



Revision of Argentinian species of *Hexacola* Foerster (Hymenoptera: Figitidae: Eucoilinae)

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ABSTRACT. The eucoiline genus *Hexacola* Foerster, 1869 is present in the Afrotropical, Neotropical, Holarctic and Ethiopian regions, as well as Oceania. In this paper, three species are reported for the first time in Argentina: *Hexacola hexatoma* (Hartig 1841), *Hexacola bifarium* Quinlan, 1986 and *Hexacola bonaerensis* Reche, **nom. nov.** proposed to replace *Hexacola fuscipes* (Kieffer 1908) by homonymy with *Hexacola fuscipes* (Kieffer 1907). Their redescrptions are provided. Species from Argentina are parasitoids of Ephydriidae and Chloropidae (Diptera). New distribution data, new host records and a key for Argentinian species are provided. Photographs of diagnostic characters and geo-reference of locality of collections are included. The material examined is deposited in the collection of the División Entomología, Museo de La Plata (Argentina).

Key words: Figitidae, *Hexacola*, Argentina, redescription, new records, parasitoids.

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Introduction

Hexacola was described by Foerster in 1869 and belongs to the Eucoilinae (Figitidae). It has been included in the *Ganaspis* group (Nordlander 1982; Fontal-Cazalla *et al.* 2002; Buffington *et al.* 2007), nowadays recognized as *Ganaspini* (Forshage and Nordlander 2008; van Noort *et al.* 2015). This genus is not always easily distinguished from other tribe genera, as *Didyctium* and *Ganaspis* (van Noort *et al.* 2015). Known *Hexacola* species are parasitoids of Chloropidae and Ephydriidae (Diptera); also it is mentioned from

Drosophilidae, Lauxaniidae, Otididae, Agromyzidae and even aphids, but Forshage *et al.* (2013) considered this as a probably erroneous association (Quinlan 1978; Beardsley 1989; Gaddi *et al.* 2010; Forshage *et al.* 2013; Díaz and Gallardo 2014; van Noort *et al.* 2015). Taxonomic studies of *Hexacola* have been made by Foerster (1869), Kieffer (1907), Dalla Torre and Kieffer (1910), Weld (1952), Yoshimoto (1962, 1963), Yoshimoto and Yasumatsu (1965), Quinlan (1978 and 1986), Beardsley (1989), Paretas-Martínez *et al.* (2013) and Forshage *et al.* (2013).

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The genus *Hexacola* include 53 species, worldwide. It is a widely distributed genus, and it is present in the Afrotropical, Neotropical, Holarctic and Ethiopian regions, as well as Oceania (Quinlan 1978; Fontal-Cazalla *et al.* 2002; van Noort *et al.* 2015). At present, only five species are known from Neotropical region, *H. fuscicornis* (Kieffer) from Nicaragua, *H. fuscipes* (Kieffer) and *H. havanensis* (Kieffer) from Cuba, *H. hexatoma* (Hartig) from Panama and *H. lemnaphilae* Gaddi and Díaz from Argentina. Diversity studies made by Fergusson (1995) refer to the presence of several species of this genus in Costa Rica, and Nieves-Aldrey and Fontal-Cazalla (1997) mention this genus from Panama, later Fontal and Nieves-Aldrey (2004) cited *H. hexatoma* and seven morphospecies for this country. Lizarralde de Grosso (1978) reported the first time *Hexacola* in Argentina but no species were identified; later Gaddi *et al.* (2010) described the first species from Argentina. The aim of this work is to report for the first time three *Hexacola* species from Argentina, to redescribe them, to provide nomenclatural changes, new distribution data, new host records and a key of all known species of the genus present in this country.

