



# Cryptic biodiversity of tropical hesperiid caterpillar-attacking parasitoid wasps: three new species of *Creagrura* Townes (Hymenoptera, Ichneumonidae, Cremastinae) from Costa Rica and Perú

Ilari E. Sääksjärvi<sup>‡</sup>, Kari M. Kaunisto<sup>‡</sup>, Michael Sharkey<sup>§</sup>, Shelby Stedenfeld<sup>||</sup>, M. Alex Smith<sup>¶</sup>, Winnie Hallwachs<sup>#</sup>, Daniel Janzen<sup>□</sup>

<sup>‡</sup> Biodiversity Unit, University of Turku, Turku, Finland

<sup>§</sup> Department of Entomology, University of Kentucky, Lexington, Kentucky, United States of America

<sup>||</sup> University of Kentucky, Department of Entomology, Kentucky, United States of America

<sup>¶</sup> University of Guelph, Guelph, Canada

<sup>#</sup> Department of Biology, University of Pennsylvania, Philadelphia, Philadelphia, United States of America

<sup>□</sup> University of Pennsylvania, Philadelphia, United States of America

Corresponding author: Ilari E. Sääksjärvi ([ilari.saaksjarvi@utu.fi](mailto:ilari.saaksjarvi@utu.fi)), Kari M. Kaunisto ([kkauni@utu.fi](mailto:kkauni@utu.fi))

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## Abstract

## Background

We describe three new species of the previously monotypic genus *Creagrura* Townes from Central and South America: *C. alejandromasisi* **sp. n.** and *C. rogerblancoi* **sp. n.** from Costa Rica and *C. allpahuaya* **sp. n.** from Peru, all of which emphasise the unknown parasitoid insect diversity yet to be revealed in the tropics.

## New information

Host relationships of the two Costa Rican species are described in detail. In addition, it is inferred that the *Creagrura* wasps find and oviposit in the caterpillar when it is exposed at night, rather than when it is concealed during daylight hours.

## Keywords

Área de Conservación Guanacaste, Allpahuayo-Mishana, Darwin wasps, HesperIIDae, koinobiont, Lepidoptera, Neotropical, nocturnal, rain forests

## Introduction

*Creagrura* Townes has been believed for 50 years to be a tropical monotypic genus of Cremastinae (Hymenoptera, Ichneumonidae) attacking caterpillars of HesperIIDae (Gauld 2007). The single known species, *C. nigripes*, was described by Townes (1971), based on adult specimens collected in Brazil, Ecuador and Suriname. Later, the taxonomy of the genus was briefly discussed by Gauld (2007).

*Creagrura* is structurally amongst the most distinguishable genera of cremastines. The females are easily separated from all other cremastines by the bizarre shape of their ovipositor, which is very short and strongly downcurved. The genus is also characterised by the broad ventral flanges of the mandibles and strongly raised lateral carinae of the scutellum. Despite the conspicuous appearance and interesting biology of the genus now revealed, it has remained little studied.

Gauld (2007) noted that, despite colour differences throughout the broad distribution of the monotypic genus (from Central America to Brazil as based on museum specimens and our samples), all the specimens appeared morphologically to be conspecific. He also noted considerable colour variation from Área de Conservación Guanacaste (ACG) (<http://www.acguanacaste.ac.cr>), north-western Costa Rica and commented to us (DHJ, WH) that he suspected that there might be several species within “*C. nigripes*” in ACG. The lack of strong morphological differences amongst “*C. nigripes*” may explain the lack of detailed studies of the genus. However, our findings, based on new material collected from Central and South America, suggest that the situation may be more complex.

During the last two decades, we (IES, KMK) have collected adult Darwin wasps (Ichneumonidae) in Peruvian Amazonia, for example, Sääksjärvi et al. (2004) and Gomez et al. (2018) and ACG has been the focus of 37 years of intense inventory of caterpillars and their parasitoids by DHJ and WH (Smith et al. 2006, Smith et al. 2008, Fernandez-Triana et al. 2014, Janzen and Hallwachs 2016, Sharkey et al. 2021). During the field works in Peru, we have discovered one distinctive new species of *Creagrura* from Amazonian lowland rain forests. On the other hand, based on hundreds of reared and barcoded ACG wasps and their host caterpillars, we (DHJ, WH) have discovered the

existence of two additional cryptic species, each specialised to parasitise different genera of caterpillars feeding on two quite different groups of plants, morphologically and taxonomically (Poaceae + Cyperaceae vs. Marantaceae + Costaceae), side by side in lowland rain forest, but just one of them extending into adjacent dry forest. Both of the Costa Rican species of wasps were initially revealed by their different DNA barcodes.

Here, we describe these three new species. By describing these species, we add understanding to the enormous amount of cryptic and little-collected diversity of tropical koinobiont Darwin wasps being daily revealed by trapping and rearing of complex tropical ecosystems. Due to the restrictions of our research permits for Peruvian material, we have not been able to DNA barcode those *Creagrura* specimens.

## Materials and methods

Morphological terminology follows mainly that of Gauld (2007). Layer photos of all three new species were taken in the Biodiversity Unit, University of Turku, Finland (ZMUT), using an Olympus SZX16 stereomicroscope attached to a Canon 5DsR digital camera. Digital photos were combined using Helicon Focus Pro software. The holotype of *C. nigripes* was illustrated for comparison in the Townes Collection by Dr. David Wahl. The holotype of *C. nigripes* was compared with the new material by using those layer photos.

