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A new species of the genus *Watsonidia* Toulgoët, 1981 (Lepidoptera, Erebidae, Arctiini): example of polymorphism in the Amazon of Peru

JUAN GRADOS
Research Associate, Department of Entomology, Natural History Museum, National University of San Marcos Av. Arenales 1256, Lima, Peru.
Bosque Llaqta, Av. Confraternidad Internacional Este N° 364, Huaraz, Perú.
E-mail: gradosjuan@hotmail.com

Abstract

A new species of the genus *Watsonidia* Toulgoët, from the Amazon region of Peru, is described, with two morphotypes. Characters of males and female genitalia of both morphotypes and the genetic analyses (COI) that support the polymorphism of the species are provided. The habitus of males and females is also illustrated.

Key words: Citizen Science, Phaegopterina, Tambopata river, Taxonomy

Introduction

The neotropical genus *Watsonidia* (Toulgoët, 1981) was proposed with *Glaucostola reimona* Schaus as its type species. The original concept of this genus also included *Glaucostola pardea* Schaus. In the same publication, Toulgoët (1981) described the species *W. porioni* and, years later (Toulgoët 1986) described the fourth known species of the genus: *W. navatteae* Toulgoët. The species *W. reimona* and *W. pardea* were described based on the individuals collected in Buena Vista, Colombia. Toulgoët (1991) noted on the basis of the figures of the types (Watson 1971) and material of the two species from Lita / San Lorenzo (Ecuador) that there were no differences in the morphology of the genital capsules of the males. This made him propose that both were the same species. That is, the species *W. reimona* would be a polymorphic species with two forms.

Watsonidia presents a wide distribution, comprising Central and South America, including Costa Rica (Toulgoët 1981), Panama (MNHP), Colombia and Ecuador (Schaus 1933; Piñas & Manzano 2003), Peru and Bolivia (MNHP).

Several cases of marked sexual dimorphism are known in Neotropical Arctiinae, among which we can mention some species of the genus *Dysschema* Hübner (Moraes *et al*. 2016) in Pericopina, the species *Idalus larissa* Druce and *Euplesia sphingidea* (Perty) (Laguerre 2016) within the Phaegopterina, some species of *Trichura* Hübner, *Euclera* Herrich-Schäffer and *Pseudosphenoptera* Butler within the Ctenuchina and some species of *Eurata* Herrich-Schäffer and *Metaloba* Hampson within the Euchromiina (Hampson 1898; Grados unpublished).

The present study describes a new species for the genus *Watsonidia* Toulgoët, distributed in South America. The species is polymorphic, presenting two morphotypes. Descriptions of characters and genetic analyzes (COI) supporting this polymorphism are provided for adult males and females of both morphotypes of the species.

Materials and methods

Field work and museum specimens. The specimens for the present study have been collected as part of our studies in Systematics and Biogeography of the Neotropical Arctiinae, through some trips to the Amazon region of Cusco and Madre de Dios; other specimens have been obtained from daily collections by guests at the Refugio Amazonas Lodge (ARA), located on the right bank of the Tambopata River (Madre de Dios, Peru), as part of the Citizen Sci-

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ence Program, with the mutual collaboration between the Natural History Museum (MUSM) and Rainforest Expeditions SAC. Specimens have been collected with light traps, using 250 W mixed light bulb, and placing them into killing jars with butyl acetate.

Specimens preserved and deposited in the following institutions were also examined: Muséum National d'Histoire Naturelle, Paris, France **(MNHP)**; Museo de Historia Natural, Universidad Nacional Mayor de San Marcos, Lima, Perú (**MUSM)**; National Museum of Natural History, Smithsonian Institution, Washington DC, USA (**USNM)**. Terminology for venation follows Comstock and Needman (1898, 1899), Miller (1970), Wootton (1979) and Common (1990); and for genitalia follows Sibatani *et al*. (1954), Kuznetsov (1967) and Klots (1970).

The genitalia of 10 specimens were dissected and prepared using a KOH solution (10%) in a water bath: six of the white morphotype and four of the stained one (Table. 1). For the best observation of the traits, Chlorazol black was used as a staining solution (Cannon 1937, 1941; Carayon 1969). Photographs of the adults were taken with a Nikon D80 camera and those of the genitalia with a Canon EOS Rebel T6 camera and a Canon MP-E 65 mm macro.

TABLE 1. Samples of *Watsonidia fulgida* **sp. nov.** Grados that have been used for the study of morphological characters of genitalia.

FORM	Genitalia	Department	Locality	Altitude	DATE	SEX
White Morphotype	GENITALIA # 850—JGA	Cusco	Cashiriari	690m	06.xii.1997	Male
	GENITALIA # 968—JGA	Madre de dios	CICRA	280m	17.xi.2006	Male
	GENITALIA # 851—JGA	Madre de dios	CICRA	280m	27.xi.2006	Female
	GENITALIA # 849—JGA	Madre de dios	CICRA	280m	16.i.2007	Male
	GENITALIA # 972—JGA	Madre de dios	CICRA	380m	08.xii.2005	Male
	GENITALIA # 1000—JGA	Puno	P.N. Bahuaja-Sonene	330m	03.vi.2013	Male
Stained morphotype	GENITALIA # 852—JGA	Cusco	Pagoreni	470m	02.x.1998	Male
	GENITALIA # 977—JGA	Madre de dios	Río Los Amigos	280m	25.xi.2006	Male
	GENITALIA # 853—JGA	Madre de dios	Albergue Refugio Amazonas	231m	12.xi.2016	Female
	GENITALIA # 1001—JGA	Madre de dios	Albergue Refugio Amazonas	231m	05.viii.2018	Male

TABLE 2. Samples used for the molecular analysis Cytochrome Oxidase C Subunit 1 (COI).