Material and methods

We studied a total of 73 specimens (47 females and 26 males) deposited in the collection of the División Entomología, Museo de La Plata (MLP), La Plata, Buenos Aires, Argentina. The specimens from Patagonia were captured with Malaise traps located on the west side of the Nahuel Huapi National Park (NHNP), in the framework of "The Darwin Initiative" programme. The specimens were not directly compared with type specimens of other described species of the genus. The species status was determined through reference to information in original

descriptions and keys (Kieffer 1907; Dalla Torre and Kieffer 1910; Weld 1952; Yoshimoto 1963; Yoshimoto and Yasumatsu 1965; Quinlan 1978; Beardsley 1989; Forshage and Nordlander 2008; Gaddi *et al.* 2010). The terminology used in the descriptions follows Buffington (2009). Biogeographical regions are in according to Morrone (2001, 2014, 2015a, 2015b). The collection localities were georeferenced with free software QGIS version 2.10.1-Pisa. The photographs were taken with a Canon Powershot A 520 adapted to a Leica stereomicroscope (S8APO).

Results

Genus *Hexacola* Foerster, 1869

Hexacola Foerster, 1869: 342. Type species. *Eucoila picicrus* Giraud, by monotypy.

Hexaplasta Foerster, 1869: 345. Type species: *Cothonaspis hexatoma* Hartig, 1841: 357, by original designation (Synonymized by Rohwer and Fagan 1917).

Aporeucoela Kieffer, 1908: 260. Type species. *Aporeucoela fuscipes* Kieffer, 1908. (Synonymized by Forshage *et al.* 2013).

Bewelda Quinlan, 1976: 67. Type species. *Bewelda striata* Quinlan, 1976. (Synonymized by Forshage *et al.* 2013)

Daruna Benoit, 1956: 540. Type species *Daruna muhavare* Benoit, 1956. (Synonymized by Forshage *et al.* 2013)

Diagnosis. The species of this genus are distinguished mostly by characters from the antenna and forewing. Antenna of females oscillate between 11 to 13 flagellomeres with a club of 5, 6, 7 or 8 flagellomeres, antenna of male of 15 flagellomeres, with F3 typically curved. The dorsal surface of scutellum and the scutellar plate are variable. The scutellum is strongly convex and the dorsal surface of scutellum is striated on lateral margins. Scutellar plate generally subelliptical, usually covering most of scutellum. The marginal cell of forewing is typically closed; sometimes partiality open on front margin or

completely open, narrow and elongate-triangular.

Distribution. Asia, Europa, South Africa, North, Central and South American. Argentinian records: Buenos Aires (Lizarralde de Grosso 1978; Gaddi *et al.* 2010); Cordoba, Misiones, Neuquen and Río Negro.

Biology. The species of *Hexacola* are parasitoids of Chloropidae, Ephydriidae, Drosophilidae, Lauxaniidae, Otididae and Agromyzidae (Diptera) (Quinlan 1978; Beardsley 1989; Gaddi *et al.* 2010; Forshage *et al.* 2013).

Key to the Argentinian species of *Hexacola* Foerster

1. Antennal club with six flagellomeres (Figs. 1-2), subfiliform or clavate. Marginal cell partiality open on frontal margin.....2
 - Antennal club with seven flagellomeres (Fig. 3), slightly clavate or clavate. Marginal cell opened (Fig. 6)..... 3
2. Antenna subfiliform (Fig. 1). Dorsal surface of the scutellum with longitudinal striated on lateral margin, distal surface smooth. Scutellar plate wide, subelliptical (Fig. 4).....
 -*Hexacola hexatoma* (Hartig, 1841)
 - Antenna clavate (Fig. 2). Dorsal surface of the scutellum entirely striated. Scutellar plate narrower, suboval (Fig. 5).....
 -*Hexacola bifarium* Quinlan, 1986
3. Antenna clavate (see Fig. 2 in Gaddi *et al.* 2010). Dorsal surface of scutellum striated on lateral margin, posterior margin reticulate-rugose (see Fig. 5 in Gaddi *et al.* 2010).....
 -*Hexacola lemnaphilae* Gaddi & Díaz, 2010
 - Antenna slightly clavate (Fig. 3). Dorsal surface of scutellum striated on lateral margin, posterior margin reticulate (Fig. 6).....
 -*Hexacola bonaerensis* Reche **nom. nov.**

