Major range extensions for two genera of the parasitoid subtribe Facitorina, with a new generic synonymy (Braconidae, Rogadinae, Yeliconini)

Buntika A. Butcher¹, Donald L. J. Quicke¹, Santhosh Shreevihar³, Avunjikkattu Parambil Ranjith²,³

¹ Department of Biology, Faculty of Science, Chulalongkorn University, Phayathai Road, Pathumwan, BKK 10330, Thailand ² Insect Ecology and Ethology Laboratory, Department of Zoology, University of Calicut, Kerala, Pin: 673635, India ³ Department of Zoology, Malabar Christian College, Kozhikode (Affiliated to University of Calicut), 673001, Kerala, India

Corresponding author: Buntika A. Butcher (buntika.a@chula.ac.th)

Academic editor: K. van Achterberg | Received 18 January 2016 | Accepted 22 March 2016 | Published 26 April 2016

Citation: Butcher BA, Quicke DLJ, Shreevihar S, Ranjith AP (2016) Major range extensions for two genera of the parasitoid subtribe Facitorina, with a new generic synonymy (Braconidae, Rogadinae, Yeliconini). ZooKeys 584: 109–120. doi: 10.3897/zookeys.584.7815

Abstract
The genera Conobregma van Achterberg and Facitorus van Achterberg are recorded from the Afrotropical region and the Indian subcontinent, respectively, for the first time, and two new species are described and illustrated: Conobregma bradpitti Quicke & Butcher, sp. n. from South Africa and Facitorus nasseri Ranjith & Quicke, sp. n. from India. Conobregma bradpitti sp. n. is intermediate between Conobregma which was described originally from the New World, and Asiabregma Belokobylskij, Zaldivar-Riverón & Maetô, which was coined for the S. E. Asian and East Palaearctic (Japanese) species described under the name Conobregma, plus more recently discovered taxa, but the differences between these genera are few and slight. Of the four previously proposed diagnostic characters for separating Asiabregma from Conobregma, the new species shares two with each, and therefore, the two genera are formally synonymised. Facitorus was previously known only from the East Palaearctic region and from S. E. Asia (Japan, Nepal, Taiwan and Vietnam).

Keywords
New distribution record, new species, new synonymy, parasitoid
**Introduction**

The Facitorini were originally described as a tribe in the subfamily Betylobraconinae by Tobias, 1979 based on the genera *Facitorus* van Achterberg from Nepal, China and Taiwan, *Conobregma* van Achterberg from the USA and Dominican Republic, and *Jannya* van Achterberg from Colombia and Costa Rica (van Achterberg 1995a). Despite all taxa placed in the Betylobraconinae being morphologically highly derived with robust femora, and shortened tarsi, moderately to very bulging faces, and curved fore wing vein M+CU (van Achterberg 1995a) they have subsequently been shown not to be monophyletic (Zaldivar-Riverón et al. 2006). The morphological homoplasy of these characters even led van Achterberg (1991) to place the rogadine tribe Yeliconini in the Betylobraconinae, though this arrangement was soon dropped as a result of further consideration of biological and morphological evidence. The Facitorini were transferred to the subfamily Rogadinae as a subtribe of the Yeliconini by Belokobylskij et al. (2008) on the basis of DNA sequence data and this placement has been supported by subsequent studies (Zaldivar-Riverón et al. 2009, Butcher et al. 2014, Quicke and Butcher 2015). Most recently, Butcher and Quicke (2015) formally synonymised Betylobraconinae with the Rogadinae maintaining it as a separate tribe. Unfortunately, nothing is yet known about the biology of the Facitorina though their similarity to *Yelicones*, which is a koinobiont larval endoparasitoid of Lepidoptera larvae concealed to some extent in silk webs, suggests that they may have similar biology.

