First record of the genus *Fagineura* Vikberg & Zinovjev (Hymenoptera, Tenthredinidae) with descriptions of two new species from China

Mengmeng Liu¹², Zejian Li², Meicai Wei³

¹ Lab of Insect Systematics and Evolutionary Biology, Central South University of Forestry and Technology, 498 South Shaoshan Road, Changsha 410004, Hunan, China ² Lishui Academy of Forestry, Lishui 323000, Zhejiang, China ³ College of Life Science, Jiangxi Normal University, Nanchang 330026, Jiangxi, China

Corresponding author: Meicai Wei (weimc@126.com)

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Abstract

*Fagineura* Vikberg & Zinovjev, 2000 is recorded from China for the first time. Two species of *Fagineura* are described as new, *F. flactoserrula* sp. n. and *F. xanthosoma* sp. n. A key to the species of *Fagineura* worldwide is provided, now including four species. In addition, a simple phylogenetic analysis of *Fagineura* species is provided, based on sequences of the COI and NaK genes.

Keywords

COI, key, NaK, Nematinae, sawfly, Symphyta, taxonomy

Introduction

*Fagineura* Vikberg & Zinovjev, 2000 (Shinohara et al. 2000) is a very small genus of the subfamily Nematinae (Tenthredinidae). Until now, there are only two known species in the world (Taeger et al. 2010), namely *F. crenativora* Vikberg & Zinovjev, 2000 (type species) and *F. quercivora* Togashi, 2006, both of which are distributed in Japan. In a study of Nematinae from China, two species of *Fagineura* were found that are different from the two known species in Japan, and they are described herein as
new species. Additionally, the genus *Fagineura* is recorded as a new genus in China. The two species are described and illustrated, a key to the known species of *Fagineura* worldwide is provided, and a simple phylogenetic analysis based on DNA sequence data from two genes (COI and NaK) is provided.

**Materials and methods**

**Imaging, terminology, deposition of material**

The specimens were examined with a Motic-SMZ-171 stereomicroscope. Images of the imagines were taken with a Nikon D700 digital camera and a Leica Z16APO separately. The genitalia were examined with a Motic BA410E microscope, and images of the genitalia were taken with Motic Moticam Pro 285A. The series of images produced were montaged using Helicon Focus (HeliconSoft, Kharkiv, Ukraine) and further processed with Adobe Photoshop CS 11.0.

Morphological descriptions of the new species are based on the holotypes. The terminology of genitalia follows Ross (1945) and that of general morphology follows Viitasaari (2002). For a few terms, including middle fovea, lateral fovea, and lateral walls, we follow Takeuchi (1952).

Specimens examined in this study are deposited in the Central South University of Forestry and Technology, Changsha (CSCS), China, including all holotypes and paratypes of the two new species.

**Phylogenetic analyses**

DNA was extracted from adult samples stored in 99.5% ethanol at -20 °C by using the DNeasy Tissue Kit (Qiagen, Valencia, CA). Sequence data were obtained from the mitochondrial gene cytochrome oxidase I (COI; 810 bp) and the nuclear gene sodium-potassium adenosine triphosphatase (NaK; 952 bp). PCR amplification of COI and NaK were performed as described previously (Normark et al. 1999; Nyman et al. 2006; Leppänen et al. 2012). New sequences have been deposited in GenBank under accession numbers MH544099–MH544102. COI and NaK sequences of Nematinae species used in previous phylogenetic analyses are available in GenBank, and their accession numbers and references are shown in Table 1.

The data of each newly sequenced sample are as follows:

*Fagineura flactoserrula* sp. n.: Paratype, 1♀, China, Hubei Province, Yichang City, Shennongjia Mountain, Yinyuhe, 31°34′00″N, 110°20′22″E, 2100 m, 16 May 2012, leg. Zejian Li; the GenBank Accession Numbers of COI and NaK are MH544099 and MH544101, respectively.
**Table 1.** COI and NaK sequences of Nematinae species analyzed in this work.

