Seventeen new dragonfly records from Colombia and the confirmation of the synonymy of *Philogenia monotis* and *P. tinalandia* (Insecta: Odonata)

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During 2.5 months of intensive fieldwork in Colombia (departments of Cauca, Nariño, and Putumayo, South America) from January to March 2017, we visited 13 localities and collected 291 specimens of 68 species of Odonata, including 17 new records for the country. We report range expansions for several species assessed as data deficient or under some degree of threat by the IUCN Red List. Furthermore, we confirmed that *Philogenia tinalandia* is a junior synonym of *P. monotis*, thus solving a longstanding enigma. We also report the rediscovery, after many decades, of *Philogenia raphaella*, *P. sucra* and *Stenocora percornuta*. The data we collected are an important contribution to the knowledge of the dragonfly diversity of the Colombian Andean region and its surroundings, including the nearby areas in Ecuador and Peru, countries with which the departments visited share boundaries.

**Keywords:** Cauca; diversity; damselfly; Nariño; Putumayo

**Introduction**

Colombia is a tropical country and one of the most biodiverse nations in the world thanks to its geography and geological history. It is located at the confluence of the Amazon and Central American biotas, while the three Andean Cordilleras that cross the country from southwest to northeast result in a wide range of habitats: from hot tropical forest in the lowlands to cold glaciers at the top of the highest mountains (Rangel-ch, 2005). In spite of this, Colombia remains one of the least biologically explored countries in the world (Paulson, 2004). Even in charismatic groups such as birds, new species for science and new country records continue to be regularly discovered (Avendaño et al., 2015; Lara, Cuervo, Valderrama, Calderón-f, & Cadena, 2012; Stiles, Laverde-R, & Cadena, 2017). Dragonflies (Odonata) are no exception: its country list of 406 species (Bota-Sierra, 2017; Bota-Sierra, Moreno-Arias, & Faasen, 2015; Bota-Sierra & Novelo-Gutiérrez, 2017; Garrison & von Ellenrieder, 2015, 2017; Rache, 2015) clearly lags behind its neighbors Peru, with 553 species (Bota-Sierra, Maufray, et al., 2016; Hoffmann, 2009), and Venezuela, with 525 (Vivas-Santeliz & De Marmels, 2017).
Southwestern Colombia, near the border with Ecuador, is one of the least explored areas in the country. It comprises the departments of Cauca, Nariño, and Putumayo, with elevations ranging from sea level along the Pacific Ocean to 4764 m at Cumbal Volcano in the Andes. The region harbors a great variety of habitats from lowland and foothill rainforest in the Amazonian (east of the Andes) and Chocó biomes (west of the Andes), cloud forests, dry forests in the Patía Valley, and several páramos, high-mountain ecosystems unique to the tropical Andes (see Figure 1). The odonate fauna of the departments of Cauca, Nariño and Putumayo is nearly unknown, as attested by their respective species totals of six, 17 and 35 (Bota-Sierra, 2014; Bota-Sierra et al., 2015; Bota-Sierra, Rache, & Palacino, 2016; Pérez-Gutiérrez & Palacino-Rodríguez, 2011), certainly a tiny fraction of the true diversity of such an ecologically rich area. These departments had been poorly explored, in part because of political unrest, but in light of recent drastic improvements in the security situation, we decided to target them for fieldwork in order to uncover some of the diversity harbored by the region and shed light on the great richness of species that has been previously disregarded in the area. Here we present the results of our expedition, including 17 species new to Colombia, the confirmation of a previously suggested synonymy and the rediscovery of three species many decades after the last known records. Additionally, we present a map with the sampled localities, photographs and natural history notes for the species recorded during the study.