Shortly after the original description of *Conobregma*, which was based on New World species, van Achterberg (1995b) added a new species from the Indonesian island of Sulawesi, thus extending the apparent distribution of the genus to the Old World tropics. Discovery of additional specimens of another genus, *Aulosaphobracon* Belokobylskij & Long, as well as DNA sequence data led Belokobylskij et al. (2008) to coin a new genus, *Asiabregma*, for the Asian and East Palaearctic species that fell within van Achterberg’s concept of *Conobregma*. However, despite their very disjunct distribution, the two genera were only separated by four, rather weak, characters (Table 1), and the new species from S. Africa is rather intermediate. We therefore synonymise *Asiabregma* with *Conobregma*, and treat the new species under the latter name.

**Materials and methods**

The holotype of *C. bradpitti* sp. n. is deposited in the Hymenoptera Institute Collection, Department of Entomology, University of Kentucky, Lexington, Kentucky. It was imaged using an Olympus SXZ16 microscope with automated multiple image capture at preset focal levels using an Olympus DP72 camera, and image combination using the Cell^D image processing system. The specimen was card-mounted and rather fragile but we successfully remounted it to enable more features to be seen.

The holotype of *F. nasserii* sp. n. is deposited in the Department of Zoology, University of Calicut, Kerala, India. It was imaged using an Leica M205A stereomicro-
Table 1. Differences used by Belokobylskij et al. (2008) to differentiate between Conobregma and Asia-bregma.

| Characters                              | Conobregma                  | C. bradpitti sp. n.           | ‘Asiabregma’       |
|-----------------------------------------|-----------------------------|-------------------------------|--------------------|
| Claw of middle leg                      | short, not pectinate        | long and pectinate            | long and pectinate |
| Postpectal carina                       | absent                      | absent                        | distinct           |
| Fore wing vein 2CUa                     | short <= m-cu               | short = m-cu                  | long > twice m-cu  |
| Carina between eye and antennal sockets | absent                      | present                       | present            |

Scope with automated multiple image capture at preset focal levels using an Leica DMC 2900 camera, and image combination using the Leica Application Suite image processing system v4.7. All images were edited using Photoshop CS6 (Version 6.1) (Adobe Inc.).

Terminology follows van Achterberg (1988) except for wing venation nomenclature which follows Sharkey and Wharton (1997); see also Figure 2.2 in Quicke (2015) for comparison of wing venation naming systems.

**Descriptive taxonomy**

*Conobregma bradpitti* Quicke & Butcher, sp. n.
http://zoobank.org/4C0937AE-13E0-43F2-B411-1CFFCB881FD6
Figures 1–6

**Material examined.** Holotype female: “South Africa, Madlangula, Kosi Bay, 14.iii – 30.iv.1985, R. Kyle”.

**Diagnosis.** *Conobregma bradpitti* sp. n. may be distinguished from the East Palae-arctic and East Asian species (*C. makiharae* (Belokobylskij, Zaldivar & Maetô, 2008), *C. ryukyuensis* (Belokobylskij, Zaldivar & Maetô, 2008)) and *C. sulaensis* van Achterberg, 1995) by fore wing vein 2CUa being approximately the same length as m-cu rather than approximately twice as long. It may be distinguished from all the New World species except for *C. cometes* van Achterberg, 1995 by having the third metasomal tergite almost entirely smooth. It differs from *C. cometes* in having the mesoscutum coarsely sculptured with deep depressions at the bases of setae rather than being coriaceous, and by having the propodeum distinctly less strongly sculptured antero-laterally.

**Description (female).** Length of body 1.75 mm, and of fore wing 1.5 mm.

Head. Antennae broken. First flagellomere 1.05 × longer than 2nd and 3rd respectively; approximately 1.8 × longer than apically wide, expanding from base to apex. Width of head: width of face: height of eye = 1.0: 0.5: 0.42. Eyes glabrous, with distinct curving fine ridge between antennal socket and eye. Distance between posterior ocelli: transverse diameter of posterior ocellus: shortest distance between posterior ocellus and eye = 1.0: 1.0: 2.5. Frons and occiput smooth. Occipital carina complete.
Figures 1–4. Montaged light micrographs of *Conobregma bradpitti* sp. n.; 1 habitus 2 face, anterior aspect 3 head and mesosoma, dorsal aspect 4 mesosoma, including propodeum, and anterior half of metasoma, oblique aspect.