Hexacola hexatoma (Hartig, 1841) (Figures 1, 4)

Cothonaspis (*Hexaplasta*) *fuscipes* Meyer, 1923
Cothonaspis hexatoma Hartig, 1841
Eucoila picicrus Giraud, 1860
Hexacola fuscipes Meyer, 1923

Hexacola picicrus (Giraud) Nordlander, 1981
Hexaplasta hexatoma (Hartig) Kierrich & Quinlan, 1960
Kleiditoma (*Hexacola*) *picicrus* (Giraud) Cameron, 1890
Trybliographa (*Hexaplasta*) *fuscipes* Meyer, 1923
Hexaplasta hexatoma Förster, 1869
Cothonaspis hexatoma Kieffer, 1901

Redescription. Female. Body scarcely setose; head, mesosoma and metasoma dark brown almost black; antenna, mandibles, wing venation and legs light brown; head entirely smooth; central area of face smooth, with few short setae; malar sulcus present; occiput weakly striated; antenna (Fig. 1) with 13 flagellomeres; F3 about scarcely more length of F4, F4-F13 subequal in length; club consisting of six flagellomeres, with rhinaria; compound eyes small; mesosoma (Fig. 4) slender, pronotal plate smooth, medial bridge broad, with lateral foveae opens and deep; dorsal margin slightly emarginated; sides of pronotum smooth and lacking sculpture, highly setose behind genae; mesoscutum entirely smooth and shining, parapsidal ridge with hair line present; parascutal impression conspicuous; scutellar foveae at base deep; lateral bars of scutellum striated with a fovea under them; dorsal surface of scutellum longitudinally striated, distal surface smooth; posterior margin rounded; scutellar plate subelliptical, elevated above the scutellum, longer than wide, dorsal surface with midpit position posteriorly, with several setiferous punctures about them; mesopleuron smooth, polished, with mesopleural carina simple; metapleuron poorly sculptured; anteroventral cavity conspicuous; posterior margin raised and hairy. Propodeum elongate, setose except on the carinae and area between them; lateral propodeal carinae subparallel; forewings setose, hyaline, apical marginal with hair fringes quite long; marginal cell elongate, twice as long as broad, partially open on front margin. Hairy patch dorsolaterally on midcoxa and patch of

hairs posterodorsally on hindcoxa present; Metasoma sessile, smooth and shining; hairy ring at base of syntergum completed dorsally, with a weak row of long setae on each side posteriorly, distally smooth.

Male. Similar to female, except following features: antenna with 15 flagellomeres, filiform, F3 about twice length of F4 (Fig. 4), strongly curved outwardly, with rhinaria; Propodeum setose in area between the carinae.

Variation. The analysis of specimens of these species shows that the differences in colour of the body between the south and north, the south being darker.

Distribution: England, Germany, Uganda (Quinlan 1986) Spain, Panama (Fontal and Nieves-Aldrey 2004) and Argentina (first record). In the Neotropical region this distribution belong to Antillean (Caribbean subregion in Morrone 2001) and Chacoan subregions; in Andinean region to Patagonian subregion (Morrone 2014, 2015a, 2015b).