SPECIES	VBC	Sex	LOCALITY	GenBank/BOLD number	Country
W. fulgida (white)	ArctVBC-200	Female	Refugio Amazonas Lodge	-	Peru
W. fulgida (white)	ArctVBC-359	Female	Refugio Amazonas Lodge	MK216509	Peru
W. fulgida (white)	ArctVBC-405	Female	Refugio Amazonas Lodge	MK216507	Peru
W. fulgida (white)	ArctVBC-492	Female	Refugio Amazonas Lodge	MK216508	Peru
W. fulgida (white)	ArctVBC-503	Female	Refugio Amazonas Lodge	MK216506	Peru
W. fulgida (white)	ArctVBC-522	Female	Refugio Amazonas Lodge	MK216505	Peru
W. fulgida (Stained)	ArctVBC-524	Female	Refugio Amazonas Lodge	MK216503	Peru
W. fulgida (Stained)	ArctVBC-530	Male	Refugio Amazonas Lodge	MK216504	Peru
W. reimona	BEVI453	Male	Braulio Carrillo N.P.	ARCTB543-08	Costa Rica
W. reimona	INB0004110949	Female	Corcovado N.P., Est. Agujas	ASARC520-11	Costa Rica
W. reimona	INB0003946781	Female	Cuesta del Burro	ASARC519-11	Costa Rica
W. reimona	BEVI454	Female	Cerro Jefe, Tocumen	ARCTB544-08	Panamá
W. reimona	BEVI452	Female	Road Santa Fe to Rio Luis, km 9	ARCTB542-08	Panamá
W. reimona	INB0003943296	Male	P.N. Barbilla, Turrialba	ASARC517-11	Costa Rica
W. reimona	INB0003943296	Female	Road Llano to Carti, km 16	ARCTB541-08	Panamá
W. porioni	BEVI449	Male	Cerro Gaital	ARCTB539-08	Panamá
W. porioni	BEVI450	Male	Road Llano to Carti, km 16	ARCTB540-08	Panamá
W. porioni	BEVI448	Male	Road Llano to Carti, km 16	ARCTB538-08	Panamá

Molecular study. Tissue samples were taken from the right hind leg of specimens from the Tambopata River (Madre de Dios, Peru) and submitted for COI sequencing. Analysis carried out at the Biodiversity Institute of Ontario, University of Guelph, according to the protocol of Vaglia *et al.* (2008). Seven free access COI sequences, from samples identified as *Watsonidia reimona* and 3 from *W. porioni*, were obtained from BOLDSYSTEM. All these samples came from Central America (Panama and Costa Rica) (Table 2). Molecular characterization and distance analyses were conducted using the program MEGA v. 7 (Tamura *et al.* 2013; Kumar *et al.* 2016). Pairwise distances were estimated between specimens using the model Kimura-2-parameters (Kimura 1980).

Systematic account

Watsonidia Toulgoët, 1981

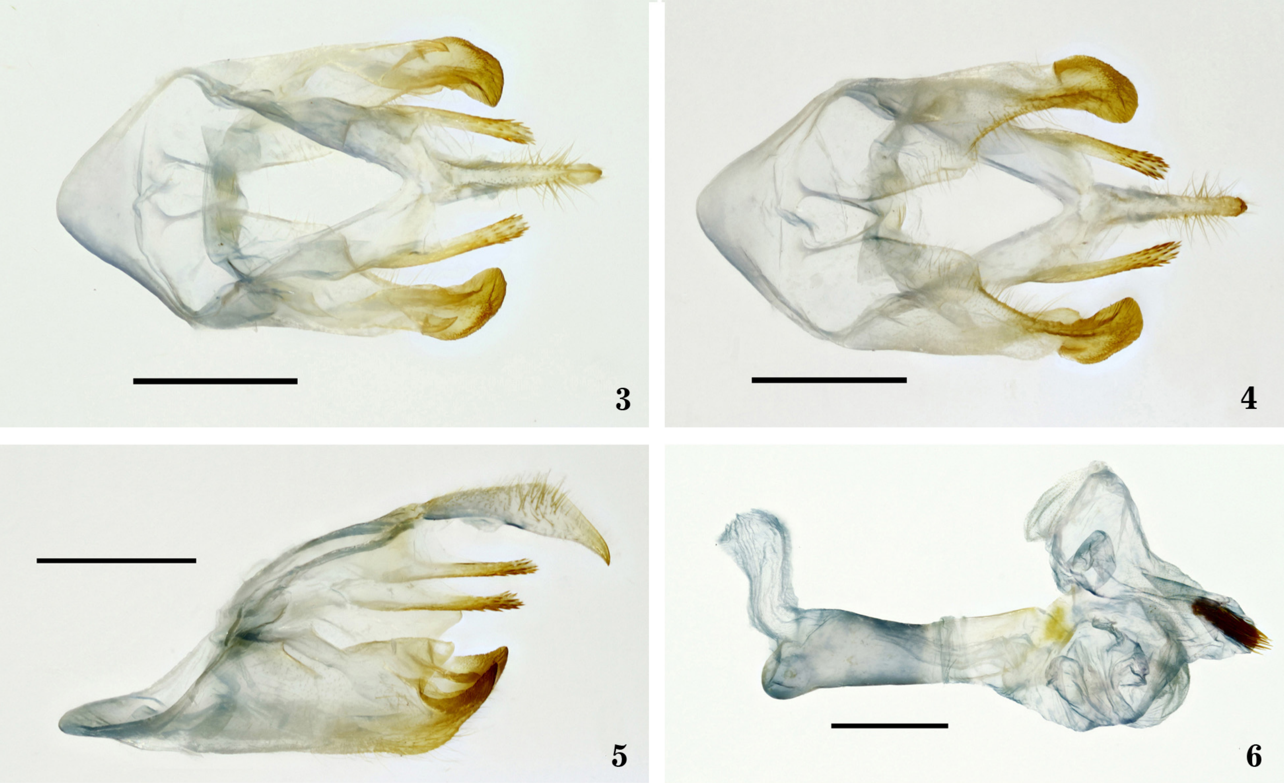
Watsonidia fulgida sp. nov.

(Figs. 1–8)

Diagnosis: It is a similar species to *W. reimona*, according to the wing color pattern. It can be differentiated from it by the following: on the forewings, the short black line originated at the lower distal part of the second black round line which involves the discal cell is not present, the black line of the apex is continuous whereas, in *W. reimona* it is interrupted; termen is black in all its extension whereas, in *W. reimona* the anterior half is black. In ventral view of the genital capsule, the distal parts of the valvae are somewhat square in *W. fulgida*, whereas in *W. reimona*, they are oval. In *W. reimona*, the lateral prolongation of the tegumen is glabrous, wide at its base, decreasing in thickness towards the distal part and bears a sharp end; in *W. fulgida* the prolongation is thin and elongated in almost all its extension, bearing spicules in the distal third.