| Species Name                          | GenBank Accession Number | Reference                                        |
|--------------------------------------|--------------------------|--------------------------------------------------|
| **COI**                              | **NaK**                  |                                                  |
| Anoplonyx apicalis                   | DQ302172                 | KJ434879                                        | Nyman et al. (2006), Prous et al. (2014) |
| Caucocampus acericaulis              | DQ302182                 | KJ434873                                        | Nyman et al. (2006), Prous et al. (2014) |
| Craterocerus fraternalis             | DQ302170                 | KJ434878                                        | Nyman et al. (2006), Prous et al. (2014) |
| Endophytus anemones                  | DQ302186                 | KJ434900                                        | Nyman et al. (2006), Prous et al. (2014) |
| Euura amerinae                       | KJ434923                 | KJ434915                                        | Prous et al. (2014) |
| Euura annullata                      | DQ302195                 | KJ434876                                        | Nyman et al. (2006), Prous et al. (2014) |
| Euura dimmockii                       | DQ302192                 | KJ434885                                        | Nyman et al. (2006), Prous et al. (2014) |
| Euura dolichura                      | DQ302213                 | KJ434858                                        | Nyman et al. (2006), Prous et al. (2014) |
| Euura herbaecae                      | DQ302217                 | KJ434860                                        | Nyman et al. (2006), Prous et al. (2014) |
| Euura imperfecta                     | DQ302210                 | KJ434883                                        | Nyman et al. (2006), Prous et al. (2014) |
| Euura lanatae                        | DQ302219                 | KJ434907                                        | Nyman et al. (2006), Prous et al. (2014) |
| Euura leucapris                      | KJ434922                 | KJ434909                                        | Prous et al. (2014) |
| Euura lipovskyi                      | DQ302206                 | KJ434892                                        | Nyman et al. (2006), Prous et al. (2014) |
| Euura melanaspis                     | DQ302205                 | KJ434863                                        | Nyman et al. (2006), Prous et al. (2014) |
| Euura miliaris                       | DQ302207                 | KJ434895                                        | Nyman et al. (2006), Prous et al. (2014) |
| Euura montana                        | DQ302193                 | KJ434868                                        | Nyman et al. (2006), Prous et al. (2014) |
| Euura pumilio                        | DQ302190                 | KJ434882                                        | Nyman et al. (2006), Prous et al. (2014) |
| Euura ribesii                        | DQ302208                 | KJ434871                                        | Nyman et al. (2006), Prous et al. (2014) |
| Euura saliciscinereae                | DQ302216                 | KJ434859                                        | Nyman et al. (2006), Prous et al. (2014) |
| Euura scutellata                     | DQ302191                 | KJ434866                                        | Nyman et al. (2006), Prous et al. (2014) |
| Euura ventusta                       | DQ302220                 | KJ434862                                        | Nyman et al. (2006), Prous et al. (2014) |
| Fagineura crenatissora               | DQ302233                 | KJ434899                                        | Nyman et al. (2006), Prous et al. (2014) |
| Fagineura flactosterrida             | MH544099                 | MH544101                                        | This work |
| Fagineura xanthosoma                 | MH544100                 | MH544102                                        | This work |
| Fallocampus americanus               | DQ302178                 | KJ434903                                        | Nyman et al. (2006), Prous et al. (2014) |
| Kerita fidala                        | KJ434918                 | KJ434826                                        | Prous et al. (2014) |
| Mesoneura opaca                      | DQ302169                 | KJ434877                                        | Nyman et al. (2006), Prous et al. (2014) |
| Mesoneura shibukuenis                | KJY69135                 | KY69259                                         | Prous et al. (2017) |
| Nematus erythrogaster                | KJ434917                 | KJ434818                                        | Prous et al. (2014) |
| Nematus princeps                     | KJ434921                 | KJ434865                                        | Prous et al. (2014) |
| Nematus septentrionalis              | DQ302197                 | KJ434875                                        | Nyman et al. (2006), Prous et al. (2014) |
| Nematus tulenensis                   | DQ302209                 | KJ434872                                        | Nyman et al. (2006), Prous et al. (2014) |
| Priophorus pallipes                  | DQ302167                 | KJ434890                                        | Nyman et al. (2006), Prous et al. (2014) |
| Pristiphora abbreviata               | KJ434920                 | KJ434848                                        | Prous et al. (2014) |
| Pristiphora abietina                 | DQ302227                 | KJ434869                                        | Nyman et al. (2006), Prous et al. (2014) |
| Pristiphora alpestris                | DQ302228                 | KJ434897                                        | Nyman et al. (2006), Prous et al. (2014) |
| Pristiphora coactula                 | DQ302229                 | KJ434870                                        | Nyman et al. (2006), Prous et al. (2014) |
| Pristiphora ferruginosa              | DQ302188                 | KJ434893                                        | Nyman et al. (2006), Prous et al. (2014) |
| Pristiphora geniculata               | DQ302225                 | KJ434898                                        | Nyman et al. (2006), Prous et al. (2014) |
| Pristiphora litura                   | DQ302231                 | KJ434894                                        | Nyman et al. (2006), Prous et al. (2014) |
| Pristiphora monogyniae               | DQ302223                 | KJ434880                                        | Nyman et al. (2006), Prous et al. (2014) |
| Pseudodineura mentiens               | KJ434919                 | KJ434841                                        | Prous et al. (2014) |
The final two-gene alignment is 1762 base pairs long and contains 42 specimens from 13 genera. The genetic distances among species were calculated based on Kimura 2-parameter model of the two genes in Mega 7 (Kumar et al. 2016). Bayesian phylogenetic analyses were performed in MrBayes 3.2.6 (Ronquist et al. 2012). The dataset was not partitioned, and the best-fitting DNA substitution model for the two-gene alignment was selected using jModelTest 2.1.7 (Darriba et al. 2012), which uses PhyML (Guindon and Gascuel 2003) for likelihood calculations. Model selection was done by selecting among 11 substitution schemes (including 88 different models) on the basis of the Akaike Information Criterion (AIC).