Mesosoma. Mesosoma 1.8 × longer than high. Propleuron largely smooth. Mesoscutum irregularly sculptured, with deep pits at bases of setae, these forming very conspicuous submarginal rows; with rugulose sculpture between notauli posteriorly.
Notauli deeply impressed and strongly sculptured. Precoxal sulcus running from anterior margin to just posterior of mid-length of metapleuron, rugulose. Mesopleuron and mesosternum otherwise largely smooth. Median area of metanotum with weak mid-longitudinal ridge. Propodeum largely foveate except for pair of triangular areas anteriorly on either side of mid-line which are finely aciculate; with short mid-longitudinal carina anteriorly.

Wings. Pterostigma 2.1 × longer than its maximum width. Fore wing vein r-rs approximately 0.65 × maximum width of pterostigma. Lengths of fore wing veins r-rs: 3RSa: 3RSb = 1.0: 3.0: 5.5. Lengths of fore wing veins CU1a: CU1b = 1.0:1.25.

Legs. Fore femur: tibia: tarsus = 1.3: 1.25: 1.0. Fore basitarsus 1.5 × longer than next three articles combined. Mid-tibial claw with well-developed, pecten. Hind femur: tibia: tarsus = 1.0: 1.2: 1.2.

Metasoma. Second metasomal tergite with fine longitudinal striation and interconnecting transverse ridges; approximately 1.8 × longer than third metasomal tergite medially. Second suture finely crenulate. Third tergite almost entirely smooth but with traces of longitudinal striation near lateral parts of second suture. Thrid-fifth metasomal tergites distinctly arched in lateral profile. Ovipositor sheath 0.4 × length of hind tibia.
Colour. Stemmaticum and mesosoma entirely dark brown, nearly black; head, antennae (part remaining) and legs pale brown-yellow; metasomal tergites brown. Wings hyaline with pale grey-brown venation.

**Etymology.** Named after the senior author’s favourite film actor Brad Pitt, whose poster adorned the wall of her laboratory during her doctoral studies.

**Male.** Unknown.

**Distribution.** South Africa.

**Host.** Unknown.

*Facitorus nasseri* Ranjith & Quicke, sp. n.

http://zoobank.org/6739F6C6-62F4-44C4-B5C6-203F8B3895C3

Figures 7–15

**Material examined.** Holotype, female, “India, Kerala, Malappuram, Calicut University Botanical Garden, 14–21.xii.2015, Malaise Trap, ex. Ranjith, A.P.”

**Diagnosis.** *Facitorius nasseri* sp. n. is distinguished from *F. brevicornis* van Achterberg and *F. superus* van Achterberg in having occipital carina complete, mesoscutum covered by long setae and scutellum with sub-posterior depression. *Facitorus nasseri* sp. n. comes close to *F. tamdaoensis* Belokobylskij & Long, by its smooth metasomal tergite 2, but it differs from *F. tamdaoensis* by the following characters; mesoscutum sculptured antero-laterally (smooth in *F. tamdaoensis*), frons without shallow pit medially (frons with shallow pit medially in *F. tamdaoensis*), propodeum with ‘H’ shaped carina posteriorly (smooth in *F. tamdaoensis*), pterostigma 2.9 × longer than maximum wide (3.6 × in *F. tamdaoensis*) and second tergite entirely smooth (densely striate basally in *F. tamdaoensis*). It differs from *F. granulosus* and *F. amamioshimus* by first flagellomere 2.1 × as long as apically wide (3.5–4.2 × in *F. granulosus* and 3.5–4.0 × in *F. amamioshimus*), second metasomal suture not crenulate (crenulate in *F. granulosus* and *F. amamioshimus*), third metasomal tergite entirely smooth (distinctly sculptured at least baso-laterally in *F. granulosus* and *F. amamioshimus*). A key for the identification of *Facitorus* species is presented below.