Description of morphotype 1: Male (Figs.1–2). Forewing span: 14–15 mm (n = 18). **Head:** Proboscis light brown. Frontoclypeus white. Vertex and postgena mustard. Palpi mustard, curved towards the head and reaching the medial part of the frontoclypeus. First palpomere with piliform scales towards its base; second palpomere similar in length to the first, wider towards the distal part; third palpomere small. Ocellus black and antennal alveolus whitish mustard. Bipectinated antennae. Scape, pedicel and axis of the flagellum, white. First three proximal rami small. Middle rami similar in size to the axis. Fifth distal part of the flagellum does not present rami. Cervical scales mustard. **Thorax**: Patagia white with mustard scales on the anterior surface. Tegula white, with a black spot postero-lateral to surface of the patagia, arising from the central part of the anterior surface, reaching the medial part, and becoming somewhat wider. Posterior part of the patagia mustard. Mesoscutum and mesoscutellum white. A mustard spot at the central anterior part of the mesoscutum and a black spot at the central posterior part. A black spot in the central part of the mesoscutellum. Metascutellum and thoracic pleura white. First pair of legs white with black spots and sparse white scales on the internal side of the femur, tibia and tarsi. Epiphysis brown. Second pair of legs white, with a thin black line along the external surface of the tibia and the tarsi. Tibial spurs white. Third pair of legs white. Tymbal organ covered by white scales on the katepisternum. **Forewing (dorsal):** White with costal margin black at the first proximal third. Black line at the base of the wing. A first semicircular black line involving the discal cell; from the first proximal third of the wing, and extending to the distal part, ending where $R_{2+3+4+5}$ arises. Mustard line near the base of the wing, ventral to the black costal margin, reaching the black semicircular line. Second semicircular black line at the apex, including the distal quarter of the costal directing ventrally from the beginning of R_4-R_5, passing through the proximal part of R_5-M_1, the medial portion of the M_1-M_2, and extending throughout the distal half of M_2-M_3. Black termen reaching the tornus and projecting itself in an oblique line crossing the distal part of the anal cell, the subdistal parts of the 1A-2A and the Cu_2-1A extending to the subdistal part of the first semicircular line. Mustard spot between the second and third semicircular lines, extending from the ventral part of the costal margin up to the M_2-M_3. A third semicircular black line begins at the proximal part of the 1A-2A, runs through the Cu_2-1A to the medial part, directs ventrally and extends from the 1A-2A, involves the anal cell and its posterior margin, towards the proximal side of it. A mustard spot between the first and third black semicircular lines; extending from the distal part and limited by a black oblique line arising from the tornus, to the posterior margin, limited by 2A. A mustard spot in the anal cell between the base of the wing and the third semicircular line. **Forewing (ventral):** White with a faint mustard line at the costal margin. A second black line present on the dorsal side, towards the apex, faintly visible. A small mustard spot in the proximal part of the R_5-M_1. **Hindwing (dorsal surface):** White with mustard scales extending from cell M_1-M_3 to anal cell, more prominent in the latter. **Hindwing (ventral surface):** White with mustard scales in the anal cell. **Abdomen:** Mustard on the dorsal side, with white piliform scales on the lateral and posterior sides of the last sternite. White on the ventral surface. **Male genitalia** (Figs. 3–6) (Genitalia # JGA 849): Tegumen somewhat sclerotized and its anterior margin shaped like an inverted "V"; presenting elongated, thin and sclerotized extensions that go beyond the tip of valvae towards the postero-lateral parts and bear spicules at the distal third; posterior margin straight. Union of the tegumen and uncus membranous. Uncus narrow at the base; setae present at the lateral parts of the proximal two thirds; sharp and sclerotized at the distal end; in lateral view, the central part twice the width at base. Valvae in lateral view, rectangular, wide and sclerotized, with a slight invagination in the medial part of the dorsal side; a large invagination at the distal end, forming a spoon shaped cavity; setae present along the ventral margin. Juxta triangular and weakly sclerotized. Transtilla with small sclerotized areas on each side. Aedeagus elongated and somewhat sclerotized. Caecum penis somewhat developed. Vesica membranous extending towards the dorsal part and presenting a sclerotized area towards the base of the dorsal part; minute spicules present on the dorsal area; cornuti at the distal central part, with tiny spicules on the area below the cornuti.

FIGURES 1–2. *Watsonidia fulgida* Grados, **sp. nov. 1**. Holotype male, dorsal. **2**. Holotype male, ventral. Scales=5 mm.