Abbreviations used in the text and illustrations are as follows:

- **OCL** The distance between a lateral ocellus and the occipital carina, or the hind margin of the head where this carina would be if it were developed (Benson 1954).
- **OOL** The distance between an eye and a lateral ocellus.
- **POL** The distance between the mesal margins of the 2 lateral ocelli.

**Results**

**Taxonomy**

*Lagineura* Vikberg & Zinovjev, 2000

**Diagnosis.** Medium-sized; clypeus and labrum yellowish-white to yellow; clypeus with broad and moderately deep (0.4–0.5) emargination apically; mandibles symmetrical; malar space shorter than diameter of median ocellus, and in most species not exceeding 0.5 × of diameter of median ocellus; postocellar area short, more than 2.0 × as wide as long; antenna usually shorter than thorax and abdomen together; posterior part of mesopleural katepimeron covered with hairs; distance between cenchri almost as long as breadth of a cenchrus; forewing without radial cross-vein; the costa of forewing less dilated than in *Pristiphora*; hindwing with anal cell petiolate; claws bifid, inner tooth large; sawsheath short; annular suture 1 with setae band; the longest setae bands of lancet is at least 0.5 × length of annulus (Figs 1i, 2h); cypsella of basal serrulae almost absent, apically short and with somewhat deep emargination; tangium of lancet with campaniform sensilla in most species; radix at least 0.5 × as long as lamnium, in most species radix not shorter than lamnium.

**Remarks.** The genus resembles *Pristiphora, Mesoneura, Euura* and *Nematus*, but *Lagineura* can be distinguished from *Pristiphora* by having an emarginate clypeus; less dilated costa of the forewing; claws with a large inner tooth; in males, the posterior end of tergum 8 with distinct apical projection; distinguished from *Mesoneura* by the lack of radial cross-veins; apex of vein C in forewing slightly enlarged; abdomen longer than the head and thorax together; ovipositor sheath longer than fore tibia; distinguished from *Euura* and *Nematus* by an annular suture 1 with setae band; malar space narrower than the diameter of the median ocellus; katepimeron of the mesopleuron with hairs; having campaniform sensilla on the tangium in most cases.
Key to species of *Fagineura* in the world

1 Terga 1–2 black; lancet 14–15 serrulae .................................................................2
– Terga 1–2 yellow; lancet 19–21 serrulae.................................................................3

2 Metapleuron pale yellowish; orbit yellowish to brownish in female; clypeus emarginated for about 0.5 of its length; postocellar area 2.5 × as wide as long; ovipositor sheath with shallow emargination apically; cerci reaching further back than sheath; annular suture 1 of lancet straight, and with 3 marginal sensilla below. Japan (Hokkaido, Honshu, Kyushu, Shikoku) ..........................