Host. Diptera Chloropidae: *Oscinella frit* (L.) (Fontal and Nieves-Aldrey 2004)

Examined material. Argentina, Buenos Aires, Berisso (34°52'S, 57°52'W) 04.ix.1970, 1♂, Schnack coll.; Ignacio Correas (35°02'56''S, 57°51'W) 27.i.1971, 1♀, Díaz coll.; Villa Ballester (34° 32'S -58° 33'W) 12.viii.1930, 1♀; Córdoba, Manfredi (31°51'S, 63°45'W), 19.ix.1973, 1♀; 03.x.1973, 3♀♀; 17.x.1973, 3♀; 24.x.1973, 1♀, Brewer coll.; 31.x.1973, 1♀, Delfino coll.; Misiones, Loreto (27°18'S, 55°32'W) 05.iv.1931, 1♂; Neuquén (NHNP), Lago Espejo (40°38'49.3''S, 71°42'12.7''W; 903m), 4 - 24.ii.2008, 2♀♀, 4♂♂; A° Blanco (41°05'14.8''S, 71°24'45.8''W; 800m), 3 - 21.i.2008, 1♂; Río Negro (NHNP), Río Frías (41°05'14.8''S, 71°48'20.9''W, 765m), 14 - 24.ii./2008, 2♂♂, Garré-M. de Oca coll., Malaise Trap.

***Hexacola bifarium* Quinlan, 1986**
(Figures 2, 5)

Redescription. Female. Body scarcely setose; head, mesosoma and metasoma dark chestnut-brown; antennal club darker than basal flagellomeres; mandibles, wing venation and legs light yellow; head entirely smooth; central area of face smooth and shining, with few short setae; malar sulcus present; occiput striated; antenna (Fig. 2) with 13 flagellomeres; F3 slightly longer than F4; F4-F7 as broad as long; club consisting of six flagellomeres, together longer than F1-F7, with rhinaria; compound eyes round and large; mesosoma. (Fig. 5) Slender; pronotal plate smooth, medial bridge broad, with lateral foveae opens and deep; dorsal margin straight; sides of pronotum smooth and lacking sculpture, highly setose behind genae. Mesoscutum entirely smooth and shining, parapsidal ridge without hair line; parascutal impression weak; scutellar foveae at base deep, higher than wider; lateral bars of scutellum slightly striated with a small fovea under them; dorsal surface of scutellum entirely striated, distal surface striated; posterior margin rounded; scutellar plate narrow, suboval, longer than wide, dorsal surface with midpit circular, position posteriorly, with four setiferous punctures about them; mesopleuron smooth, hairless, with mesopleural carina complete; metapleuron poorly sculptured; anteroventral cavity present; posterior margin raised and hairy; propodeum elongate, setose except on the carinae and area between them; lateral propodeal carinae subparallel and straight; forewings setose, hyaline, apical marginal with hair fringes long; marginal cell longer than wide, partiality open on front margin; with hairy patch dorsolaterally on midcoxa and hindcoxa. metasoma sessile, smooth and shining; dense hairy ring at base of syntergum completed dorsally, without row of long setae on each side posteriorly; distally smooth.

Male. Similar to female, except following features: antennae with 15 flagellomeres, filiform, F3 long, once and half as F4, flattener externally, curved outwardly, remaining flagellomeres longer than wide, with rhinaria.

Variation. The analysis of specimens of these species shows that the differences in the laterals bars and foveae at base of scutellum of the original descriptions but this feature are not enough to separate a new species.

Distribution. Nigeria, Zaire, Zimbabwe (Quinlan 1968) and Argentina (first record). In the Neotropical region this distribution belong to Chacoan subregion (Morrone 2001, 2014, 2015a).

Biology. Unknown.

Examined material. **Argentina,** Buenos Aires, Ignacio Correas (35°02'56"S, 57°51'W) 27.i.1971, 1♀, Díaz coll.; La Plata (34°55'16"S, 57°57'16"W) 03.xi.1973, 1♀, Loíacono leg. Punta Lara (34°49'S, 57°58'W) 05.iv.1974, 1♀, 1♂, Sansone-Llanos coll.; Ranchos (35°30'59"S, 58°19'08"W) 06.i.1970, 1♀, 1♂, Díaz coll.; Sauce Grande (38°59'S, 61°11'W) 13.x.1970, 1♂, Grosso coll.; Córdoba; Manfredi (31°51'S, 63°45'W), 3.x.1973, 2♀♀, Brewer coll.; 10.x.1973, 1♂, Delfino coll.; 10.x.1973, 1♀; 11.vii.1973, 1♀; 24.x.1973, 1♀, Brewer coll.; Misioness, Loreto (27°18'S, 55°32'W), x.1930, 2♀♀, 1♂; viii.1930, 1♀; 18.i.1931, 1♀.

