Min.–Max.		Mean ± s.d.	Min.–Max.		Mean ± s.d.	Min.–Max.
Body size									
Idiosoma L	178	192 ± 11.7	178–215	155	159 ± 4.0	153–165	155	148 ± 13.7	126–165
Idiosoma W	80	79 ± 3.5	74–83	65	64 ± 2.3	61–68	75	76 ± 2.5	73–81
Prodorsum									
Prodorsal shield L	60	60 ± 2.3	57–66	46	50 ± 2.1	46–52	58	58 ± 2.6	53–63
Prodorsal shield W	80	77 ± 3.8	72–81	65	64 ± 2.8	60–68	75	75 ± 2.6	71–80
Scapular tubercles apart	22	22 ± 0.9	20–23	15	17 ± 1.3	15–19	20	21 ± 1.3	18–22
Setae *sc* L	5	6 ± 0.5	5–6	6	6 ± 0.5	5–6	5	5 ± 0.3	5–6
Opisthosoma									
Setae *c2* L	21	22 ± 1.5	20–25	18	19 ± 1.2	18–21	10	13 ± 2.6	10–18
Setae *d* L	51	48 ± 3.9	42–55	43	42 ± 2.8	38–46	53	47 ± 4.4	40–53
Setae *e* L	50	51 ± 1.9	48–54	38	42 ± 2.0	38–44	43	38 ± 5.1	29–43
Setae *f* L	26	26 ± 2.5	21–29	23	23 ± 1.5	21–25	22	25 ± 1.9	22–29
Setae *h2* L	38	31 ± 3.6	25–38	36	66 ± 2.4	32–39	25	26 ± 4.8	19–34
Setae *h1* L	5	5 ± 0.7	3–5	4	5 ± 0.5	4–5	4	4 ± 0.0	4–4
Ventral annulus position of *c2*	11	11 ± 0.0	11–11	12	11 ± 0.4	11–12	11	11 ± 0.3	10–11
Ventral annulus position of *d*	26	25 ± 1.4	23–28	25	23 ± 1.1	22–25	27	25 ± 1.2	24–27
Ventral annulus position of *e*	41	40 ± 0.7	39–41	37	36 ± 0.9	35–37	42	40 ± 1–7	39–43
Ventral annulus position of *f*	64	63 ± 1.3	60–64	58	57 ± 0.9	56–58	65	64 ± 1.6	61–66
Setae *c2*–*c2* D	61	62 ± 3.8	54–69	50	51 ± 1.6	49–54	59	59 ± 2.3	57–64
Setae *d*–*d* D	33	34 ± 1.9	29–37	25	27 ± 1.3	25–29	32	33 ± 1.2	31–35
Setae *e*–*e* D	19	19 ± 1.1	17–21	15	16 ± 0.5	15–16	17	18 ± 0.8	17–19