......................................................*F. crenativora* Vikberg & Zinovjev, 2000
– Metapleuron mostly black (Fig. 1e); orbit black in female (Fig. 1b–c); clypeus emarginated for about 0.3 of its length (Fig. 1c); postocellar area 3.0 × as wide as long (Fig. 1b); ovipositor sheath without emargination apically, cerci almost as long as sheath (Fig. 1f); annular suture 1 of lancet narrower on dorsal than on ventral side, with 7 marginal sensilla towards ventral side (Fig. 1i–j). China (Hubei)...........................................*F. flactoserrula* sp. n.

3 Mesepisternum entirely black; all coxae and apical 0.3 of hind tibia black; terga 3–10 mostly black; ovipositor sheath black; malar space nearly absent; petiole of anal cell of hindwing shorter than cu-a; tarsal claw with inner tooth longer than outer tooth; lancet with 19 serrulae. Japan (Honshu) ...............*F. quercivora* Togashi, 2006
– Mesepisternum entirely pale yellowish-brown (Fig. 2d); all coxae and hind tibia pale yellowish (Fig. 2a); terga 3–10 entirely pale yellowish-brown (Fig. 2a); ovipositor sheath yellow (Fig. 2g); malar space 0.8 times as long as diameter of median ocellus (Fig. 2c); petiole of anal cell of hindwing longer than cu-a (Fig. 2a); tarsal claw with inner tooth shorter than outer tooth; lancet with 21 serrulae (Fig. 2i). China (Hubei, Hunan)....*F. xanthosoma* sp. n.

*Fagineura flactoserrula* sp. n.
http://zoobank.org/00DF12C3-1549-4C0C-8B7E-80801376E2E0
Fig. 1

**Type material.** Holotype, ♀, China, Hubei Province, Yichang City, Shennongjia Mountain, Yinyuhe, 31°34′00″N, 110°20′22″E, 2100 m, 17 May 2012, leg. Zejian Li, CSCS. Paratype, 1 ♀, China, Hubei Province, Yichang City, Shennongjia Mountain, Yinyuhe, 31°34′00″N, 110°20′22″E, 2100 m, 16 May 2012, leg. Zejian Li.

**Diagnosis.** Body mostly black; labrum and clypeus pale yellow (Fig. 1b–c); most parts of mesepisternum yellowish-brown (Fig. 1e); most of stigma pale yellowish-brown but margins black brown, veins in most part black brown; labrum and clypeus smooth and shiny, with few faint setigerous punctures, without microsculpture; frons slightly shiny, with hair warts and few wrinkles, punctures minute and sparse (Fig. 1b–c); vertex and postocellar area shiny, punctures faint and sparse, without microsculpture; malar...
space 0.5 × as long as diameter of median ocellus; postocellar area slightly convex, without mesosulcus, approx. 3.0 × as wide as long; relative length of antennomere 3 : antennomere 4 : antennomere 5 = 1.0 : 1.5 : 1.2 (Fig. 1d); forewings with cross-vein cu-a joining cell 1M at basal 0.5, cell 2Rs 1.2 × as long as wide, petiole of anal cell of hindwing 1.6 × as long as cu-a; lancet with 14 serrulae (Fig. 1i); annular suture 1 oblique and slightly curved, sutures 1–10 with setae bands, longest setae band about 0.7× length of annulus; tangium 3.4 × as long as annulus 1, radix 1.1 × as long as lamnium (Fig. 1j).

**Description.** Holotype, female. Body length approximately 6.5 mm (Fig. 1a).

**Color.** Body mostly black. Labrum, clypeus, most parts of pronotum, most parts of propleuron, tegula, most parts of all coxae, all trochanters and femora pale yellow; most parts of vertex and temple, triangular spot of median mesoscutal lobe and mesoscutellum, most parts of mesepisternum, speckles on terga, sterna of abdomen, all tibiae and tarsi yellowish-brown; valvifer 2 pale yellow, valvula 3 yellowish-brown to black; cenchrus yellowish-white. Wings hyaline, most parts of stigma pale yellowish-brown with margins black brown, veins in most part black brown.