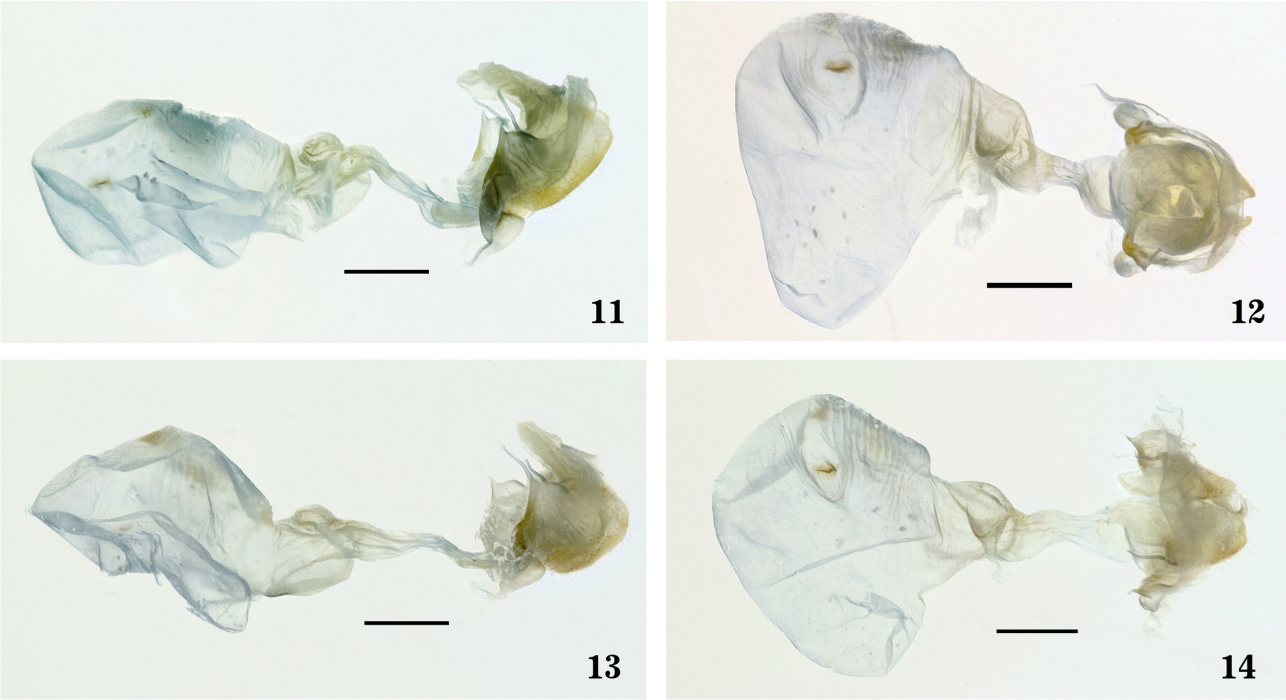


FIGURES 3–6. Genitalia of *Watsonidia fulgida* Grados, **sp. nov.** Male. (Genitalia # JGA–849). **3**. Dorsal view. **4**. Ventral view. **5**. Lateral view. **6**. Aedeagus. Scales= 1 mm.

Female (Figs. 7–8): Forewing span: 15–17 mm (n=14). Patterns of wing and body color similar to the male, differing on the following characters: antennae with minute rami; hindwings elongated and somewhat triangular; frenulum composed of three bristles. **Female genitalia** (Figs. 11–12) (Genitalia # JGA 851): Pheromone glands present. Eighth tergite uniformly sclerotized. Anal papillae well developed bearing setae throughout the area, denser on the proximal and dorsal surfaces; in lateral view, height 1.5 times its width. Posterior apophyses four times larger than the anterior ones. Ostium and antrum in central position, the latter sclerotized. Antevaginal lamella somewhat sclerotized. Postvaginal lamella membranous. Ductus bursae membranous, wide and flattened; distal third somewhat sclerotized. Cervix bursae somewhat sclerotized, wider than long. Corpus bursae membranous, somewhat globose; in dorsal view, oval, somewhat narrower to the left side. A small signum at the dorsal side and another at the posterior of the right side. Ductus seminalis arising from the left side of the cervix bursae.

FIGURES 7–10. *Watsonidia fulgida* Grados, **sp. nov.** Females. **Figs. 7–8**. White form (Refugio Amazonas Lodge). **7**. Dorsal view. **8**. Ventral view. **Figs. 9–10**. Stained form (Refugio Amazonas Lodge). **9**. Dorsal view. **10**. Ventral view. Scales=5 mm.

Type material: HOLOTYPE male (Figs. 1–2): **PERU, CUSCO**: Cashiriari, 11°52'S, 72°39'W, 690 m, 04–05.xii.1997, J. Grados (11:00 pm–12:00). 30 Paratypes (16 males and 14 females): **PERU, UCAYALI,** 1 male, Masisea, C.C.N.N., Betel, 08°25'29.94"S, 74°15'42.81"W, 138 m, 08.viii.2009, C. Carranza; 1 female, Puerto Putin, 08°44'59.2"S, 74°08'19.52"W, 122 m, 17.vii.2008, M. Alvarado; 1 female, Río Tamaya, 08°51'41.9"S, 74°04'20.6"W, 150 m, 07–08.vii.2008, M. Alvarado. **JUNIN**: 2 females, Mazamari, 11°20'33"S, 74°33'04"W, 1100 m, 28–29.v.2011, P. Hocking leg. **CUSCO:** 1male, 12 km O de Sonampiato, 11°39'52.07"S, 73°14'35.01"W, 887 m, 29.v.2011, C. Espinoza; 1 male, San Martín C, 11°47'S, 72°41'W, 480 m, 06.iv.1997, J. Grados; 1 male, Pagoreni, 11°42'S, 72°54'W, 470 m, 02.x.1998, G. Valencia;1 male, 7.5 km SO de Puerto Huallana (Río Picha), 11°49'21"S, 72°11'24"W, 441 m, 05–07.ix.2017, J. Gonzáles; 2 males, Cashiriari, 11°52'S, 72°39'W, 690 m, 04–05.xii.1997, J. Grados (2:00–3:00 am)(Light trap MV/UV); 1 male, idem except, 06.xii.1997; 1 male, idem except (GENITALIA # 850–JGA); 1 female, Las Malvinas, 11°52'S, 72°56'W, 360 m, 20.ix.1997, J. Grados (Light trap MV/UV). **MADRE DE DIOS:** 1 male, CICRA, Río Los Amigos, 12°33'S, 70°06'W, 280 m, 06.xi.2006, A. Asenjo; 2 males, idem except, 17.xi.2006; 1 female, idem except, 27.xi.2006 (GENITALIA # 851–JGA)(Genitalia # 968–JGA); 1 male, idem except, 16.i.2007 (GENITALIA # 849–JGA); 1 male, idem except, 12°34'7.35"S, 70°05'56.8"W, 380 m, 08.xii.2005, J. Grados leg. (Genitalia # 972–JGA); 1 female, Albergue Posada Amazonas, 12°47'S, 69°14'W, 300 m, 05.xii.2003, A. Lescano; 1 male, idem except, 13.xii.2003; 1 female, idem except, 12°48’17”S, 69°17’35”W, 280 m, 03.x.2004, T. McCabe; 1 female, Tambopata Research Center, 13°08’S, 69°36’W, 300 m, 13.v.2001, J. Grados (Light trap MV); 1 female, Albergue Refugio Amazonas, Río Tambopata, 12°52’30”S, 69°24’35”W, 231 m, 09.x.2016, D. Couceiro; 2 females, idem except, 22.x.2016; 1 female, idem except 24.vi.2017; 1 female, idem except, 16.vii.2017, Wendy and Joshua Villanueva; 1 female, idem except, 20.x.2017, D. Couceiro; 1male, idem except, 05.viii.2018. **PUNO:** 1 male, P.N. Bahuaja-Sonene, 13°11’42”S, 70°07’56”W, 330 m, 03.vi.2013, J. Grados, E. Razuri & J. Barrientos (Genitalia # 1000–JGA); 1 male, idem except, 13°11’35”S, 70°07’56”W, 05.vi.2013. **Additional material examined. PERU, MADRE DE DIOS**: 1 female, Rio Tambopata Res: 30 air km. SW Pto. Maldonado, 290 m, 11–15.xi.1979, J.B. Heppner (subtropical moist forest) (USNM); 4 males, idem except, 6–10.xi.1979.