Sequence data, trace files and metadata for all the currently available two new species from ACG are available on BOLD ([www.barcodinglife.org](http://www.barcodinglife.org)) using this DOI: <https://dx.doi.org/10.5883.DS-ASCREAGR>. Further samples after publication can be retrieved from BOLD by searching for individual voucher codes or the BIN code for each species ([AAA2329](#), [AAA5105](#)). Currently, the two new ACG species are called *C. nigripes*DHJ01 and *C. nigripes*DHJ03 in these public databases. Additional collection information is deposited at <http://janzen.sas.upenn.edu> and all sequences have been deposited in the GenBank database, when they are transferred from BOLD to GenBank by the Centre for Biodiversity Genomics at the University of Guelph, Guelph, Canada.

The holotype and some paratypes of the Costa Rican species, which are formally Costa Rican government property on loan/custody to DHJ, are deposited on loan in the Utah State University (USU) insect collection, the new home for the former collection of the American Entomological Institute (AEI), previously located in Gainesville, Florida. Additional paratypes will be deposited in the Canadian National Insect collection in Ottawa (CNI) and in the Museo Nacional de Costa Rica (MNC), Santo Domingo de Heredia. A male and female paratype of each of the two new Costa Rican species are deposited in the ZMUT. The holotype and paratypes of the Peruvian species will be deposited in the Museo de Historia Natural, Universidad de San Marcos, Peru (UNSM). Two paratype females (Peruvian specimens) are in the ZMUT. The holotype and paratypes of the Peruvian species are currently on loan in ZMUT.

In the material examined, the SRNP code refers to the voucher code of the host caterpillar, while the DHJPAR code is the voucher code of the wasp itself, with full data available through <http://janzen.sas.upenn.edu/caterpillars/database.lasso>.

## Taxon treatments

### *Creagrura* Townes, 1971

#### Nomenclature

*Creagrura* Townes, 1971: 6. Type-species: *Creagrura nigripes* Townes, by original designation.

#### Type species

*Creagrura nigripes* Townes, 1971

#### Description

Modified from Gauld (2007).

Moderately large species, mainly yellowish-orange or orange-blackish, variously infusate dorsally, front wings with a dark spot apically. Fore-wing length 8.0 to 9.8 mm. Clypeus separated from face by a suture. Mandibles with a broad ventral flange. Upper tooth of mandible longer and broader than lower tooth. Palpae formula 5:4. Frons slightly biconcave, polished. Antennae hirsute, flagellomeres infusate, pedicel and scape variable in colouration. Occipital carina broadly interrupted mediodorsally, laterally strong, joining hypostomal carina at base of mandible. Pronotum unspecialised, with epomia slightly raised parallel to anterior margin, upper end detached and angled towards upper margin of pronotum. Mesoscutum with notauli present, broadly, but shallowly, depressed. Scutellum moderately convex, with strong lateral carinae reaching the posterior end. Mesopleuron smooth, punctuated on lower part. Epicnemial carina complete. Metapleuron punctated, separated from propodeum by a strong pleural carina. Propodeum with anterior and posterior transverse carinae present and complete. Lateral longitudinal carinae of propodeum present or rarely absent. Lateromedian longitudinal carinae present or rarely absent. Area superomedia more or less coffin-shaped or very rarely absent. Lateromedian longitudinal carina forming a V- or Y-shaped area basalis. Legs with tarsal claws small, pectinated to apices. Mid-tibia with two apical spurs. Hind femur smooth, without ventral tooth. Fore-wing with an enclosed oblique areolet. Pterostigma slender, blackish, narrower than first subdiscal cell. Distal abscissa of M complete to wing margin. Hind-wing with distal abscissae of M, Cu1 and 1A spectral distally or otherwise incomplete. Metasoma laterally strongly compressed. First tergite elongate, without glymma, ventral margins enclosing most of the sternite. Second tergite slender, varying in length, with a large thyridium. Laterotergite of the second tergite membranous, pendant. Ovipositor short

and stout, orange-brownish in colouration and strongly decurved (hook-shaped), without subapical dorsal notch. Male claspers unspecialised, aedeagus slender, decurved, subapical bristles present.

### Diagnosis

*Creagrura* is easy to distinguish from all other genera of the subfamily Cremastinae by the following set of characters: 1) ovipositor short and strongly down-curved, hook-shaped, 2) scutellum with strong lateral carinae, 3) mandible with broad ventral flange, 4) first tergite of metasoma ventrally almost completely enclosing the sternite and 5) second tergite of metasoma with a large thyridium.

### Biology

In ACG, the two new species of *Creagrura* are middle to late instar koinobiont endoparasitoids of caterpillars that are diurnally concealed in longitudinally folded grass, sedge, ginger, palm or marantaceous leaves (Gauld 2007, DJ, WH, personal observation). However, this is a false impression created by the foraging habits of insect collectors. The caterpillars hide all day in a folded/rolled leaf of their food plant, but venture forth to eat that same and adjacent leaves at night. Since the wasps display all the yellow-orange colour and the behaviour of nocturnal adult Darwin wasps (Obs.: they do not have enlarged ocelli), we infer that the wasps find and oviposit in the caterpillar when it is exposed at night, rather than when it is concealed in a tight leaf tube during daylight hours. This hypothesis is further supported by the fact that specimens of *Creagrura* are rarely collected by Malaise trapping (see above) which is the standard tropical sampling method for diurnal Darwin wasps.