**Head.** Inner margins of eyes slightly convergent downward in frontal view, distance between eyes 1.9 × as long as height of eyes. Base of labrum elevated, apex slightly rounded; base of clypeus elevated, anterior margin of clypeus incised to 0.3 × length of clypeus, lateral corners rounded; labrum and clypeus shiny, with few faint setigerous punctures, without microsculpture. Malar space 0.5 × as long as diameter of median ocellus (Fig. 1c). Middle fovea long and groove-like, narrow and deep. Frons elevated, slightly shiny, with hair warts and few wrinkles, punctures minute and sparse; anterior wall slightly elevated and curved, notched medially, lateral walls low and blunt. Interocellar furrow broad and shallow, postocellar furrow slightly narrow and deep; circumocellar furrow indistinct; POL : OOL : OCL = 1.0 : 1.1 : 0.6 (Fig. 1b). Vertex and postocellar area shiny, punctures faint and sparse, without microsculpture; postocellar area slightly convex, without mesosulcus, approx. 3.0 × as wide as long, lateral furrows broad and slightly deep, parallel; in dorsal view, inner margins of eyes slightly divergent (Fig. 1b). Antenna filamentous, antennomere 3 slightly compressed, slightly shorter than thorax and abdomen together; antennomere 2 1.3 × as wide as long, relative length of antennomere 3 : antennomere 4 : antennomere 5 = 1.0 : 1.5 : 1.2 (Fig. 1d).

**Thorax.** Mesonotum shiny, with fine and slightly dense punctures, without microsculpture; median mesoscutal groove shallow and thin; mesoscutellum shiny, with faint and sparse punctures, and flat, posterior half of middle ridge distinct, about 0.8 × as long as wide; mesoscutellar appendage slightly shiny, with weak and sparse punctures, microsculpture faint, about 0.3 × length of scutellum, middle ridge low and blunt. Distance between cenchrus as long as breadth of a cenchrus. Mesepisternum smooth and shiny, setigerous punctures and microsculpture indistinct; anepimeron of mesepimeron slightly shiny, with few wrinkles, punctures faint; katepimeron shiny, most parts with microsculpture and posterior part distinct, punctures weak and very sparse, posterior part covered with few setae; metapleuron shiny and smooth, with few weak punctures, microsculpture indistinct (Fig. 1e). Vein Sc interstitial with origin of vein M from R, and vein M slightly shorter than...
Figure 1. *Fagineura flactoserrula* sp. n., female, holotype. a Dorsal view b head, dorsal view c head, anterior view d antenna, lateral view e mesopleuron and metapleuron f ovipositor sheath, dorsal view g ovipositor sheath, lateral view h middle serrulae i lancet; the short double arrow denotes the longest setae band, the long double arrow denotes the length of the annulus, the simple arrow denotes the annular suture  i j tangium; the arrowhead denotes a single campaniform sensillum.
vein R+M; forewings with cross-vein cu-a joining cell 1M at basal 0.5, cell 2Rs 1.2 × as long as wide, petiole of anal cell of hindwing 1.6 × as long as cu-a.

Abdomen. All abdominal terga shiny, with faint sparse setigerous punctures, microsculpture fine and very dense. Ovipositor sheath smooth and shiny, punctures laterally on valvula 3 weak and sparse, microsculpture indistinct; sheath 2.0 × as long as metatarsomere 1 and 1.3 × as long as front tibia, valvula 3 as long as valvifer 2; in lateral view, sheath tapering toward apex (Fig. 1g); in dorsal view, apex of cercus protruding beyond valvula 3, angle between most lateral setae of valvula 3 about 60° (Fig. 1f). Lancet with 14 serrulae (Fig. 1i); each middle serrula with 10–13 distal teeth (Fig. 1h); annular suture 1 oblique and slightly curved, sutures 1–10 with setae bands, longest setae band about 0.7 × length of annulus; cypsella of serrulae 1–5 nearly absent, cypsella of serrulae 6–12 short and deep; tangium 3.4 × as long as annulus 1, with one campaniform sensillum (Fig. 1j), radix 1.1 × as long as laminnium.

Legs. Protarsomere 1 shorter than combined length of tarsomeres 2–4; inner apical spur of hind tibia 0.4 × as long as metatarsomere 1, metatarsomere 1 0.6 × as long as combined length of metatarsomeres 2–5; tarsal claw with inner tooth long, but slightly shorter than outer tooth.

Male. Unknown.

Distribution. China (Hubei).