Methods

Study area

During 2.5 months of travel, from 4 January to 25 March 2017, we visited 13 localities that ranged from 50 to 1350 m in elevation and from 2929 to 6923 mm of rainfall (Hijmans, Cameron,
Table 1. Localities visited during the trip. For any visited site we report department, locality name, locality code, habitat studied, coordinates, altitude, annual average precipitation and date of field activities.

| Department | Locality | Locality code | Habitats for Odonata | Coordinates, altitude, and annual average precipitation | Date of field activities (in 2017) |
|------------|----------|---------------|----------------------|--------------------------------------------------------|----------------------------------|
| Putumayo   | Municipality of Orito, Orito town outskirts | OR | Wet pastures | 0.66792°N 76.86758°W 350 m 3341 mm | 14 Jan |
| Putumayo   | Municipality of Orito, Reserva Natural La Isla Escondida | IE | Medium to fast-flowing streams and rivulets in foothill forest | 0.65775°N 77.07216°W 650–950m 3351 mm | 15–20 Jan; 3–23 Mar |
| Putumayo   | Municipality of Orito, trail to Monopamba | MO | Fast-flowing streams and rivulets in patchy foothill forest and pastures | 0.63825°N 77.08447°W 700 m 3241 mm | 21 Jan |
| Putumayo   | Municipality of Orito, Vereda El Líbano | LI | Streams and seeps in foothill forest | 0.62038°N 77.05247°W 600–700 m 3389 mm | 22 Jan |
| Putumayo   | Municipality of Puerto Leguizamo, mouth of Rio Caucayá | RC | Varzea forest and small marshes bordered by pastures | 0.18128°S 74.81289°W 190 m 2981 mm | 29 Jan |
| Putumayo   | Municipality of Puerto Leguizamo, Vereda San Francisco | SF | Streams and small ponds in lowland Amazonian terra firma rainforest and cattle pastures | 0.10647°S 74.65983°W 190 m 3062 mm | 30 Jan |
| Putumayo   | Putumayo River, Municipality of Puerto Leguizamo, river island 9 km upstream from Puerto Leguizamo | RI | Sandbar on the river with early successional vegetation, some of it flooded | 0.23634°S 74.85961°W 180 m 2929 mm | 29 and 31 Jan |
| Cauca      | Municipality of Piamonte, Finca Mirasol, Vereda Miraflores, foot of the Serranía de los Churumbelos | VM | Streams and ponds fringed by strips of forest in largely deforested Amazonian lowlands | 1.02422°N 76.46517°W 300 m 4141 mm | 23–24 Jan |
| Cauca      | Municipality of Piamonte, Vereda La Sevilla, foothills in the Serranía de los Churumbelos | LS | Streams in foothill forest | 1.10000°N 76.41750°W 450 m 4256 mm | 25–26 Jan |

(Continued).
Table 1. Continued.

| Department | Locality | Locality code | Habitats for Odonata | Coordinates, altitude, and annual average precipitation | Date of field activities (in 2017) |
|------------|----------|---------------|----------------------|--------------------------------------------------------|----------------------------------|
| Nariño     | Municipality of Barbacoas, Reserva Natural Rio Ñambí | RN | Streams and rivulets in cloud-forest | 1.29853°N 78.08317°W 1350 m 3570 mm | 17 Feb |
| Nariño     | Municipality of Barbacoas, road Barbacoas-Junín | BJ | Road-side vegetation close to well preserved forests | 1.38450°N 78.07783°W 1000 m 5026 mm | 18 Feb |
| Nariño     | Municipality of Barbacoas, road Tumaco-Junín, close to Reserva la Nutria | NU | Road-side vegetation close to well preserved forests | 1.35558°N 78.17450°W 800m 6923 mm | 18 Feb |
| Nariño     | Municipality of Tumaco, km 42 on the Tumaco-Junín road | TJ | Road-side vegetation and channels in mixed forest and pastures | 1.43022°N 78.61669°W 50 m 3132 mm | 18 Feb |
Parra, Jones, & Jarvis, 2005), in the departments of Cauca, Nariño and Putumayo (Table 1, Figure 1) to study and collect the local odonates.