FIGURES 11–14. Genitalia of *Watsonidia fulgida* Grados, **sp. nov.** Females. Figs. **11–12**. White form. (Genitalia # JGA–851). **11**. Dorsal view. **12**. Ventral view. Figs. **13–14**. Stained form. (Genitalia # JGA–853). **13**. Dorsal view. **14**. Ventral view. Scales= 1 mm.

Etimology: *fulgida* is a feminine adjective in singular nominative meaning bright. The name was chosen by Wendy and Joshua Villanueva, participants of the Citizen Science project.

Distribution: Known in Peru from the departments of Ucayali, Junín, Cusco and Madre de Dios (Peruvian Amazon).

Barcoding: The mitochondrial DNA sequence (COI) of one of the paratypes (Voucher MUSM-Arctiinae VBC # **359**) is as follows:

AACTTTATATTTTATCTTTGGTzATCTGAGCTGGAATAGTAGGAACTTCTCTAAGTTTATTAATTCGTGCTGAATTAGGAAATCCTGGATCTTTAATTGGAGACGATCAAATTTATAATACAATTGTAACTGCCCATGCTTTTATTATAATTTTCTTTATAGTAATACCAATTATAATTGGAGGATTTGGTAATTGATTAGTACCTTTAATACTAGGAGCCCCAGATATAGCATTCCCTCGAATAAATAATATAAGTTTTTGACTCTTACCCCCATCATTAACATTATTAATTTCAAGAAGAATCGTAGAAAATGGAGCAGGAACAGGATGAACAGTATACCCCCCACTTTCATCTAATATTGCTCATGGAGGAAGTTCCGTAGATTTAGCTATTTTTTCATTACACTTAGCTGGAATTTCATCAATTTTAGGAGCCATCAATTTTATTACAACAATTATTAATATACGATTAAATAATTTATCATTTGATCAAATACCTTTATTTATTTGAGCTGTAGGTATTACAGCTTTTTTATTATTATTATCATTACCTGTTTTAGCTGGAGCTATTACAATATTATTAACAGATCGTAATCTTAATACTTCATTTTTTGATCCTGCTGGAGGAGGAGACCCAATTCTCTACCAACATTTATTC

Remarks: *Watsonidia reimona* was described by Schaus (1933) from two male and one female specimens from Buena Vista (Colombia), a male was designated as Holotype. The information provided by Watson (1971) is as follows: holotype male; "Collection Wm. Schaus; S.C. Patchett Coll; Buena Vista, Colombia; Type No. 34388 U.S.N.M.; *Glaucostola reims* Schaus. Type; Arctiidae genitalia slide no. AW253; Holotype male *Glaucostola reigns* Schaus A.W. 1967."

Watsonidia was proposed by Toulgoët (1981), composed of four species: *W. reimona* (Glaucostola), *W. pardea* (*Glaucostola*), *W. porioni* and *W. navatteae*. He designated *Watsonidia reimona* as the type species of the genus (Schaus 1933) (= *Glaucostola reimona* Schaus, 1933). When describing the species *W. porioni*, Toulgoët (1981) compared the genital capsule of the new species with a male specimen from Apuya, Napo River (Ecuador), which he identified as *W. reimona* (nec *W. reimona*).

Comparing the color pattern and the genital traits of the specimen used, deposited and photographed by Toulgoët (1981: 65, Figs. 1, 2 and 5) with the holotype of *W. reimona* (Watson 1971: 124, plate 20: f; plate 50: c,d), different characters can be seen, indicating they correspond to distinct species. In his publication Toulgoët (1981) considered he was representing *W. reimona* but he did not realize it was an unknown species.

Description (stained morphotype): Male (Figs. 27, 30, 33). Forewing span: 14–15 mm (n = 5). Except for the black spot on the forewings, the stained morphotype is similar to the male of the white one (Figs. 27,30, 33). The male genitalia (Fig. 28–29, 31–32, 34–35) is similar to the white morphotype. Valvae and lateral processes of the tegumen are variable, and the range of variability is continuous in both morphotypes.

Female (Figs. 9–10): Forewing span: 13–15 mm (n=4). Wing and body color pattern similar to the male, differing in the following characters: antennae with minute rami; hindwings elongated; frenulum composed of three bristles. Except for the black spot on the forewings, it is similar to the female of the white morphotype. **Female genitalia** (Figs. 13–14) (Genitalia # 853–JGA): There are no differences between this and the genitalia of the white morphotype.

Material examined: PERÚ: CUSCO: 1 male, Pagoreni, 11°42'S, 72°54'W, 470 m, 02.x.1998, G. Valencia (GENITALIA # 852—JGA); 1 male, Segakiato, Río Camisea, 11°48'S, 72°52'W, 330 m, 08.x.1997, J. Grados (Light trap MV); 1 female, 1.3 km SSO de Las Malvinas, 11°51'30''S, 72°57'00' W, C. Espinoza. **MADRE DE DIOS:** 1 male, Río Los Amigos, CICRA, 12°33'S, 70°06'W, 280 m, 25.xi.2006, A. Asenjo (Genitalia # 977–JGA); 1 female, Albergue Refugio Amazonas, Río Tambopata, 12°52'30''S, 69°24'35''W, 231 m, 12.xi.2016, D. Couceiro (GENITALIA # 853—JGA); 1 female, idem except, 20.x.2017; 1 male, ídem except 12.v.2018, J. Shoobridge *et al*.; 1male, ídem except, 05.viii.2018 (Genitalia # 1001–JGA); 1 male, Rio Tambopata Res: 30 air km. SW Pto. Maldonado, 290 m, 11–15.xi.1979, J.B. Heppner (subtropical moist forest)(USNM); 1 male, idem except 21–25.xi.1979 (USNM).