**Description (female).** Holotype, female (♀), length of body 1.7 mm and fore wing 1.35 mm.

Head. Antennae with 18 segments. First flagellomere 1.2 × as long as second and third respectively, 2.1 × longer than apically wide, distinctly expanded from base to apex. Terminal flagellomere acute, 3.1 × as long as its maximum width. Width of head: width of face: height of eye = 13.4: 6.8: 7.1. Frons and occiput smooth with long setae. Eyes glabrous, with a straight groove between antennal socket and eye margin. Distance between posterior ocelli: transverse diameter of posterior ocellus: shortest distance between posterior ocellus and eye = 13.5: 10.25: 18.8. Occipital carina complete.

Mesosoma. Mesosoma 1.72 × longer than high. Propleuron smooth. Mesoscutum sculptured antero-laterally, smooth medio-posteriorly with long setae. Notauli impressed, meeting posteriorly and finely crenulate. Scutellar sulcus wide, deep and di-
Figures 7–12. Montaged light micrographs of *Facitorus nasseri* sp. n.; 7 habitus 8 head, anterior aspect 9 head, dorsal aspect 10 mesosoma, dorsal aspect 11 mesosoma, lateral aspect 12 propodeum and first metasomal tergite, dorsal aspect.
vided by a single carina. Scutellum smooth, sparsely setose with subposterior transverse depression. Median area of metanotum with medio-longitudinal ridge, rest smooth. Precoxal sulcus distinct only anteriorly impressed. Metapleuron medially smooth, rest rugose. Propodeum without medio-longitudinal carina, basal half distinctly foveate and with ‘H’ shaped carinae and transverse carinae. Pterostigma $2.9 \times$ longer than maximally wide. Fore wing vein $r-rs$ approximately $0.8 \times$ maximum width of pterostigma. Lengths of fore wing veins $r-rs$: $3RsA: 3RsB = 2.8: 4.4: 12.5$. Lengths of fore wing veins $CU1a: CU1b = 3.25: 4.37$. Fore femur: tibia: tarsus $= 4.7: 4.58: 3.34$. Fore basitarsus $1.6 \times$ longer than next three articles combined. Mid-tibial claw well-developed, pectinate. Hind femur: tibia: tarsus $= 5.4: 7.7: 7.0$.

Figures 13–15. Montaged light micrographs of *Facitorus nasseri* sp. n.; 13 head & mesosoma (in part), lateral aspect 14 metasomal tergite 2 and following tergites, dorsal aspect 15 wings.
Metasoma. Metasomal tergite 1 distinctly striate, smooth medio-posteriorly, striae reaching posterior margin laterally, slightly convex apically, sparsely setose. Tergite 2 smooth, sparsely setose medially, setose laterally, 1.6 × as long as third tergite. Second metasomal suture slightly impressed, not crenulate. Tergite 3 smooth with a pair of setae medio-basally and postero-laterally. Rest of the tergite smooth, exposed in lateral view and sparsely setose. Ovipositor sheath setose and 0.42 × as long as hind tibia.

Colour. Body dark brown except scape, pedicel, first flagellomere, basal half of second flagellomere, maxillary palp, tegulae, legs and ovipositor yellow; face yellowish brown anteriorly below antennal sockets; propleuron ventrally yellowish brown; wings hyaline; pterostigma and venation light brown.

**Etymology.** APR dedicates this species to Dr. M. Nasser for his encouragement and sharing his knowledge about the behaviour of parasitoids, and also for the fruitful discussions during the field trips.

**Male.** Unknown.

**Distribution.** India (Kerala).

**Host.** Unknown.

---

**Key to species of *Facitorus* van Achterberg**

1. Scutellum without sub-posterior depression; occipital carina interrupted medially; mesoscutum without long setae .......................................................... 2

   – Scutellum with subposterior depression; occipital carina complete; mesoscutum often covered by long setae. ............................................................. 3

2. Fore wing vein r 1.5 × as long as 2-SR; malar space 2.8 × basal width of mandible; face sparsely punctate; second tergite largely smooth ...........

   .................................................................................. *F. brevicornis* van Achterberg

   – Fore wing vein r almost equal or shorter than 2-SR; malar space 2 × basal width of mandible; face smooth; second tergite rugose-punctate...........