***Hexacola bonaerensis* Reche nom. nov.**
(Figures 3, 6)

Aporeucoela fuscipes Kieffer, 1908

Hexacola fuscipes: Forshage, Nordlander and Buffington, 2013 [non *Hexacola fuscipes* (Kieffer, 1907)]

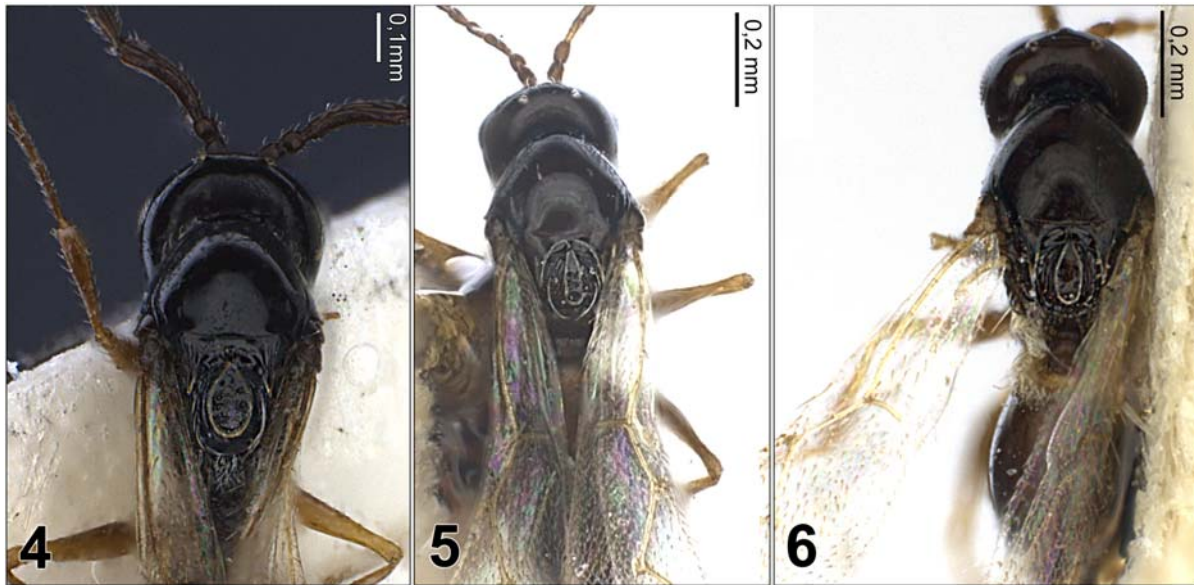
Remarks. *Ganaspis fuscipes* Kieffer, 1907 is transfer by Weld to *Hexacola* genus in 1952 resulting in the new combination *Hexacola fuscipes* (Kieffer 1907; Weld, 1952). Later, Forshage *et al.* (2013) transfer *Aporeucoela fuscipes* to *Hexacola* genus, obtaining binomial

Hexacola fuscipes (Kieffer 1908; Forshage *et al.* 2013), therefore a secondary homonymy occurs. According to the article 60.3 of ICNZ is proposed at junior homonym by a new substitute name, *Hexacola bonaerensis* Reche **nom. nov.**