Characters	Protogyne						Deutogyne		
	Female (n = 11, incl. holotype)			Male (n = 7)			Female (n = 8)		
	Holotype	Mean ± s.d.	Min.–Max.		Mean ± s.d.	Min.–Max.		Mean ± s.d.	Min.–Max.
Setae *f–f* D	22	23 ± 1.4	21–25	21	21 ± 1.1	20–23	22	21 ± 1.0	20–22
Coxisternal region									
Coxisternal apodeme L	10	10 ± 0.5	9–11	10	10 ± 0.5	9–10	10	10 ± 0.4	10–11
Setae *1a* L	20	20 ± 1.5	18–22	13	14 ± 1.1	12–15	17	17 ± 0.7	16–18
Setae *2a* L	32	31 ± 2.8	28–38	21	24 ± 2.7	21–28	25	24 ± 3.5	18–29
Setae *1b* L	8	9 ± 1.0	7–10	8	8 ± 0.5	8–9	10	10 ± 0.7	8–10
Setae *1a–1a* D	10	10 ± 0.6	10–12	9	9 ± 0.8	8–10	10	10 ± 0.7	8–10
Setae *2a–2a* D	32	32 ± 1.1	30–34	25	25 ± 0.7	24–26	29	30 ± 1.1	28–32
Setae *1b–1b* D	17	15 ± 0.8	14–17	13	13 ± 0.7	12–14	15	14 ± 0.9	13–15
Setae *1a–2a* D	10	11 ± 0.7	10–12	8	9 ± 0.6	8–10	10	10 ± 0.7	8–10
Setae *1b–1a* D	2	2 ± 0.3	2–3	2	2 ± 0.0	2–2	3	2 ± 0.3	2–3
Legs									
Leg I L	31	32 ± 1.0	30–33	29	31 ± 1.2	29–33	30	32 ± 1.7	30–35
Femur I L	11	10 ± 0.5	10–11	9	10 ± 0.5	9–10	10	11 ± 0.7	10–12
Genu I L	5	5 ± 0.5	4–5	5	5 ± 0.5	4–5	4	4 ± 0.5	4–5
Tibia I L	8	8 ± 0.5	7–9	7	8 ± 0.4	7–8	7	8 ± 0.7	7–9
Tarsus I L	6	6 ± 0.4	5–7	5	6 ± 0.5	5–6	6	6 ± 0.4	6–7
Femur I setae *bv* L	10	10 ± 1.0	9–12	7	7 ± 0.7	6–8	8	7 ± 1.2	7–11
Genu I setae *l''* L	21	21 ± 1.2	19–23	16	18 ± 1.4	16–20	19	20 ± 2.5	15–23
Tibia I setae *l'* L	6	5 ± 0.6	4–6	5	5 ± 0.5	5–6	5	5 ± 0.0	5–5
Tarsal I setae *ft''* L	27	26 ± 0.7	25–27	20	21 ± 0.9	20–23	22	23 ± 1.3	22–25
Tarsal I setae *ft'* L	22	22 ± 0.5	21–22	18	19 ± 1.1	18–21	21	21 ± 0.6	20–22
Tarsal I solenidion ω L	7	8 ± 0.5	7–8	6	7 ± 0.5	6–7	9	8 ± 0.4	8–9
Tarsal I empodium *em* L	7	6 ± 0.5	6–7	5	6 ± 0.4	5–6	6	6 ± 0.0	6–6
Tarsal I empodium rays	6	6 ± 1.1	5–8	5	5 ± 0.0	5–5	6	6 ± 0.0	6–6
Tarsal I setae *u'*	4	4 ± 0.5	4–5	4	4 ± 0.4	4–5	4	4 ± 0.0	4–4