   .................................................................................. *F. superus* van Achterberg

3. Mesoscutum entirely smooth or rugose antero-laterally; third tergite entirely smooth ............................................................................. 4

   – Mesoscutum granulate; third tergite distinctly sculptured, at least baso-laterally ............................................................................. 5

4. Mesoscutum rugose antero-laterally; transverse diameter of eye twice as long as temple; frons without shallow pit near antennal sockets; anterior half of propodeum foveate, with ‘H’ shaped carina posteriorly and transverse carina; pterostigma 2.9 × as long as its maximum width; hind coxa entirely smooth .........

   .................................................................................. *F. nasseri* Ranjith & Quicke, sp. n.

   – Mesoscutum entirely smooth; transverse diameter of eye 2.7 × as long as temple; frons with shallow pit near antennal sockets; propodeum densely rugose-reticulate; pterostigma 3.6 × as long as its maximum width; hind coxa rugose-striate laterally .......................... *F. tamdaoensis* Belokobylskij & Long
5 Hind coxa dorsally striate; second metasomal suture deep; pterostigma enlarged, 1.1–1.2 × as long as R1; third tergite distinctly and widely sculptured; mesoscutum distinctly granulate........ F. granulosus Belokobylskij & Long
– Hind coxa entirely smooth; second metasomal suture shallow; pterostigma not enlarged, 0.9× as long as R1; third tergite only baso-laterally finely striate or rugulose-strate; mesoscutum finely granulate.................................

Discussion

Conobregma bradpitti sp. n. is the first record of the Facitorina from the African continent, the others occurring in the East Palaearctic, East Asia and North America (including Caribbean). The new species keys out easily to Conobregma in the generic key to Betylobraconi (as –inae) by van Achterberg (1985), but its characters are intermediate between those of Conobregma and the more recently described genus Asiabregma established by Belokobylskij et al. (2008). Originating from an intermediate location longitudinally, it may be not surprising that the new species displays a mix of character states between Conobregma and Asiabregma (Table 1). Differences between Conobregma and Asiabregma are in any case rather slight and probably would not normally be used to justify separate generic status had they not shown a disjunct distribution. With the discovery of the new species which shares two derived states with each nominal genus, we have to choose whether to arbitrarily assign it to one of them whilst keeping both separate though with reduced differences, creating a new genus for it based only on two small differences, or synonymising them. We have chosen the latter route because of the minimal differences, and therefore, we hereby formally synonymise Asiabregma Belokobylskij, 2008, with Conobregma van Achterberg, 1995.

Facitorus nasseri sp. n. is the first facitorine recorded from Indian subcontinent. The yeliconine subtribe Facitorina consists of the genera Facitorus, Conobregma and Jannya and they share the following characters; antennal sockets closer to each other than to eyes, frons without groove, antenna situated on a shelf, fore wing vein M+CU strongly curved apically (van Achterberg 1995a). Facitorus differs from the rest in having fore wing vein CU1a arising distinctly below the level of 2-CU1 and with comparatively large dorsope, but it shares a plesiomorphic character with Conobregma and Jannya of having a subposterior depression at the scutellum (Belokobylskij and Long 2005; Belokobylskij et al. 2008). All Facitorus species are distributed in the Oriental and South Palearctic Regions. The new species, F. nasseri is different from its closest relative F. superus (known from Nepal) in having the scutellum with the sub-posterior depression.
Acknowledgements

BAB and DLJQ are very grateful to Mike Sharkey (Kentucky) for making available for study many interesting braconid specimens. BAB and DLJQ would like to thank Chulalongkorn University Centenary Academic Development Project for support, and the Animal Systematic Research Unit and the Integrative Ecology Lab, Department of Biology, Faculty of Science, Chulalongkorn University for allowing us to use their Cell^D imaging facility. SS and APR financially supported by Department of Science and Technology, Government of India under SERB-Young Scientist Scheme (SB/YS/LS-42/2014).