*Creagrura alejandromasisi* sp. n. (BIN [AAA2329](#)) is known only from ACG, where it is exclusively a specialist at parasiting the mid- to last instars of medium-sized (2-4 cm) Hesperinae (Hesperiidae) caterpillars feeding on and day-time sequestering amongst the mature leaves of broad-leafed rain forest perennial monocots (Costaceae, Marantaceae, Cannaceae) in mostly insolated and full shade microhabitats 90-900 m elevation. It does not extend into adjacent ACG dry forest, as does *C. rogerblancoi* sp. n., which feeds on Poaceae, Arecaceae and Cyperaceae in both sun and shady microhabitats. It may be common elsewhere in Costa Rica, but not collected, simply because, in decades of Malaise trapping its ACG microhabitats, it has never been caught by a Malaise-trap. While there are many other genera and species of hesperiine and non-hesperiine caterpillars living and feeding in these microhabitats, *C. alejandromasisi* sp. n. is notable for parasitising only the following species of caterpillars (n = 634 of 155,932 ACG Hesperidae wild caterpillars reared between 1978 and 2021), almost never a palm-eater, grass-eater or sedge-eater and 91% of the time reared from one of eight species of *Saliana* (Hesperiidae): (<http://janzen.sas.upenn.edu/caterpillars/database.lasso>): *Calpodes ethlius* (5), *Cynea Burns02* (1), *Cynea irma* (2), *Cynea megalops* (1), *Decinea decinea derisor* (1), *Parphora decora* (1), *Rhinthon molion* (1), *Rhinthon osca* (29), *Saliana antoninus* (70), *Saliana Burns03* (10), *Saliana Burns06* (1), *Saliana esperi* (379), *Saliana fusta* (15), *Saliana longirostris*

(1), *Saliana placens* (3), *Saliana severus* (85) and *Talides Burns04* (1). These caterpillars show a wide range of body types and colours, in contrast to those parasitised by *C. rogerblancoi*. An image of the solitary wasp cocoon with caterpillar cadaver is available at <http://janzen.sas.upenn.edu/Wadults/searchplaycat4apr15.lasso?Voucher==05-SRNP-43145&-search> and images of all of these species of caterpillars are available at <http://janzen.sas.upenn.edu>.

To date, *C. alejandromasisi* sp. n. has no suggestion of being attacked by any of the many tens of species of ACG common hyperparasitoids (e.g. *Mesochorus*, Ichneumonidae; *Perilampus*, Perilampidae, Chalcididae). Its host caterpillars are also attacked by a small array of other species of parasitoids, but those will be treated in other more cross-taxon ecological publications.

*Creagrura rogerblancoi* sp. n. (BIN [AAA5105](#)) has a caterpillar biology quite similar to that of *Creagrura alejandromasisi* sp. n. described above, except for its species of food plants and caterpillars, lesser sample size and a slight difference in sympatric microecosystems. While there are many other genera and species of hesperiine and non-hesperiine caterpillars living and feeding in its microhabitats, *C. rogerblancoi* sp. n. is notable for parasitising only the caterpillars of *Orses cynisca* (257), rarely three genera of grass-eating hesperiinae Hesperidae and six species of *Perichares* (37) as grass-eating and understorey palm-eating caterpillars (306 of 155,932 ACG Hesperidae wild caterpillars reared between 1978 and 2021). *Orses cynisca* is only feeding on leaves of four species of Cyperaceae and 34 species of Poaceae and the *Perichares* feed only on grasses and understorey palm leaves. *Creagrura alejandromasisi* never parasitises *Perichares* caterpillars feeding on palms or *Orses cynisca*, whatever plant species it is eating. Equally, *C. rogerblancoi* never attacks *Saliana* caterpillars, wherever they are feeding. As a result of their parasitisation of *Perichares* feeding on leaves of deeply shaded rainforest understorey palms, *C. rogerblancoi* wasps are more often reared from shady portions of the microhabitat than are *C. alejandromasisi*, but because the parasite-host interaction presumably takes place at night, this is probably just a serendipitous outcome of the species of host caterpillars and their food preferences. The caterpillars of the four species of *Perichares* studied intensively (Burns et al. 2008) are nearly identical in superficial appearance, but subtly different in their morphology to each other and similar to the caterpillars of *Orses cynisca* (<http://janzen.sas.upenn.edu/caterpillars/database.lasso>). *C. rogerblancoi* is common throughout ACG lowland rainforest, but also extends into ACG lowland dry forest (parasitising hesperiine caterpillars eating grasses and sedges).

### Taxon discussion

*Creagrura* Townes has been viewed as a monotypic Neotropical genus ranging from Central to South America for 50 years. Small morphological intraspecific variation previously led to the recognition of only one species, *C. nigripes* Townes 1971 (Townes 1971, Gauld 2007). Gauld (2007) stated that it is widespread throughout the Neotropics, but prior to more than a superficial understanding of ACG specimens and

their DNA barcodes that emerged in 2004. This new understanding was not available to Gauld in 2007 because the indicative barcode data was still embedded in the gradually accumulating databases of the ACG inventory.

After studying a large amount of new genetic, morphological and biological data, it is now clear that there is more than one species in the genus and all previous descriptions of morphology and geographic ranges are pools of multiple species not individually recognised. All of the hundreds of the two new species, reared in the ACG biodiversity inventory, were misidentified as *Creagrura nigripes*. There is no evidence that *C. nigripes* even occurs in Costa Rica or further north. Neither of the two new Costa Rican species have ever been captured in a Malaise trap, despite decades of Malaise trapping ACG forests where the two new species are very common. This result suggests that standard collections of tropical Hymenoptera are likely to not obtain *Creagrura*, despite its being a common wasp parasitising its common host species of HesperIIDae caterpillars. This note is further supported by our data from South America. Despite of collecting > 250 MTMs (Malaise trap months) in Peru (Gomez et al. 2018), we have found only a very few *Creagrura* specimens from these samples.