**Collection methods**

We were in the field from dawn to dusk most days, although the bulk of our collecting activities took place after about 8 am, once odonates became more active. We walked existing forest trails and explored any suitable habitats – ponds, creeks, marshes, and swamps – we found. Odonates were spotted with the naked eye or with 7 × and 10 × binoculars, chiefly when up on trees or high vegetation. They were collected with green bag nets of 46 cm and 30 cm diameter, mounted on long (1.80 cm) and short (1.20 cm) aluminum telescopic handle poles. Field photographs were taken with a Canon 7d dslr camera (Japan) and a Sigma 150 mm f 2.8 lens (Japan). For all specimens, detailed photos were taken, shortly after capture, against a standard white background from an X-Rite color checker that also features a 50 mm ruler on the left side (USA). The map was composed in QGIS v.2.8.3 (QGIS Development Team, 2018) using WorldClim elevation data (Hijmans et al., 2005) and the field coordinates were taken in degree format; also the annual average rainfall was obtained using the data provided by WorldClim for each locality. All the collected specimens are deposited at the Colección Entomológica de la Universidad de Antioquia (CEUA) in Medellín (Colombia). Here, they were identified by comparison with reference specimens and using specialized literature, mainly Garrison, von Ellenrieder, and Louton (2006, 2010) and Heckman (2006, 2008). Further, several generic revisions and species descriptions were consulted, including: Calvert (1909, 1924); Ris (1918); Kennedy (1938, 1941); Belle (1984); Dunkle (1986); Bick and Bick (1988); De Marmels (2001); Donnelly (1992); von Ellenrieder (2003, 2013); von Ellenrieder and Garrison (2003, 2017); Garrison (2004, 2006, 2009); Daigle (2005); Garrison and von Ellenrieder (2015, 2017); Tennessen (2015).

**Results**

A total of 291 specimens of 68 species were collected (Table 2). We confirmed Philogeneia tinalandia Bick and Bick, 1988 as a junior synonym of Philogeneia monotis (Kennedy, 1941). Further, we report the rediscovery of Philogeneia raphaella Selys, 1886, Philogeneia sucra

| Species                      | Locality code | Department | IUCN Category | Figure |
|------------------------------|---------------|------------|----------------|--------|
| Perissolestes cornutus (Selys, 1886) | SF,LI         | Pu         | LC             |        |
| Perissolestes remotus (Williamson & Williamson, 1924) | RN           | Na         | LC             |        |
| Palaemnema picicaudata Kennedy, 1938* | LI           | Pu         | LC             | 2c     |
| Hetaerina aurora Ris, 1918    | RN            | Na         | LC             |        |
| Hetaerina caja caja (Drury, 1773) | JT            | Na         | NA             |        |
| Hetaerina occisa Hagen, 1853   | LS            | Ca         | NA             |        |
| Mnesarete fulgida (Selys, 1879) | IE            | Pu         | NA             |        |
| Mnesarete hauxwelli (Selys, 1869)* | IE,LI        | Pu         | NA             | 2b     |
| Helioclaris amazonea Selys, 1853 | VM            | Ca         | NA             |        |
| Heteragrion aequatoriale Selys, 1886 | RN        | Na         | LC             |        |
| Heteragrion bickorum (Daigle, 2005)* | IE           | Pu         | LC             | 2a     |
| Heteragrion inca Calvert, 1909 | IE,SI,LI     | Pu         | NA             |        |
| Teinopodagrion curtum (Selys, 1886) | IE            | Pu         | LC             |        |
| Philogeneia minieri Dunkle, 1986* | LI            | Pu         | LC             | 2f     |
| Philogeneia monotis (Kennedy, 1941)* | RN        | Na         | EN             | 2d, e  |

(Continued).
Table 2. Continued.