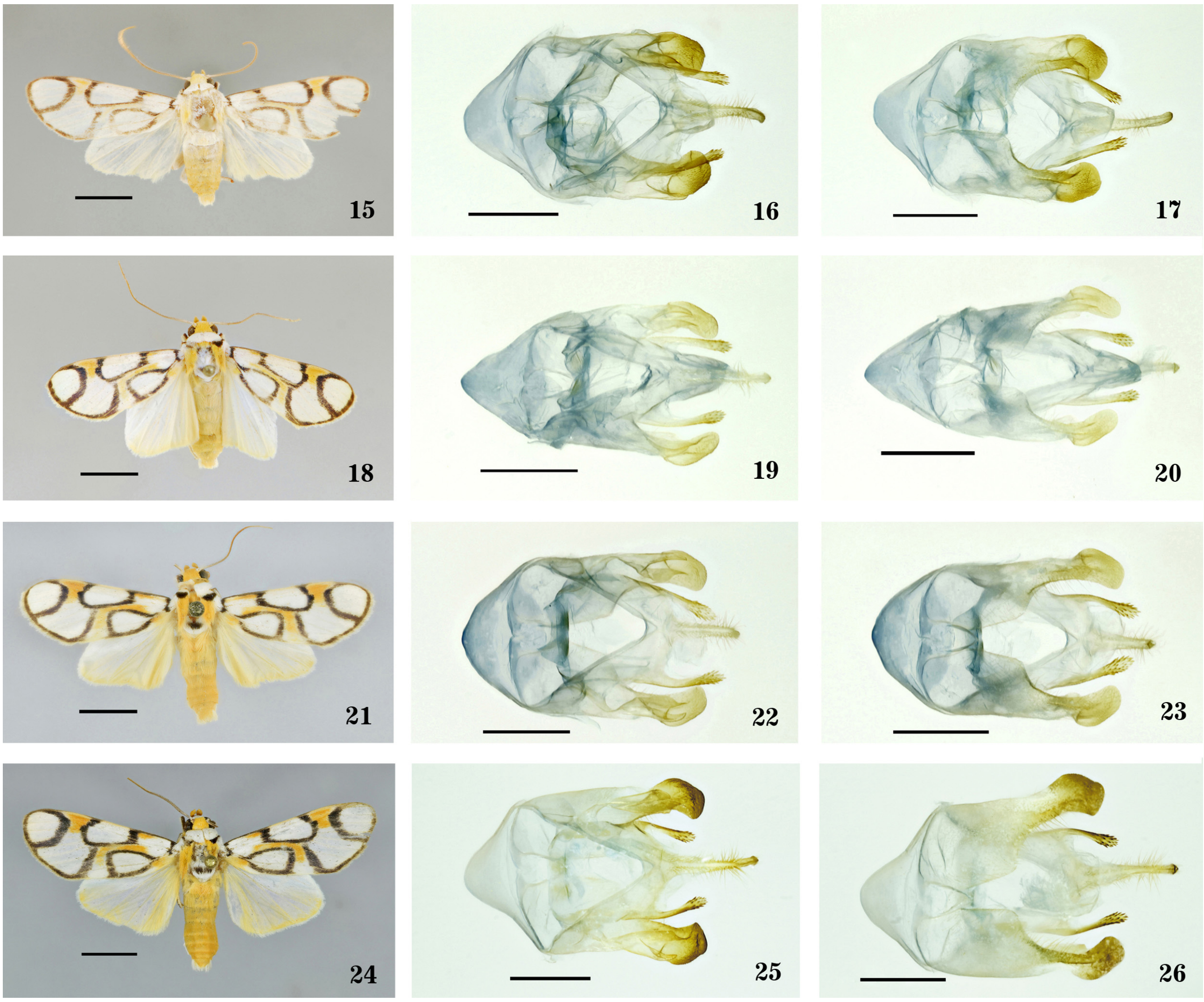
Barcoding: The mitochondrial DNA sequence (COI) of one specimen is as follows (Voucher MUSM-Arctiinae VB # 200):

AACTTTATATTTTATCTTTGGTATCTGAGCTGGAATAGTAGGAACTTCTCTAAGTTTATTAATTCGTGCTGAATTAGGAAATCCTGGATCTTTAATTGGAGACGATCAAATTTATAATACAATTGTAACTGCCCATGCTTTTATTATAATTTTCTTTATAGTAATACCAATTATAATTGGAGGATTTGGTAATTGATTAGTACCTTTAATACTAGGAGCCCCAGATATAGCATTCCCTCGAATAAATAATATAAGTTTTTGACTCTTACCCCCATCATTAACATTATTAATTTCAAGAAGAATCGTAGAAAATGGAGCAGGAACAGGATGAACAGTATACCCCCCACTTTCATCTAATATTGCTCATGGAGGAAGTTCCGTAGATTTAGCTATTTTTTCATTACACTTAGCTGGAATTTCATCAATTTTAGGAGCCATCAATTTTATTACAACAATTATTAATATACGATTAAATAATTTATCATTTGATCAAATACCTTTATTTATTTGAGCTGTAGGTATTACAGCTTTTTTATTATTATTATCATTACCTGTTTTAGCTGGAGCTATTACAATATTATTAACAGATCGTAATCTTAATACTTCATTTTTTGATCCTGCTGGAGGAGGAG

Discussion

Morphological study. First collections performed in southeastern Peru (Tambopata River, Los Amigos River and others) have been recorded since 1997 and almost all specimens of this study came from this area. Thirty-two specimens of the new species were examined: 18 males and 14 females of the white morphotype; 5 males and 4 females of the spotted morphotype. These are all the specimens that came to the light trap in all the years of work.

Sexual dimorphism was observed, except for the characters of the antennae and the genitalia at the posterior part of the abdomen. Lastly, when analyzing between male specimens and between female specimens of both forms, no intermediate color pattern was found. These findings reflect that the variability of the color pattern observed among both forms, the black spot on the forewings, is not related to a continuous variability, but on the contrary, it has the characteristic of a discrete variation.