The mandibular flange and lateral carinae of the scutellum are key identifying characters of *Creagrura*, but they can also be found in some other Neotropical cremastines. Species of *Eiphosoma* Cresson exhibit this flange and one, apparently undescribed, Amazonian species has been found to possess a raised, lateral carina on the scutellum (Stedenfeld and Sääksjärvi, unpublished data).

### ***Creagrura alejandromasisi* Sääksjärvi, 2022, sp. n.**

- ZooBank [F03E6918-80A2-4F71-B6BA-15ACC5CAA85A](https://www.zoobank.org/F03E6918-80A2-4F71-B6BA-15ACC5CAA85A)

#### **Materials**

##### *Holotype:*

- continent: Americas; country: Costa Rica; locality: Area de Conservacion de Guanacaste; samplingProtocol: Rearing; individualID: 05-SRNP-43720; sex: Female; associatedSequences: DHJPAR0009786; identifiedBy: D.H.Janzen, W.Hallwachs; datasetID: DHJPAR0009786; institutionCode: AEI; occurrenceID: D2AE4CD4-686C-53BD-B042-39F54449B8A5

##### *Paratypes:*

- continent: Americas; country: Costa Rica; locality: Area de Conservacion de Guanacaste; samplingProtocol: Rearing; individualID: 09-SRNP-40615; sex: Female; associatedSequences: DHJPAR0035191; identifiedBy: D.H.Janzen, W.Hallwachs; datasetID: DHJPAR0035191; institutionCode: CNI; occurrenceID: FFDD92D9-0F31-5DE3-B45F-60790C297B66
- continent: Americas; country: Costa Rica; locality: Area de Conservacion de Guanacaste; samplingProtocol: Rearing; individualID: 08-SRNP-564; sex: Female; associatedSequences: DHJPAR0023408; identifiedBy: D.H.Janzen, W.Hallwachs; datasetID: DHJPAR0023408; institutionCode: ZMUT; occurrenceID: F1733153-7631-5029-8D82-9887652D1283

- c. continent: Americas; country: Costa Rica; locality: Area de Conservacion de Guanacaste; samplingProtocol: Rearing; individualID: 08-SRNP-463; sex: Male; associatedSequences: DHJPAR0023423; identifiedBy: D.H.Janzen, W.Hallwachs; datasetID: DHJPAR0023423; institutionCode: AEI; occurrenceID: 4F44D56B-006C-5E89-928B-E063DD94CAF4
- d. continent: Americas; country: Costa Rica; locality: Area de Conservacion de Guanacaste; samplingProtocol: Rearing; individualID: 06-SRNP-34134; sex: Male; associatedSequences: DHJPAR0016378; identifiedBy: D.H.Janzen, W.Hallwachs; datasetID: DHJPAR0016378; institutionCode: AEI; occurrenceID: DC9AEF7C-E9B6-5CD6-A8B8-8C9830C964B4
- e. continent: Americas; country: Costa Rica; locality: Area de Conservacion de Guanacaste; samplingProtocol: Rearing; individualID: 08-SRNP-5087; sex: Male; associatedSequences: DHJPAR0028406; identifiedBy: D.H.Janzen, W.Hallwachs; datasetID: DHJPAR0028406; institutionCode: CNI; occurrenceID: 889FC6C5-7740-58B2-B622-E88B4B41CA10
- f. continent: Americas; country: Costa Rica; locality: Area de Conservacion de Guanacaste; samplingProtocol: Rearing; individualID: 08-SRNP-488; sex: Male; associatedSequences: DHJPAR0023422; identifiedBy: D.H.Janzen, W.Hallwachs; datasetID: DHJPAR0023422; institutionCode: MNC; occurrenceID: BE1B57F9-DAC9-5E9A-B00E-7FBB83E39296
- g. continent: Americas; country: Costa Rica; locality: Area de Conservacion de Guanacaste; samplingProtocol: Rearing; individualID: 07-SRNP-30407; sex: Male; associatedSequences: DHJPAR0017220; identifiedBy: D.H.Janzen, W.Hallwachs; datasetID: DHJPAR0017220; institutionCode: ZMUT; occurrenceID: 96AE0980-0B84-5250-A6D9-F790FAC7A5BD

## Description

Female: Mandibles with outer surface bearing long scattered whitish hairs; clypeus about 1.7-1.8 times as broad as high, strongly convex, shiny; lower face shiny, centrally with convex swelling (Fig. 1a). Mesoscutum polished, with median and lateral lobes punctate, posterior part of lateral lobe less punctate; notauli clearly impressed; meso- and metapleuron finely punctate, posterior transverse carina of the mesosternum strong and highly elevated. Propodeum in profile moderately long, extending to approximately 0.2-0.3 the length of posterior coxae, evenly declivous, with anterior and posterior transverse carinae strong, lateromedian longitudinal carina and pleural carina strong, lateral longitudinal carina more or less absent, weakly present posteriorly to posterior transverse carina and anteriorly to anterior transverse carina; area superomedia more or less coffin-shaped, curved laterally (Fig. 1d). Hind tarsal claw small, with a row of close pectinae. Metasoma with tergite 2 about 1.3 times as long as tergite 1, with a clearly discernible thyridium which is widely separated from the anterior margin, laterotergite membranous, pendant (Fig. 1b). Ovipositor short, strongly decurved, stout, without a subapical notch, ovipositor sheath with long, scattered hairs. Structure otherwise as figured (Fig. 1) and described in generic description.