| Species                                | Locality code | Department | IUCN Category | Figure |
|-----------------------------------------|---------------|------------|---------------|--------|
| Philogenia raphaella Selys, 1886         | IE, LI        | Pu         | DD            | 2 h, i |
| Philogenia succa Dunkle, 1986            | LS            | Ca         | DD            | 2j     |
| Polythoridae                            |               |            |               |        |
| Polythore concina (McLachlan, 1881)      | IE, LI        | Pu         | LC            |        |
| Polythore derivata (McLachlan, 1881)     | IE            | Pu         | LC            |        |
| Stenocora percornuta Kennedy, 1940†     | IE            | Pu         | NT            | 3a     |
| Coenagrionidae                          |               |            |               |        |
| Acanthagrion obsoletum ( Förster, 1914)  | VM            | Ca, Pu     | LC            |        |
| Acanthagrion peruvianum Leonard, 1977    | LS            | Ca         | LC            |        |
| Acanthagrion trilobatum Leonard, 1977    | JT            | Na         | NA            |        |
| Acanthallagma caeruleum Williamson &     | VM            | Ca         | NA            |        |
| Williamon, 1924                         |               |            |               |        |
| Amazoneca westfalli Machado, 2001†      | LI            | Pu         | LC            | 3b     |
| Argia difficilis Selys, 1865             | LI            | Pu         | NA            |        |
| Argia dives Förster, 1914                | IE, LI        | Pu         | LC            |        |
| Argia oculata Selys, 1865                | LI            | Pu         | LC            |        |
| Argia pulla Selys, 1865                  | VM, LS, MO    | Ca, Pu     | LC            |        |
| Argia schneideri Garrison & von         | IE            | Pu         | NA            | 3c     |
| Ellenrieder, 2017*                       |               |            |               |        |
| Calvertagrion mauffrayi (Tennessen, 2015)* | RI            | Pu         | NA            | 3 g, h |
| Drepanoneura laetitia (Donnelly, 1992)*  | JT            | Na         | NA            |        |
| Enallagma novahispamiae Calvert, 1907    | VM            | Ca         | NA            |        |
| Epitleoneura venezuelensis Racenis, 1955 | VM            | Ca         | NA            |        |
| Ischnura capreolus (Hagen, 1861)         | SF            | Pu         | NA            |        |
| Mecistogaster jocaste Hagen, 1869        | VM            | Ca         | NA            |        |
| Metaleptobasis gabrielae von Ellenrieder, 2013* | VM            | Ca         | DD            | 3d     |
| Metaleptobasis mauffrayi Daigle, 2000    | LI, SF        | Pu         | LC            |        |
| Microstigma anomalum Rambur, 1842        | IE            | Pu         | NA            |        |
| Microstigma rotundatum Selys, 1860       | IE            | Pu         | NA            |        |
| Protooneura woytkowskii Gloyd, 1939*     | IE            | Pu         | NA            | 3e     |
| Psaironeura angeli Tennessen, 2016       | JT            | Na         | NA            |        |
| Psaironeura bifurcata (Sjöstedt, 1918)*  | LI            | Pu         | NA            | 3f     |
| Psaironeura tenuissima (Selys, 1886)     | IE, LI        | Pu         | NA            |        |
| Telebasis carota Kennedy, 1936*          | IE            | Pu         | NA            | 3k     |
| Telebasis flameoela Kennedy, 1936*       | OR            | Pu         | EN            | 3j     |
| Telebasis grifinii (Martin, 1896)        | VM            | Ca         | LC            |        |
| Telebasis versicolor Fraser, 1946        | VM            | Ca         | LC            |        |
| Aeshnidae                               |               |            |               |        |
| Gynacantha litoralis Williamson, 1923    | OR            | Pu         | NA            |        |
| Gynacantha membranalis Karsch, 1891      | IE, SF        | Pu         | NA            |        |
| Libellulidae                            |               |            |               |        |
| Triacanthagyna satyrus (Martin, 1909)*   | SF            | Pu         | NA            | 3i     |
| Brechmorhoga vivax Calvert, 1906         | RN            | Na         | NA            |        |
| Erythemis vesicolosa (Fabricius, 1775)   | SF            | Pu         | LC            |        |
| Erythriodiplax abjecta (Rambur, 1842)    | JB            | Na         | NA            |        |
| Erythriodiplax attenuata (Kirby, 1889)   | RI            | Pu         | NA            |        |
| Erythriodiplax basilis (Kirby, 1897)     | LS, OR, MO, RC, SF | Ca, Pu | NA |        |
| Erythriodiplax fusca (Rambur, 1842)      | LS, RC, SF    | Ca, Pu     | NA            |        |
| Erythriodiplax latimaculata Ris, 1911    | MO            | Pu         | NA            |        |
| Erythriodiplax umbrata (Linnaeus, 1758)  | LS, SF        | Ca, Pu     | NA            |        |
| Erythriodiplax uninaculata (De Geer, 1773) | RC            | Pu         | NA            |        |
| Gynothemis pusilla (Karsch, 1889)        | VM            | Ca         | LC            |        |
| Miathria marcella (Selys, 1857)          | RC            | Pu         | LC            |        |
| Misagria paraana Kirby, 1889             | VM            | Ca         | NA            |        |
| Nephepeta phryn (Perty, 1834)            | RC            | Pu         | LC            |        |
| Orthemis cultriformis Calvert, 1899      | JT, IE        | Na, Pu     | NA            |        |
| Uranis fastigiate Burmeister, 1839       | IE, LI        | Pu         | NA            |        |
| Uranis imbuta Burmeister, 1839           | OR            | Pu         | NA            |        |
| Gomphidae                               |               |            |               |        |
| Phyllogomphoides brunneus Belle, 1981*   | IE            | Pu         | NA            | 2g     |