References

van Achterberg C (1985) Notes on Braconidae V. The systematic position of the genera Ecnomios Mason and Pselaphanus Szépligeti (Hymenoptera: Braconidae). Zoologische Mededelingen, Leiden 59: 341–348.
van Achterberg C (1988) Revision of the subfamily Blacinae Foerster (Hymenoptera: Braconidae). Zoologische Verhandelingen, Leiden 249: 1–324.
van Achterberg C (1991) Revision of the genera of the Afrotropical and W. Palaearctic Rogadinae Foerster (Hymenoptera: Braconidae). Zoologische Verhandelingen, Leiden 273: 1–102.
van Achterberg C (1995a) Generic revision of the subfamily Betylobraconinae (Hymenoptera: Braconidae) and other groups with modified fore tarsus. Zoologisches Verhandelingen, Leiden 298: 1–242.
van Achterberg C (1995b) New taxa of the subfamilies Betylobraconinae, Cenocoeliinae, Ecnomiinae, Homolobinae, and Sigalphinae (Hymenoptera: Braconidae) from East Indonesia. Zoologische Mededelingen, Leiden 69: 307–328.
Belokobylskij SA, Long KD (2005) The braconid wasps of the subfamily Betylobraconinae (Hymenoptera, Braconidae) in Vietnam. Deutsche Entomologische Zeitschrift 52(1): 155–164. doi: 10.1002/mmnd.200410008
Belokobylskij SA, Zaldivar-Riverón A, Maetó K, Sáez AG (2008) Asian Betylobraconinae (Hymenoptera, Braconidae), with description of a new genus and phylogenetic affinities of the tribe Facitorini. Insect Systematics and Evolution 39: 133–154. doi: 10.1163/187631208788784110
Butcher BA, Quicke DLJ (2015) A remarkable new genus and species of Rogadinae (Hymenoptera: Braconidae) of uncertain tribal placement, from Papua New Guinea, resembling Betylobraconini stat. nov. Journal of Natural History 49: 2045–2054. doi: 10.1080/00222933.2015.1009405
Butcher BA, Zaldívar-Riverón A, van de Kamp T, Dos Santos Rolo T, Baumbach T, Quicke DLJ (2014) Extension of historical range of Betylobraconinae (Hymenoptera: Braconidae) into Palaearctic Region based on a Baltic amber fossil, and description of a new species of Mesocentrus Szépligeti from Papua New Guinea. Zootaxa 3860: 449–463. doi: 10.11646/zootaxa.3860.5.4
Quicke DLJ (2015) Biology, Systematics, Evolution and Ecology of Braconid and Ichneumonid Parasitoid Wasps. Wiley Blackwell, Chichester, 688 pp.
Quicke DLJ, Butcher BA (2015) Description of a new Betylobraconini-like parasitoid wasp genus and species (Hymenoptera: Braconidae: Rogadinae) from Chile. Zootaxa 4021(3): 459–466. doi: 10.11646/zootaxa.4021.3.5
Sharkey MJ, Wharton RA (1997) Morphology & terminology. In: Wharton RA, Marsh PM, Sharkey MJ (Eds) Identification Manual to the New World Genera of Braconidae. Special Publication of the International Society of Hymenopterists, 1, Washington, 19–37
Tobias VI (1979) Two new and little known subfamilies of Braconidae (Hymenoptera) from Australia. Entomologicheskoe Obozrenie 58: 128–142. [In Russian]
Zaldivar-Riverón A, Mori M, Quicke DLJ (2006) Systematics of the cyclostome subfamilies of braconid parasitic wasps (Hymenoptera: Ichneumonoidea): a simultaneous molecular and morphological Bayesian approach. Molecular Phylogenetics and Evolution 38: 130–145. doi: 10.1016/j.ympev.2005.08.006
Zaldivar-Riverón A, Shaw MR, Sáez AG, Mori M, Belokobylskij SA, Shaw SR, Quicke DLJ (2009) Evolution of the parasitic wasp subfamily Rogadinae (Braconidae): phylogeny and evolution of lepidopteran host ranges and mummy characteristics. BMC Evolutionary Biology 8: 329. doi: 10.1186/1471-2148-8-329