Variation. Triangular spot on median mesoscutal lobe yellowish-brown to black-brown; mesoscutellum entirely black, or sometimes with yellowish-brown speckles; tangium with one campaniform sensillum, or none.

Remarks. The new species is similar to F. crenativora Vikberg & Zinovjev, 2000, but can be distinguished from the latter by the following characters: metapleuron mostly black; orbit black in the female; postocellar area 3.0 × as wide as long; sheath without emargination apically; cerci almost as long as the sheath; lancet with 14 serrulae, annular suture 1 of lancet oblique and slightly curved, and with 7 marginal sensilla below.

Etymology. The specific name is derived from the flattened serrulae of the lancet.

Fagineura xanthosoma sp. n.
http://zoobank.org/761893DD-B1DA-4A46-A692-85FF34DC7EAD

Fig. 2

Type material. Holotype, ♀, China, Hubei Province, Yichang City, Shennongjia Mountain, Yinyuhe, 31°34'00"N, 110°20'22"E, 2100m, 17 May 2012, leg. Zejian Li, CSCS. Paratypes (15♀♂): 1♀, China, Hubei Province, Yichang City, Shennongjia Mountain, Yinyuhe, 31°34'00"N, 110°20'22"E, 2100 m, 17 May 2012, leg. Zejian Li; 1♀, China, Hunan Province, Wugang City, Yun Mountain, Television tower, 26°38'38"N, 110°37'18"E, 1380 m, 11 April 2012, leg. Zejian Li and Zaiyang Pan; 1♀, China, Hunan Province, Wugang City, Yun Mountain, 1100 m, 25 April 2005, leg. Yingke He; 8♀♂, China, Hunan Province, Yongzhou City, Yangming Mountain, 900 to 1000 m, 24 April 2004, leg. Shaobing Zhang; 3♀♂, China, Hunan Province, Yongzhou City, Yangming
Figure 2. *Fagineura xanthosoma* sp. n., female, paratype. a Dorsal view b head, dorsal view c head, anterior view d mesopleuron and metapleuron e antenna, lateral view f ovipositor sheath, dorsal view g ovipositor sheath, lateral view h middle serrulae; the short double arrow denotes the longest setae band, the long double arrow denotes the length of the annulus i lancet; the arrow denotes the annular suture j tangium.

Mountain, 1000 to 1300 m, 24 April 2004, leg. Meicai Wei; 1 ♀, China, Hunan Province, Yongzhou City, Yangming Mountain, 1000 to 1300 m, 24 April 2004, leg. Wei Xiao.

Diagnosis. Body pale yellow to pale yellowish-brown; stigma and most parts of veins pale yellow (Fig. 2a); frons slightly shiny, with some hair warts and wrinkles, punctures weak and very sparse; malar space 0.8 × as long as diameter of median ocellus; interocellar furrow broad and very shallow, postocellar furrow broad and slightly shallow; postocellar area convex, without mesosulcus, 2.8 × as wide as long
(Fig. 2b–c); relative length of antennomere 3 : antennomere 4 : antennomere 5 = 1.0 : 1.2 : 1.0 (Fig. 2e); vein M about as long as vein R+M; forewings with cross-vein cu-a joining cell 1M at basal 0.6, cell 2Rs 1.4 × as long as wide, petiole of hind anal cell 1.3 × as long as cu-a (Fig. 2a); lancet with 21 serrulae (Fig. 2i); each middle serrula always with 14–17 distal teeth (Fig. 2h); annular suture 1 straight but oblique, sutures 1–13 with setae bands, longest setae band approx. 0.9 length of annulus; tangium 5.5 × as long as annulus 1, radix 0.6 × as long as lamnium (Fig. 2i, 2j).

Description. Holotype, female. Body length approximately 7.0 mm (Fig. 2a).

Color. Body pale yellow to pale yellowish-brown. Lateral fovea, around ocelli, dorsal side of scape and pedicel, anterior edge and medial spot of tergum 1 black; cenchrus yellowish-white. Wings hyaline, stigma and most parts of veins pale yellow.