Note: The bold species are the new records for the country.
†First records of the genus in Colombia; *first records of the species in Colombia.
Abbreviations: Ca, Cauca department; Na, Nariño department; Pu, Putumayo department; NA, not assessed; LC, least concern; NT, near threatened; EN, endangered; DD, data deficient.
Seventeen new dragonfly records from Colombia

Dunkle, 1986 and Stenocora percornuta Kennedy, 1940, after 131, 48 and 77 years respectively. Also, 17 species were recorded for the first time in Colombia (Figures 2–4), two of them are records for new genera for the country (Stenocora percornuta Kennedy, 1940 and Amazoneura westfalli Machado, 2001). The new species for Colombia belong to the following families...
and species: Coenagrionidae (Amazoneura westfalli, Argia schneideri, Calvertagrion mauffrayi, Drepanoneura laetitia, Metaleptobasis gabriela, Protonoeura woytkowskii, Psaironeura bifurcata, Telebasis carota, and Telebasis flammeola) (Figure 2), Platystictidae (Palaemnema picicaudata), Calopterygidae (Mnesarete hauxwelli), Heteragrionidae (Heteragrion bickorum), Polythoridae (Stenocora percornuta), Aeshnidae (Triacanthagyna satyrus) and Gomphidae (Phyllogomphoides brunneus) (Figure 3), Philogenidae (Philogenia minteri and Philogenia monotis) (Figure 4). Our records raise the number of odonate species known from the country
to 423. The number of records in the departments of Cauca, Nariño and Putumayo are increased respectively to 34, 17 and 69 (Table 2).

Discussion

*Rare and/or endangered species*

Of the 68 species found, 30 have been assessed by the IUCN Red List. Most are listed as Least Concern, but six of the species we recorded are under some threat status. Three are listed as Data Deficient, two as Endangered and one as Near Threatened:
Philogenia raphaella and P. sucrã, the only Colombian endemics of the six threatened, are rediscovered after 131 and 48 years respectively, since they were first collected (Bick & Bick, 1988; Dunkle, 1986). Both are listed as Data Deficient because they were only known from their respective type localities (Bota-Sierra, Palacino, & Rache, 2016; Bota-Sierra, Palacino, Rache, & von Ellenrieder, 2016). Our records are the first since these species were described. Further, P. raphaella was described in 1886 from a single male labeled “Bogotá”, a catch-all locality for specimens that were collected elsewhere (Bota-Sierra & Novelo-Gutiérrez, 2017). Our record is the first to be associated with a specific locality, which fortunately falls within a protected area. P. sucrã was only known from Caquetá department; therefore, our records from Cauca expand its range approximately 100 km to the southwest. Cueva de los Guácharos National Park lies between these two sites, and we expect P. sucrã to occur there.

We suspect that P. raphaella is the senior synonym of Philogenia redunca Cook, 1989. Following Calvert’s (1924) key, we easily identified our specimens as P. raphaella; in order to confirm we read Selys’s original description which also matches our specimens perfectly (Selys, 1886); however, reviewing Cook’s description of P. redunca, we find that our specimens also match his types perfectly (Cook, 1989). Additionally, the type locality of P. redunca is Yanamanaca (Napo province, Ecuador), only approximately 150 km south of Orito, where we collected our specimens. Nevertheless, the drawings of the type of P. raphaella by P. L. Whitycombe in Calvert’s paper are not as accurate as Cook’s illustrations for P. redunca. Therefore, a revision of the holotype of P. raphaella in the BMNH is needed in order to clarify this issue and will be the target of our future studies.