A primarily yellowish species, with antenna, dorsal stripes (3) of pronotum, scutellum, propodeum, tarsal segments of mid-leg, tibia and tarsal segments of hind leg blackish or brownish; hind femur orange, with apical whitish spot; hind coxa orange; area dentipara brownish; metasoma predominantly orange, tergite 1 apically brownish, tergites 2-3 dorsally brownish or blackish (Fig. 1a). Ovipositor yellowish-orange,



ovipositor sheath blackish. Wings hyaline, with veins, pterostigma and apical part (approximately 0.2) of front wing dark brownish.

Male: Similar to female in size, structure and colouration. Claspers simple, orange in colouration. aedeagus slender, slightly enlarged and rounded apically, with fine whitish bristles apically.

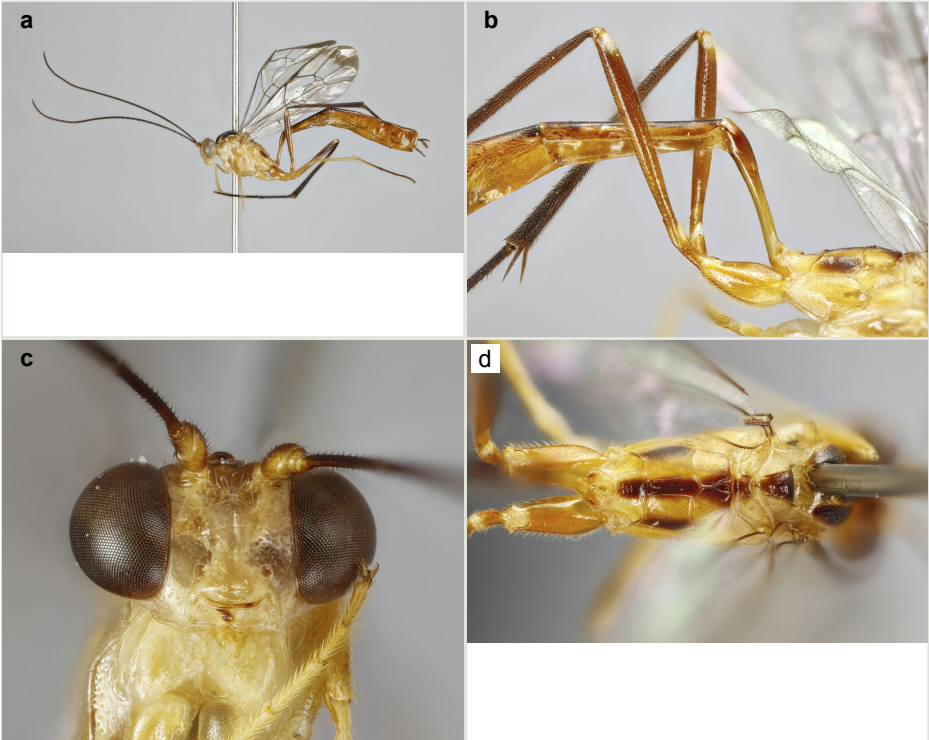


Figure 1.

*Creagrura alejandromasisi* sp. n.

a: Holotype, female: habitus (lateral) [doi](#)

b: Paratype, female: first and second tergites (lateral) [doi](#)

c: Paratype, female: face (anterior) [doi](#)

d: Paratype, female: propodeum (dorsal) [doi](#)

## Diagnosis

*Creagrura alejandromasisi* can be distinguished from other species of *Creagrura* by the following set of characters: tergite 1 about 1.3x as long as tergite 2; propodeum yellowish, with a brownish longitudinal stripe extending from area petiolaris to area basalis and brownish spot in area dentipara; hind coxa and femur orange and metasoma predominantly yellowish. It closely resembles the holotype of *C. nigripes* Townes in colouration. However, femurs of *C. nigripes* are shiny black and hind coxa orange ventrally and brownish dorsally. In addition, propodeum of *C. nigripes* has a

W-shaped brown area dorsally. *C. alejandromasisi* sp. n. is sympatric (in Costa Rica) with *C. rogerblancoi* sp. n. However, these two species are readily distinguishable from each other by their colouration and their DNA barcodes.

### Etymology

*Creagrura alejandromasisi* is named in honour of Costa Rica's Alejandro Masís Cuevillas in recognition of his 27 years of intense biological and administrative support to ACG parataxonomists, INBio, ACG as its Director and the Guanacaste Dry Forest Conservation Fund as its advisor.

### Distribution

North-western Costa Rica.

### Ecology

See above.

## *Creagrura allpahuaya* Sääksjärvi, 2022, sp. n.

- ZooBank [E74B9CCD-9153-4ADE-943F-77459DF69836](https://doi.org/10.21203/rs.3.rs-1234567/v1)

### Materials

#### *Holotype:*

- continent: South America; country: Peru; stateProvince: Loreto; locality: Allpahuayo; samplingProtocol: Malaise trap; eventDate: 19-25.9-2011; habitat: Lowland rainforest; fieldNotes: Week18; sex: Female; identifiedBy: Isrrael Gómez & Ilari E. Sääksjärvi; institutionCode: UNSM; occurrenceID: AE3C8A3C-96D5-53DA-9841-16BD70F6A5E9