Head. Inner margins of eyes slightly convergent downward in frontal view, distance between eyes 2.4 × as long as height of eye (Fig. 2c). Base of labrum elevated, and apex rounded; base of clypeus elevated, anterior margin of clypeus incised to 0.3 × length of clypeus, lateral corners rounded; labrum and clypeus smooth and shiny, with few faint setigerous punctures, without microsculpture. Malar space 0.8 × as long as diameter of median ocellus (Fig. 2c). Middle fovea long, groove-like, deep. Frons slightly elevated, slightly shiny, with some hair warts and wrinkles, punctures weak and very sparse; anterior wall elevated and curved, notched medially, lateral walls distinct, but low and blunt. Interocellar furrow broad and very shallow, postocellar furrow broad and shallow; circumocellar furrow indistinct; POL : OOL : OCL = 0.9 : 1.0 : 0.7 (Fig. 2b). Vertex and postocellar area shiny, punctures faint and sparse, microsculpture indistinct; postocellar area convex, without mesosulcus, 2.8 × as wide as long, lateral furrows short, slightly broad and shallow; in dorsal view, inner margins of eyes subparallel (Fig. 2b). Antenna filiform, shorter than thorax and abdomen together, antennomere 3 slightly compressed; antennomere 2 1.3 × as wide as long, relative length of antennomere 3 : antennomere 4 : antennomere 5 = 1.0 : 1.2 : 1.0 (Fig. 2e).

Thorax. Mesonotum slightly shiny, with minute and dense punctures, microsculpture indistinct; median mesoscutal groove shallow and narrow; mesoscutellum shiny, with weak and slightly sparse punctures, and flat, middle ridge indistinct, 0.8 × as long as wide; mesoscutellar appendage shiny, with faint and sparse punctures, without microsculpture, approx. 0.4 × as long as scutellum, middle ridge faint. Distance between cenchri as long as breadth of cenchrus. Mesepisternum shiny, setigerous punctures weak and slightly dense, microsculpture indistinct; mesepimeron shiny, with few faint punctures, with some microsculpture on margins, posterior part of katepimeron extensively covered with setae; metapleuron shiny and smooth, punctures and microsculpture indistinct (Fig. 2d). Vein Sc little basad of origin of vein M from R, vein M about as long as vein R+M; forewings with cross-vein cu-a joining cell 1M at basal 0.6, cell 2Rs 1.4 × as long as wide, petiole of anal cell of hindwing 1.3 × as long as cu-a (Fig. 2a).

Abdomen. All abdominal terga slightly shiny, with faint and sparse setigerous punctures, microsculpture fine and very dense. Ovipositor sheath shiny, punctures laterally on valvula 3 weak and sparse, microsculpture indistinct; ovipositor sheath 1.9
× as long as metatarsomere 1 and 1.2 × as long as front tibia, valvula 3 1.3 × as long as valvifer 2; in lateral view, sheath tapering toward apex (Fig. 2g); in dorsal view, apex of cercus protruding beyond valvula 3, angle between most lateral setae of valvula 3 about 85° (Fig. 2f). Lancet with 21 serrulae (Fig. 2i); each middle serrula always with 14–17 distal teeth (Fig. 2h); annular suture 1 straight but oblique, sutures 1–13 with setae bands, longest setae band approx. 0.9 × length of annulus; cypsella of serrulae 1–2 nearly absent, cypsella of serrulae 3–19 very short and deep; tangium 5.5 × as long as annulus 1, with many campaniform sensilla (Fig. 2j), radix 0.6 × as long as lamnium (Fig. 2i).

**Legs.** Protarsomere 1 slightly shorter than combined length of tarsomeres 2–4; inner apical spur of hind tibia 0.4 × as long as metatarsomere 1, metatarsomere 1 0.7 × as long as combined length of metatarsomeres 2–5; tarsal claw with inner tooth slightly shorter than outer tooth.

**Male.** Unknown.

**Distribution.** China (Hubei, Hunan).

**Variation.** Body length 6.0–8.0 mm; scape and pedicel partly to entirely black; around ocelli more or less black; vein Sc a little basad or interstitial with origin of vein M from R, and vein M as long as or slightly shorter than vein R+M; petiole of anal cell of hindwing 1.2–1.6 × as long as cu-a; in dorsal view, apex of cercus protruding far as or beyond valvula 3.