The third data deficient species we found is Metaleptobasis gabrielae von Ellenrieder, 2013, a recently described species known from a single locality, Tamshiyacu-Tahuayo Reserve in Loreto department, Peru (von Ellenrieder, 2013). Our finding expands its range approximately 700 km to the northeast. Several protected areas – La Paya National Park in Colombia and the Guéppi-Sekime National Park and Amiyacu Regional Conservation Areas in Peru – lie between these two sites, and M. gabrielae is likely to occur there as well.

The two species listed as Endangered were both believed to be endemic to Ecuador: Philogenia monotis and Telebasis flammeola Kennedy, 1936 (Tennessen & Mauffray, 2016a, 2016b). We discussed P. monotis – for which P. tinalandia is the junior synonym – above, and our records expand its distribution about 500 km to the north. It has now been documented in three protected areas: the Tinalandia reserve in Ecuador, the Río Ñambí Nature Reserve and Farallones de Cali National Park in Colombia. T. flammeola was only known from three localities in the Amazonian foothills of eastern Ecuador. In one of these areas, its habitat recently disappeared due to intensive agriculture (Tennessen & Mauffray, 2016b). Here we report its presence in Putumayo department, a northward range expansion of about 150 km; unfortunately, the site where we found it is an unprotected area also under threat from intensive agriculture.

Finally, S. percornuta, in a monotypic genus, is listed as Near Threatened, as it was only known from three localities on the east slope of the Andes in Peru and Ecuador. Its most recent record dates back to 1940 (von Ellenrieder, 2009); therefore, our rediscovery of the species in a protected area approximately 150 km north of its previously known distributional limit is excellent news for its conservation.

Philogenia monotis and Philogenia tinalandia synonymy

Kennedy (1941) described Agnophilogenia monotis from a female collected on 8 March 1941, at Lorena, close to Santo Domingo de los Colorados (Pacific slope of the northern Ecuadorean Andes in Pichincha province, Ecuador). Bick and Bick (1988) described P. tinalandia on the basis of two males collected on 13 May 1985, also near Santo Domingo de los Colorados
and only 3 km away from the type locality of *A. monotis*. von Ellenrieder (2003) examined these type specimens and showed that the characters used by Kennedy to describe the genus *Agnophilogenia* fall within the range of variation of the species of the genus *Philogenia*. She thus synonymized these genera and suggested that *P. tinalandia* was probably a junior synonym of *P. monotis*, but as neither type series included both sexes, she concluded: “whether *P. tinalandia* is a junior synonym of *P. monotis* or whether they represent separate species is a question that will be answered once a series including both males and females is collected within the area E of San Domingo de Los Colorados.” The surprise here is that the answer did not come from Santo Domingo de los Colorados, but from Colombia, where we found two new populations of this species: one located in Nariño department, at the Río Ñambi nature reserve (approximately 250 km north of the type locality), the second in Valle del Cauca department, in the Farallones de Cali National Park (approximately 500 km north of the type locality) (Figure 1). In both locations males and females were found together (some were collected while mating), the males perfectly matching the description of *P. tinalandia* and the females perfectly matching *P. monotis*, confirming that von Ellenrieder (2003) was correct. Indeed, based on the examination of the following specimens, we conclude that *P. tinalandia* is a junior synonym of *P. monotis*:

**COLOMBIA:** 3♀ and 2♂, Nariño department, Barbacoas municipality, Río Ñambi Reserve, 1,29853°N 78.08317°W, 1400 m asl, 17 February 2017, M. Vigano, A. Corso & O. Janni Leg.; 1♀ and 1♂, Valle del Cauca department, Dagua municipality, Farallones de Cali National Park, 3,57493°N 76, 89015°W, 956 m asl, 9 May 2017, J. Sandoval Leg.

The data collected on this expedition are a significant contribution to the knowledge of the dragonfly diversity in Colombia. We strongly encourage researchers interested in Odonata and other taxonomic groups to contribute their distributional records, as this information remains limited for many areas of Colombia and for many taxa. Better and more complete data is vital for improving assessments of conservation status and the implementation of conservation actions.

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