#### *Paratypes:*

- continent: South America; country: Peru; stateProvince: Loreto; locality: Allpahuayo; samplingProtocol: Malaise trap; eventDate: 14.9.-4.10.2000; habitat: Lowland rainforest, white sand; fieldNotes: APHI G3/1; sex: Female; identifiedBy: Ilari E. Sääksjärvi et al.; institutionCode: UNSM; occurrenceID: 74A3844F-5B54-5229-84FC-690142FC109B
- continent: South America; country: Peru; stateProvince: Loreto; locality: Allpahuayo; samplingProtocol: Malaise trap; eventDate: 18.9.-4.10.1998; habitat: Lowland rainforest, white sand (varillal); fieldNotes: APHI D1/3 012; sex: Female; identifiedBy: Ilari E. Sääksjärvi (IES) & Reijo Jussila (RJ); institutionCode: UNSM; occurrenceID: 714EC3C6-C904-5D7B-8D30-1863DD51723D
- continent: South America; country: Peru; stateProvince: Loreto; locality: Allpahuayo; samplingProtocol: Malaise trap; eventDate: 2-24.3.2000; habitat: Lowland rainforest, white sand; fieldNotes: APHI G1/3; sex: Female; identifiedBy: Ilari E. Sääksjärvi (IES) & Reijo Jussila (RJ); institutionCode: UNSM; occurrenceID: 9A666798-1999-5A7D-BF68-C92B3930ACF3
- continent: South America; country: Peru; stateProvince: Loreto; locality: Allpahuayo; samplingProtocol: Malaise trap; eventDate: 1-15,12.2000; habitat: Lowland rainforest,

- clay; fieldNotes: APHI J1/17; sex: Female; identifiedBy: Ilari E. Sääksjärvi et al.; institutionCode: ZMUT; occurrenceID: 2D8F44FE-9F21-5F8D-A3B5-C82708144023
- e. continent: South America; country: Peru; stateProvince: Loreto; locality: Mishana; samplingProtocol: Malaise trap; eventDate: 1-16.11.1998; habitat: Lowland rainforest, clay; fieldNotes: APHI A1/6 022; sex: Male; identifiedBy: Ilari E. Sääksjärvi (IES) & Reijo Jussila (RJ); institutionCode: UNSM; occurrenceID: E6D28160-38B1-53C4-9BFD-ABB906D955BD

## Description

Female: Mandibles with outer surface bearing long scattered whitish hairs; clypeus about 1.7-1.8 times as broad as high, strongly convex, shiny; lower face shiny, centrally with convex swelling (Fig. 2c). Mesoscutum polished, with median and lateral lobes punctate, posterior part of lateral lobe less punctate; notauli clearly impressed; meso- and metapleuron finely punctate, posterior transverse carina of the mesosternum strong and highly elevated. Propodeum in profile very long, extending to approximately 0.4-0.5x the length of posterior coxae, evenly declivous, with anterior and posterior transverse carinae strong, lateromedian longitudinal carina and pleural carina strong, lateral longitudinal carina more or less absent, weakly present posteriorly to posterior transverse carina and anteriorly to anterior transverse carina; area superomedia more or less coffin-shaped, straight laterally (Fig. 2d). Hind tarsal claw small, with a row of close pectinae. Metasoma with tergite 2 about 1.6 times as long as tergite 1, with a clearly discernible thyridium which is widely separated from the anterior margin, laterotergite membranous, pendant (Fig. 2b). Ovipositor short, strongly de-curved, stout, without a subapical notch, ovipositor sheath with long, scattered hairs. Structure otherwise as figured (Fig. 2) and described in generic description.

A primarily yellowish-orange species, with antenna, hind femur, hind tibia, hind tarsal segments and tergites 2-6 dark brownish to shiny blackish; central lobe of pronotum brownish; propodeum orange, without brownish areas. Ovipositor dark brown or orange, ovipositor sheaths blackish. Wings hyaline, with veins, pterostigma and apical part (approximately 0.2) of front wing blackish. Structure otherwise as figured (Fig. 2) and described in generic description.

Male: Similar to female in size, structure and colouration. Claspers simple, brownish in colouration. Aedeagus slender, slightly enlarged and rounded apically, with fine whitish bristles apically. Obs.: only one male specimen has been found. This specimen has strongly elevated propodeal carination.

## Diagnosis

*Creagrura allpahuaya* sp. n. is the most distinctive species of *Creagrura*. It can be easily distinguished from other species of *Creagrura* by the following set of characters: tergite 2 long, approximately 1.6 times as long as tergite 1, mesosoma predominately yellowish-orange, hind coxa orange (ventrally and laterally), hind femur (except for apical white spot), tibia and tarsal segments black and tergite 2-6 predominantly blackish. It resembles *C. nigripes* in colouration of hind legs (both species have black

or blackish hind femura). However, metasoma of *C. nigripes* is predominantly orange and it has large brownish areas in pronotum, scutellum, propodeum and hind coxa. These structures are yellowish-orange in *C. allpahuaya*.



Figure 2.

*Creagrura allpahuaya* sp. n. Holotype, female:

- a: Habitus (lateral) [doi](#)
- b: First and second tergites (lateral) [doi](#)
- c: Face (anterior) [doi](#)
- d: Propodeum (dorsal) [doi](#)
- e: Ovipositor, lateral [doi](#)

## Etymology

The specific name “*allpahuaya*” refers to the type locality: National Reserve of Allpahuayo-Mishana (Perú).

## Distribution

Peru.

## Biology

Nothing is known about the host relationships of this species.

## Taxon discussion

This species is only known from the Western Amazonian lowland rain forests (National Reserve of Allpahuayo-Mishana, Department of Loreto, Iquitos, Perú).