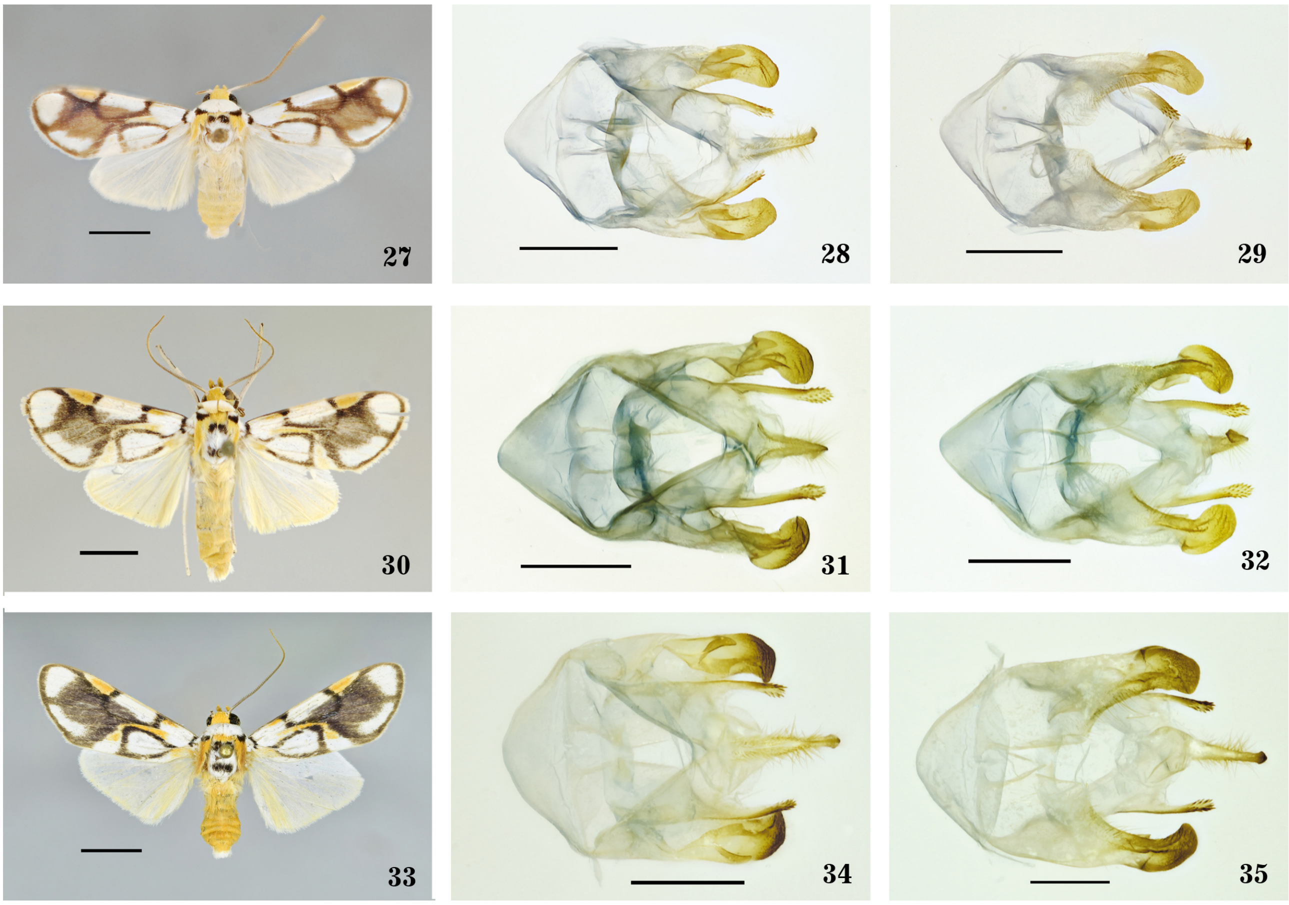


FIGURES 15–26. Adults and genitalia of *Watsonidia fulgida* Grados, **sp. nov.** White form. Males. **Figs. 15–17.** Adult. (Genitalia # JGA–850). **15**. Adult, dorsal view. **16**. Genitalia, dorsal view. **17**. Genitalia, ventral view. **Figs. 18–20.** Adult. (Genitalia # JGA–968). **18**. Adult, dorsal view. **19**. Genitalia, dorsal view. **20**. Genitalia, ventral view. **Figs. 21–23.** Adult. (Genitalia # JGA–972). **21**. Adult, dorsal view. **22**. Genitalia, dorsal view. **23**. Genitalia, ventral view. **Figs. 24–26.** Adult. (Genitalia # JGA–1000). **24**. Adult, dorsal view. **25**. Genitalia, dorsal view. **26**. Genitalia, ventral view. Scales of adults=5 mm. Scales of genitalia=1 mm.

It has long been known that in the animal world the genital organs of males are one of the characters with high variability and evolutionary divergence (Simmons 2014). In insect's taxonomy, morphology of male genitalia has been used to distinguish species for more than 150 years (Dufour 1844), highlighting the reproductive isolation between species and their phylogenetic relationships. Differences in the morphology of the genitalia of two sets of organisms would imply two different species (Dufour 1844, Jordan 1896, Tuxen 1970, Shapiro & Porter 1989). This approach has been very useful to increase our knowledge of evolutionary processes of organisms and is used in all taxonomic work.

Differentiation of species in Arctiinae has not escaped the morphological studies of the male genitalia. When thoroughly studying the genitalia of males of *W. fulgida*, we find two types of characters: those which do not present any variation between both forms and those which have a marked variability. When analyzing the genitalia of the males of the white morphotype (Figs 16–17, 19– 20, 22–23, 25– 26) and the spotted morphotype (Figs 28–29, 31–32, 34–35), that the aedeagus (Fig. 6) in both morphotypes was almost uniform, with no marked variability. The most variable characters among individuals of both morphotypes were observed in the tegumen, the saccus and the valvae: the lateral processes of the tegumen can be shorter than the valvae or just slightly larger; the saccus may be slightly developed to very well differentiated; the valvae are somewhat elongated with the distal parts dilated (in dorsal and ventral view), going from almost straight to somewhat curved towards the central axis. These characters, in both morphotypes show continuous variability.

In the systematic work, when few specimens of two apparently different species are examined, it is possible to confuse some characters and take them as exclusive of a species, with no relation to the gene flow between both species. When examining more individuals of the population, in some cases it can be noticed that they are simply characters with continuous variation, or that those characters are not polymorphic at low frequencies of analysis (Wiens 1999).



FIGURES 27–35. Adults and genitalia of *Watsonidia fulgida* Grados, **sp. nov.** Stained form. Males. **Figs. 27–29.** Adult. (Genitalia # JGA–852). **27**. Adult, dorsal view. **28**. Genitalia, dorsal view. **29**. Genitalia, ventral view. **Figs. 30–32.** Adult. (Genitalia # JGA–977). **30**. Adult, dorsal view. **31**. Genitalia, dorsal view. **32**. Genitalia, ventral view. **Figs. 33–35.** Adult. (Genitalia # JGA–1001). **33**. Adult, dorsal view. **34**. Genitalia, dorsal view. **35**. Genitalia, ventral view. Scales of adults=5 mm. Scales of genitalia=1 mm.