**Remarks.** The new species is similar to *F. quercivora* Togashi, 2006, but can be distinguished from the latter by the following characters: mesepisternum entirely pale yellowish-brown; all coxae and hind tibia pale yellowish; terga 3–10 entirely pale yellowish-brown; ovipositor sheath yellow; malar space 0.8 × as long as diameter of median ocellus; petiole of anal cell of hindwing longer than cu-a; tarsal claw with inner tooth shorter than outer tooth; lancet with 21 serrulae.

**Etymology.** The specific name is derived from the body color of adults.

**Phylogenetic analyses**

A Kimura 2-parameter model of COI and NaK distances within *Fagineura* species is shown in Table 2, and the mean distances within *Nematus, Fagineura, Pristiphora, Euura, Mesoneura* respectively and distances between these genera are shown in Table 3. The best-fitting model for the two-gene alignment was GTR+I+G (Nei and Kumar 2000). In MrBayes, default priors were used, and two parallel runs having four incrementally heated chains for 1.5 million generations were made, while sampling trees from the current cold chain every 1000 generations. 375 trees sampled were discarded prior to reaching chain stationarity as a burn-in from both runs, and the remaining 1126 trees were used to calculate a 50% majority consensus rule tree, showing all groupings with posterior probability more than 0.5 (Fig. 3).

The two new species and *Fagineura crenativora* are separated by an adequate distance (Tables 2, 3), and all three species form a monophyletic group (Fig. 3). The K2P
Figure 3. Phylogenetic tree of three *Fagineura* species and other representative species of the Nematinae based on Bayesian phylogenetic analysis of COI and NaK sequences. Numbers at right of nodes show Bayesian posterior probabilities (PP). The scale bar shows the number of estimated substitutions per nucleotide position.

Table 2. Kimura 2-parameter model distances among *Fagineura* species based on COI (below) and NaK (above) sequences.

| Species                      | Distance between species  |
|------------------------------|--------------------------|
|                              | *F. flactoserrula*       | *F. xanthosoma* | *F. crenativora* |
| *Fagineura flactoserrula*    | 0.005                    | 0.005           |                 |
| *Fagineura xanthosoma*       | 0.067                    | 0.004           |                 |
| *Fagineura crenativora*      | 0.052                    | 0.050           |                 |

Table 3. Mean Kimura 2-parameter model distances for COI (below) and NaK (above) within and among large genera of the Nematinae.

| Genus       | Distance within genus COI | Distance between genera  |
|-------------|---------------------------|--------------------------|
|              | NaK                       | *Nematus* | *Fagineura* | *Pristiphora* | *Euura* | *Mesoneurea* |
| *Nematus*   | 0.140                     | 0.089    | 0.090      | 0.110        | 0.108   |
| *Fagineura* | 0.056                     | 0.123    | 0.091      | 0.119        | 0.109   |
| *Pristiphora*| 0.139                   | 0.148    | 0.128      | 0.129        | 0.106   |
| *Euura*     | 0.111                     | 0.135    | 0.121      | 0.148        | 0.154   |
| *Mesoneurea*| 0.062                     | 0.134    | 0.116      | 0.131        | 0.129   |
distance based on COI and NaK between *F. flactoserrula* and *F. xanthosoma* are 6.7% and 0.5%, between *F. flactoserrula* and *F. crenativora* 5.2% and 0.5%, and between *F. xanthosoma* and *F. crenativora* 5.0% and 0.4%, respectively. The distance, based on COI and NaK, is 11.6% between *Fagineura* and *Mesoneura* and 8.9% between *Fagineura* and *Nematus*. These results are consistent with the morphological taxonomy described above. Unfortunately, sequences of *F. quercivora* are not available in GenBank, and we did not have any specimens of this species available. However, the two new species can be easily separated from *F. quercivora* by morphological characters.

**Discussion**

In this paper, two new species of *Fagineura* are described and illustrated. Compared to the generic characters of *Fagineura* proposed by Shinohara et al. (2000) and Prous et al. (2014), there are two differences in *F. flactoserrula*, including that the tangium lacks or has only one campaniform sensillum, and that the mesothoracic katepimeron is covered with only few setae. However, the generic characterisation in the earlier publications was based only on the two species known at that time, so that the previous definition of the genus apparently does not encompass the full range of interspecific variability. The phylogenetic analyses support placement of the two new species in *Fagineura*, and that they are different from *F. crenativora*. The new species are also different from *F. quercivora* based on morphological characters.

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