## *Creagrura rogerblancoi* Sääksjärvi, 2022, sp. n.

- ZooBank [45235D41-927F-4229-AE3D-32301B2EC9CF](https://doi.org/10.3897/zoo.45235D41-927F-4229-AE3D-32301B2EC9CF)

## Materials

### Holotype:

- a. country: Costa Rica; locality: Area de Conservacion de Guanacaste; samplingProtocol: Rearing; individualID: 06-SRNP-43689; sex: Female; associatedSequences: DHJPAR0016381; identifiedBy: D.H.Janzen & W. Hallwachs; institutionCode: AEI; occurrenceID: 0658998C-FA34-5B6E-BDC2-A5E0BCE03F70

### Paratypes:

- a. country: Costa Rica; locality: Area de Conservacion de Guanacaste; samplingProtocol: Rearing; individualID: 08-SRNP-57407; sex: Female; associatedSequences: DHJPAR28409; identifiedBy: D.H.Janzen & W. Hallwachs; institutionCode: AEI; occurrenceID: BE2D3220-3903-56A9-8F71-9A8098ED7C86
- b. country: Costa Rica; locality: Area de Conservacion de Guanacaste; samplingProtocol: Rearing; individualID: 07-SRNP-42145; sex: Female; associatedSequences: DHJPAR0021134; identifiedBy: D.H.Janzen & W. Hallwachs; institutionCode: CNI; occurrenceID: 60A782D4-A10E-53C8-8FAC-A8C3062E046E
- c. country: Costa Rica; locality: Area de Conservacion de Guanacaste; samplingProtocol: Rearing; individualID: 07-SRNP-42145; sex: Female; associatedSequences: DHJPAR0021134; identifiedBy: D.H.Janzen & W. Hallwachs; institutionCode: CNI; occurrenceID: 49EAE486-0DC5-53FB-8D9C-3BDE8133A564
- d. country: Costa Rica; locality: Area de Conservacion de Guanacaste; samplingProtocol: Rearing; individualID: 08-SRNP-57409; sex: Female; associatedSequences: DHJPAR0028410; identifiedBy: D.H.Janzen & W. Hallwachs; institutionCode: MNC; occurrenceID: 80375DD1-D09D-5A10-AA90-95FC4663F1C9
- e. country: Costa Rica; locality: Area de Conservacion de Guanacaste; samplingProtocol: Rearing; individualID: 07-SRNP-40196; sex: Female; associatedSequences:

- DHJPAR0016933; identifiedBy: D.H.Janzen & W. Hallwachs; institutionCode: ZMUT; occurrenceID: 9C3FECC4-CAE3-5CB1-8BE5-A96E60F3C4C8
- f. country: Costa Rica; locality: Area de Conservacion de Guanacaste; samplingProtocol: Rearing; individualID: 07-SRNP-42148; sex: Male; associatedSequences: DHJPAR0021104; identifiedBy: D.H.Janzen & W. Hallwachs; institutionCode: AEI; occurrenceID: 77A35467-6A2C-5FE1-A749-FE086087D8FC
- g. country: Costa Rica; locality: Area de Conservacion de Guanacaste; samplingProtocol: Rearing; individualID: 07-SRNP-56455; sex: Male; associatedSequences: DHJPAR0019860; identifiedBy: D.H.Janzen & W. Hallwachs; institutionCode: AEI; occurrenceID: 191EB5B2-488A-5B8F-9E66-29833F5779A5

## Description

Female: Mandibles with outer surface bearing long scattered whitish hairs; clypeus about 1.7-1.8 times as broad as high, strongly convex, shiny; lower face shiny, centrally with convex swelling (Fig. 3c). Mesoscutum polished, with median and lateral lobes punctate, posterior part of lateral lobe less punctate; notauli clearly impressed; meso- and metapleuron finely punctate, posterior transverse carina of the mesosternum strong and highly elevated. Propodeum in profile moderately long, extending to approximately 0.2-0.3x the length of posterior coxae, evenly declivous, with anterior and posterior transverse carinae strong, lateromedian longitudinal carina and pleural carina strong, lateral longitudinal carina more or less absent, weakly present posteriorly to posterior transverse carina and anteriorly to anterior transverse carina; area supermedia more or less coffin-shaped, straight laterally (Fig. 3d). Hind tarsal claw small, with a row of close pectinae. Metasoma with tergite 2 about 1.3 times as long as tergite 1, with a clearly discernible thyridium which is widely separated from the anterior margin, laterotergite membraneous, pendant (Fig. 3b). Ovipositor short, strongly decurved, stout, without a subapical notch, ovipositor sheath with long, scattered hairs. Structure otherwise as figured (Fig. 3) and described in generic description.

A primarily yellowish-orange species, with antenna, hind tibia, hind tarsal segments, tergite 1 dorsally and apical part of tergite 2 dorsally black or blackish; central lobe of pronotum fuscous; propodeum orange, without brownish areas; hind femur orange, with apical whitish spot; hind coxa orange (Fig. 3b). Ovipositor yellowish-orange, ovipositor sheaths blackish. Wings hyaline, with veins, pterostigma and apical part (approximately 0.2) of front wing blackish. Structure otherwise as figured (Fig. 3) and described in generic description.

Male: Similar to female in size, structure and colouration. Claspers simple, orange in colouration. aedeagus slender, slightly enlarged and rounded apically, with fine whitish bristles apically.

## Diagnosis

*Creagrura rogerblancoi* sp. n. can be distinguished from other species of *Creagrura* by the following set of characters: tergite 1 about 1.3x as long as tergite 2, propodeum entirely orange (without any brownish or blackish spots or stripes), hind coxa orange

(both ventrally and dorsally) and hind femur orange. This species is sympatric (in Costa Rica) with *C. alejandromasisi* sp. n. However, these two species are readily distinguishable by their colouration. *C. rogerblancoi* is also readily distinguished from *C. nigripes* which has, for example, blackish hind femurs and brownish “W-shape” on propodeum.