Redescription. Female. Body scarcely setose; head, mesosoma and metasoma brown; club antennal brown dark, flagellomeres brown yellowish; mandibles and wing venation yellowish; legs light brown; head. entirely smooth, in front view round with few short setae; central area of face smooth; malar sulcus present; occiput smooth; antennae (Fig. 3) with 13 flagellomeres; F3 as F4 and F5 together; remaining flagellomeres longer than wide; club consisting of seven flagellomeres, with rhinaria; compound eyes round; mesosoma (Fig. 6) slender; pronotal plate straight, medial bridge narrow, lateral fovea opens not deep; dorsal margin straight; sides of pronotum smooth and hairless behind genae; mesoscutum smooth with a few scattered setae; parapsidal ridge hair line and parascutal impression absent; scutellar foveae at base deep; lateral bars of scutellum smooth and long without a fovea under them; dorsal surface of scutellum striated on lateral margin, posterior margin reticulate, with a few long setae; scutellar plate subelliptical, longer than wider, dorsal surface with midpit small position posteriorly, with setiferous punctures; mesopleuron smooth, hairless, with weak mesopleural carina; anteroventral cavity hairy, posterior margin raised and hairy; propodeum elongate, hairless except on the upper side; lateral propodeal carinae parallel and straight; forewings setose, hyaline, apical margin with hair fringes long; marginal cell entirely open, twice longer than wide, with hairy patch on hindcoxa; metasoma, sessile; hairy ring at base of syntergum represented by a weak row of long setae on each side posteriorly; distally smooth.



Figures 1-3. Antenna of female. 1. *Hexacola hexatoma* (Hartig, 1841); 2. *Hexacola bifarium* Quinlan, 1986; 3. *Hexacola bonaerensis* Reche **nom. nov.**



Figures 4–6. Dorsal view. 4. *Hexacola hexatoma* (Hartig, 1841) (♂); 5. *Hexacola bifarium* Quinlan, 1986 (♀); 6. *Hexacola bonaerensis* Reche **nom. nov.** (♀).

Male. Similar to female, except following features: antennae with 15 flagellomeres; F3 as F4+F5 together, flattener externally, strongly curved outwardly; remaining flagellomeres longer than wide; with rhinaria. Pronotum sides with few scattered hair behind genae. Scutellar plate with several setiferous punctures.

Etymology. The epithet “*bonaerensis*” refers to the province where this species occurs in Argentina (Buenos Aires).

Variation. The analysis of specimens of these species shows that the differences in the colour of body of the original descriptions but this feature are not enough to separate a new species.

Distribution. United States of America (Quinlan 1968); Cuba (Kieffer 1907), Argentina (new country record). In the Neotropical region this distribution belong to Antillean (Caribbean subregion in Morrone 2001) and Chacoan subregions (Morrone 2014, 2015a).

Biology. Specimens from Argentina were obtained from puparium of Ephydriidae (Diptera) (**New record**).

Material examined. Argentina, Buenos Aires, Arroyo Vitel (35° 31'S - 58° 09'W),

12.iii.1974, 3♀♀, 1♂; 16.iv.1974, 2♂♂, Merlasino coll.; Berisso (34°52'S, 57°52'W), 4.ix.1970, 1♂, Schnack coll.; Pereyra Iraola (34°51'55"S, 58°04'08"W), vi.1971, obtained from puparium of Ephydriidae (Diptera), 10♀♀, 3♂♂, Lizarralde coll.

Hexacola lemnaphilae Gaddi & Díaz, 2010

(For figures to see Gaddi *et al.* 2010)

Diagnosis. Yellowish-brown. Female antennae with a club consisting of seven flagellomeres; male antennae with F3 strongly curved, longer than the following flagellomeres, F4 straight and cylindrical, similar to the following flagellomeres. Posterior margin of pronotal plate almost straight. Proximal and mid surface of scutellum with longitudinal striation, distal surface reticulate-rugose. Marginal cell open (Gaddi *et al.* 2010).

Description: In Gaddi *et al.* 2010.

Distribution. Argentina: Buenos Aires; Cordoba (new record). In the Neotropical region this distribution belong to Chacoan subregion (Morrone 2001, 2014, 2015a).

Biology. *Hexacola lemnaphilae* was reared from pupae of *Lemnaphilae neotropica* (Ephydriidae) (Gaddi *et al.* 2010).