Characters		Protogyne						Deutogyne	
	Female (n = 11, incl. holotype)			Male (n = 7)			Female (n = 8)		
	Holotype	Mean ± s.d.	Min.–Max.		Mean ± s.d.	Min.–Max.		Mean ± s.d.	Min.–Max.
Leg II L	29	29 ± 0.9	27–30	27	28 ± 0.9	27–30	27	28 ± 1.6	26–31
Femur II L	10	10 ± 0.6	9–11	8	9 ± 0.9	8–10	9	10 ± 0.7	9–11
Genu II L	4	4 ± 0.3	4–5	4	4 ± 0.0	4–4	3	4 ± 0.3	3–4
Tibia II L	6	6 ± 0.3	6–7	6	6 ± 0.4	6–7	6	6 ± 0.6	5–7
Tarsus II L	5	5 ± 0.4	5–6	5	5 ± 0.5	5–6	6	5 ± 0.5	5–6
Femur II setae *bv* L	11	9 ± 1.2	7–11	8	8 ± 0.8	6–8	8	8 ± 0.7	6–8
Genu II setae *l''* L	6	5 ± 0.6	4–6	4	5 ± 0.7	4–6	5	5 ± 0.6	4–6
Tarsal II setae *ft''* L	23	23 ± 1.3	20–25	20	21 ± 0.5	20–21	21	21 ± 1.6	18–23
Tarsal II setae *ft'* L	5	5 ± 0.5	4–5	4	5 ± 0.4	4–5	4	4 ± 0.5	4–5
Tarsal II solenidion ω L	7	7 ± 0.7	6–8	6	7 ± 0.5	6–7	9	8 ± 0.7	7–9
Tarsal II empodium *em* L	6	6 ± 0.6	5–7	5	6 ± 0.5	5–6	6	6 ± 0.4	6–7
Tarsal II empodium rays	5	5 ± 0.5	5–6	5	5 ± 0.0	5–5	5	6 ± 0.4	5–6
Tarsal II setae *u'*	4	4 ± 0.3	4–5	4	4 ± 0.5	4–5	4	4 ± 0.3	3–4
External genitalia									
Genital coverflap L	16	16 ± 0.9	15–17	13	13 ± 0.7	12–14	16	15 ± 0.5	15–16
Genital coverflap W	25	24 ± 1.2	22–25	17	18 ± 0.7	17–19	25	24 ± 1.3	22–27
Setae *3a* L	40	32 ± 3.8	26–40	27	27 ± 2.0	24–30	25	26 ± 2.3	22–30
Setae *3a* D	16	17 ± 1.0	16–19	15	15 ± 0.4	14–15	19	18 ± 0.5	17–19
Annulus									
Number of dorsal annuli	39	37 ± 1.0	36–39	36	36 ± 0.5	36–37	41	38 ± 2.4	34–41
Number of ventral annuli	70	68 ± 1.3	66–70	64	63 ± 0.9	62–64	70	69 ± 1.6	66–71

References

Campbell, C. L., Tanaka, N., White, K. H., and Thorsness, P. E. (1994). Mitochondrial morphological and functional defects in yeast caused by yme1 are suppressed by mutation of a 26S protease subunit homologue. *Molecular Biology of the Cell* **5**, 899–905 doi:10.1091/mbc.5.8.899.

Dabert, M., Witalinski, W., Kazmierski, A., Olszanowski, Z., and Dabert, J. (2010). Molecular phylogeny of acariform mites (Acari, Arachnida): strong conflict between phylogenetic signal and long-branch attraction artifacts. *Molecular Phylogenetics and Evolution* **56**, 222–241 doi:10.1016/j.ympev.2009.12.020.

Folmer, O., Black, M., Hoeh, W., Lutz, R., and Vrijenhoek, R. (1994). DNA primers for amplification of mitochondrial cytochrome c oxidase subunit I from diverse metazoan invertebrates. *Molecular Marine Biology and Biotechnology* **3**, 294–299.

Hillis, D. M., and Dixon, M. T. (1991). Ribosomal DNA: molecular evolution and phylogenetic inference. *The Quarterly Review of Biology* **66**, 411–453. doi:10.1086/417338

Kambhampati, S., and Smith, P. T. (1995). PCR primers for the amplification of four insect mitochondrial gene fragments. *Insect Molecular Biology* **4**, 233–236 doi:10.1111/j.1365-2583.1995.tb00028.x.

Liu, Q., Yuan, Y.-M., Lai, Y., Wang, G.-Q., and Xue, X.-F. (2019). Unravelling the phylogeny, cryptic diversity and morphological evolution of *Diptilomiopus* mites (Acari: Eriophyoidea). *Experimental & Applied Acarology* **79**, 323–344 doi:10.1007/s10493-019-00443-8.

Whiting, M. F., Carpenter, J. C., Wheeler, Q. D., and Wheeler, W. C. (1997). The Strepsiptera problem: phylogeny of the holometabolous insect orders inferred from *18S* and *28S* ribosomal DNA sequences and morphology. *Systematic Biology* **46**, 1–68 doi:10.1093/sysbio/46.1.1.