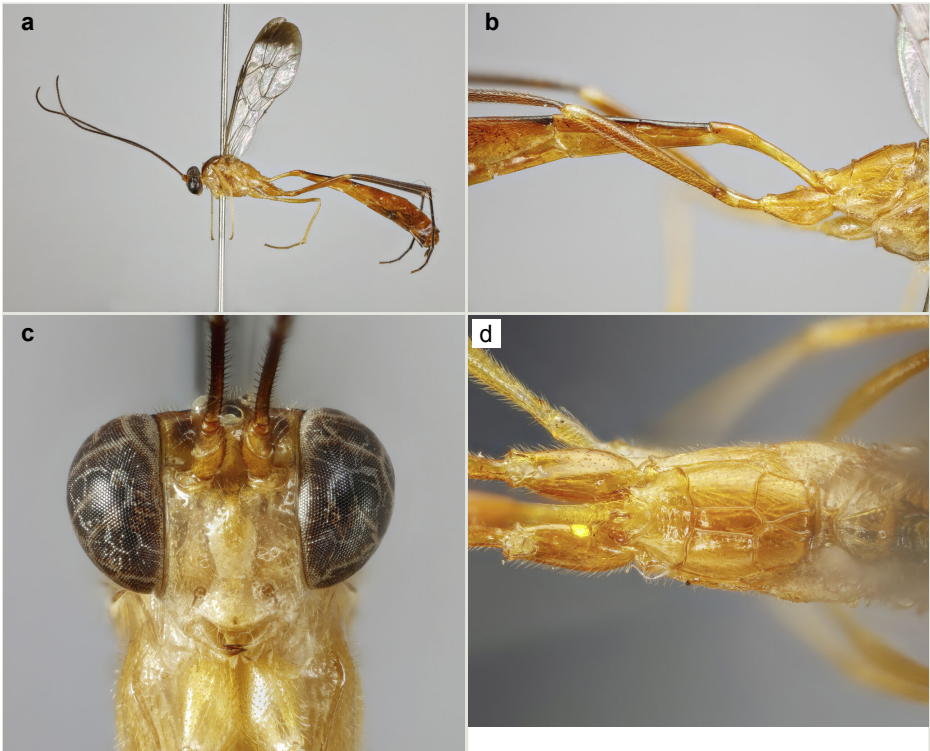


Figure 3.

*Creagrura rogerblancoi* sp. n. Holotype, female:

a: Habitus (lateral) [doi](#)

b: First and second tergites (lateral) [doi](#)

c: Face (anterior) [doi](#)

d: Propodeum (dorsal) [doi](#)

### Etymology

This species is named in honour of Costa Rica’s Roger Blanco Segura to honour his four decades of intense and dedicated management and care of the biodiversity of Parque Nacional Santa Rosa and then its expansion to become Área de Conservación Guanacaste, Costa Rica.

### Distribution

North-western Costa Rica.

## Biology

See above.

## Discussion

### General patterns in species richness of Neotropical parasitoid wasps

Darwin wasps (Hymenoptera, Ichneumonidae) have been hypothesised to be more species-poor in the tropics than in some higher latitudes (Gauld 1991, Gauld et al. 1992, Timms et al. 2016), but this is obviously a misconception, based on limited classical ways of insect collecting and on relying on morphological differentiation of museum specimens with no appreciation of their natural history.

Recent thorough trapping and host rearing in ACG habitats and Peruvian Amazonia (Sääksjärvi et al. 2004, Smith et al. 2008, Veijalainen et al. 2012, Gomez et al. 2018, Janzen et al. 2020, Sharkey et al. 2021,) are revealing that there are enormous numbers of species of Neotropical parasitoid wasps that are unappreciated and unknown to science and society.

The three described here are emphasised now because their roles in emerging ACG ecological patterns need identifying names and because they are readily distinctive from what was believed to be the single species in a monotypic genus.

## Acknowledgements

We (IES, KMK, DHJ, WH) would like to thank Dr. David Wahl (AEI / USU) for loaning us specimens of *Creagrura* from the AEI collection. The Peruvian research and exportation permits were given by the Instituto Nacional de Recursos Naturales (INRENA). The Costa Rican specimens were collected and exported under permit R-SINAC-ACG-PI-061-2021 and R-019-2019-OT-CONAGEBIO issued to DHJ and WH. The project was partly funded by the Kone Foundation (Finland), the Academy of Finland (IES and KMK) the Entomological Society of Finland and the Ministry of Education (Finland) and the Wege Foundation of Grand Rapids, Michigan (USA). The following friends and colleagues helped in the field during the 1998–2011 sampling programmes: late Pekka Soini, Jukka Salo, late Andres Marmol Burgos, Manuel Reategui, José Alvarez, Mario Escobedo and the villagers of Mishana (Peru). We thank the following institutions for support during the study: Universidad Nacional de la Amazonía Peruana, UNAP (Peru), Instituto Nacional de Recursos Naturales, INRENA (Peru), Instituto de Investigaciones de la Amazonía Peruana, IIAP (Peru), Instituto Nacional de Investigación Agraria, INIA (Peru) and Universidad Nacional Mayor de San Marcos (Peru). We (DHJ, WH) would like to thank Ian Gauld (RIP) for first identifying *Creagrura* for Costa Rica, followed by intense care and taxonomising of the ACG Costa Rican specimens by David Wahl at the former AEI and now USU collection and the ACG Parataxonomist Program (Janzen and Hallwachs 2011) for finding and rearing the caterpillars and parasitoids of the ACG inventory, supported by



the Guanacaste Dry Forest Conservation fund and through the government of Costa Rica support for ACG.

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