Material examined. Argentina, Buenos Aires, Arroyo Vitel (35° 31'S, 58° 09'W) 12.iii.1974, 2♀, 1♂, Merlasino coll.; 10.x.1968, 1♂; 17.vii.1970, 1♀, Ronderos coll.; Berisso (34°52'S, 57°52'W), 4.vii.1970, 4♀, 1♂; 21.x.1970, 1♂, Schnack coll.; Ranchos (35°30'59"S, 58°19'08"W), 6.i.1970, 1♂. Díaz coll.; Córdoba, Manfredi (31°51'S, 63°45'W), 03.x.1973, 1♀, Brewer coll.

Discussion

In the Neotropical region, *Hexacola* is known for Antillean (Caribbean subregion in Morrone 2001), Chacoan subregions and it is mentioned for the first time for the Andean region (Patagonian subregion). Considering these data, it expands the southern distribution limits of the genus *Hexacola*. In Argentina, *H. lemnaphilae* is mentioned for the first time in Cordoba province, *H. hexatoma* is reported for the first time this country and *H. bifarium* is the new record for Neotropical region. With reference to biology, the Argentinian species of *Hexacola* were mentioned in other studies for Chloropidae and Ephydriidae. Specimens here studied of *Hexacola bonaerensis* were obtained from puparium of Ephydriidae, it is the first of the host for this species.

Gaddi *et al.* (2010), propose two morphologically different species groups of genus *Hexacola*. One of them is composed by *H. hexatoma*, *H. havanensis* (Kieffer), *H. fuscipes* (Kieffer), *H. cognata* Yoshimoto and Yasumatsu, *H. samuelsoni* Yoshimoto and Yasumatsu and *H. neocastellae* Beardsley. They all have the antennal club composed of six flagellomeres in the female. The second group is characterized by having seven flagellomeres in the female antennal club. It includes *H. antennata* Yoshimoto and Yasumatsu, *H. tahitiensis* Yoshimoto and *H. subaperta* (Kieffer). However, we observed that *Hexacola bonaerensis* (= *H. fuscipes*) has antennal club with seven flagellomeres; therefore this species should move to second species group, because this

character state is consistent with the original description.

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بازبینی گونه‌های آرژانتینی جنس *Hexacola* Foerster (Hymenoptera: Figitidae: Eucoilinae)وانینا آنادینا رچه^۱، فابیانادیت گالاردو^۲

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چکیده: زنبورهای eucoilinae متعلق به جنس *Hexacola* Foerster, 1869 در نواحی افروتروپیکال، نئوتروپیکال، اتیوپین و ... انتشار دارد. در این مقاله سه گونه از این جنس برای اولین بار از آرژانتین گزارش می‌شود که عبارتند از: *Hexacola hexatoma* (Hartig, 1841)، *Hexacola bifarium* Quinlan, 1986 و *Hexacola bonaerensis* Reche **nom. nov.** گونه اخیر جایگزین گونه *Hexacola fuscipes* (Kieffer, 1908) گردید که همنام گونه *Hexacola fuscipes* (Kieffer, 1907) می‌باشد. توصیف مجدد گونه‌ها ارایه شده است. گونه‌های گزارش شده از آرژانتین پارازیتوئید دوبالان خانواده Ephydridae و Chloropidae هستند. اطلاعات جدیدی در مورد انتشار گونه‌ها، میزبانهای جدید و کلید گونه‌های آرژانتین ارایه شده است. تصویر خصوصیات کلیدی و محل نگهداری گونه‌ها ارایه شده است. نمونه‌های مورد بررسی در کلکسیون بخش حشره‌شناسی موزه دلاپلاتا (آرژانتین) نگهداری می‌شود.

واژگان کلیدی: *Hexacola*, Figitidae, آرژانتین، توصیف مجدد، گزارش جدید، پارازیتوئید