The two morphotypes of *W. fulgida* described here are sympatric in southeastern Peru. Based on that both morphotypes present the same external morphological characters, on the continuous variability of the male genitalia morphology, and that the spotted morphotype is different from the white morphotype only by the presence of the spot on the forewings, both would be two morphotypes of the same species.

Considering only the collections carried out at the Refugio Amazonas Lodge, where the Citizen Science Project is held, collecting almost every night from March 2016 until the end of 2018, there were 3 males and 8 females, of which 2 males and 3 females were of the spotted morphotype. These results demonstrate that this species is not common, differing from other common species of Arctiinae in the area, such as *Xanthoarctia pseudameoides* (Rothschild), *Azatrephes argyrotis* Hampson, *Azatrephes discalis* (Walker), *Delphyre dizona* Druce and *Evius ocassus*

Grados among others. On the other hand, considering all the specimens which were studied in this work, the spotted specimens represent 25% of the total population of the species.

Molecular analysis. Since the proposal of the use of the COI gene for the identification of species by Hebert *et al*. (2003), several taxonomic works in neotropical Arctiinae have been carried out using barcoding (Vincent & Laguerre 2013, Laguerre 2016, Grados 2018, Vincent 2018). These have been carried out from an integrative taxonomy perspective (Dayrat 2005), with barcoding being used as another tool in systematic work, also considering the analysis and differentiation of the species morphological characters. Until now, the morphological differences of the species studied have been related to genetic distances close to 2%. However, this is not true for all species complexes of Arctiinae and other groups of Lepidoptera (Dasmahapatra *et al*. 2010).

When comparing the genetic distances between *W. fulgida* and the taxa identified in BOLD as *W. reimona* and *W. porioni*, the genetic distance with the former was between 5.11–5.62 and with the latter 4.76–5.11. These results only confirm that *W. fulgida* is a different species from the two mentioned taxa. However, it is important to note the interspecific distances between the species *W. reimona* and *W. porioni* which are within the range of 0.96–1.28. It is necessary to study these species in detail, incorporating morphological data to clarify if they are two different species, which is beyond the scope of this study.

Analyzing only *W. fulgida*, the genetic distances between the individuals of the white morphotype were between 0% –0.16%; same results were obtained for the stained morphotype. Lastly, the genetic distances between individuals of both morphotypes were between 0%–0.32%. These results of such small genetic distances, involving differences of two DNA nucleotides at most, reinforce the similarity between both morphotypes (Table 3).

Polymorphism. In the first chapter of his book on the variability of organisms, Darwin (1859) pointed out that "a high degree of variability is evidently favorable, since it gives without limitation the materials for selection to work on". He refers to the variability of species, which implies slight intraspecific differences, which are part of the continuous variability that every species presents and falls within a normal distribution curve (Ford 1966, Hennig 1968). Polymorphism is the occurrence of two or more different forms of the same species in a same habitat (Ford 1945). It has also been conceptualized as the discontinuous variation among members of a population (Mayr 1969). It is feasible to find polymorphism in several taxonomic groups; however, it is not so common (Hoffman & Blouin 2000, Mikhailow 2001, Hugall & Stuart-Fox 2012, Paladini *et al* 2018). The most well-known polymorphisms are sexual polymorphism (sexual dimorphism), environmental polymorphism (polyphenism), melanic or color polymorphism and geographic polymorphism (Ford 1945, Long 1952, Kettlewell 1956, 1958, Gullan & Cranston 2010, Simpson *et al*., 2011). Color polymorphism has been defined as the presence of two or more distinct, genetically determined forms within a population, where the rarest is the result of a recurrent mutation (Huxley 1955).

The adaptive polymorphism proposed by Dobzhansky (1951) connected the advantage that species living in the same place under two different forms could better exploit the ecological resources of their environment. From an evolutionary point of view, Hennig (1968) mentioned that the specific bifurcation would not be related to individual variability and polymorphism. In work carried out on the nocturnal butterfly *Biston betularia*, an example of industrial melanism, it was proposed that the polymorphism observed was strongly controlled by natural selection (Kettlewell 1956, Cook & Saccheri 2013). It has also been proposed that the polymorphism could be due to genetic drift, as has been found in the spider *Enoplognatha ovata* (Oxford 1993).

Studies on the mimetic polymorphism in the neotropical butterfly species *Heliconius numata* (Lepidoptera), demonstrated that it is due to a supergene and maintained in the population by natural and sexual selection, each of them intervening in opposite way (Joron *et al*. 2011, Chouteau *et al*., 2017). Recent works have postulated the idea that color polymorphism could be related to sympatric speciation (McKinnon & Pierotti 2010, Gray & McKinnon 2007, Hugall & Stuart-Fox 2012), a proposal that needs to be corroborated with more studies.

Each species has its own evolutionary history. Not all the species presenting polymorphism necessarily have to correspond to the evolutionary processes that are known up to date. The polymorphism of *W. fulgida* is one more example among others that must be occurring in the Amazon. For now, we still have intriguing questions: which genes are involved? What is the cause for low population densities? Which evolutionary forces keep the populations of the two morphotypes? Which advantage does polymorphism give to them? Is polymorphism present in the larval stage? Are the larvae generalists or specialists? Is there any type of segregation of host plants between the two morphotypes? All these and other questions remain to be investigated just in this species, which brings to mind Vannevar Bush's (1945) wise statement on Science and its infinite frontier to discover.

TABLE 3. Distance for DNA barcode sequence (Kimura-2-parameter) calculated between each of the taxa of *Watsonidia fulgida* Grados **sp. nov.** with his two morphotypes and two other species.

	ARCTB543-08 W. reimona	ASARC520-11 W. reimona	ASARC519-11 W. reimona	ARCTB544-08 W. reimona	ARCTB542-08 W. reimona	ASARC517-11 W. reimona	ARCTB541-08 W. reimona	ARCTB539-08 W. porioni	ARCTB540-08 W. porioni	ARCTB538-08 W. porioni	RFEWA200-17 W. fulgida (stained)	RFEWA359-17 W. fulgida (white)	RFEWA405-18 W. fulgida (white)	RFEWA492-18 W. fulgida (white)	RFEWA503-18 W. fulgida (white)	RFEWA522-18 W. fulgida (white)	RFEWA524-18 W. fulgida (stained)	RFEWA530-18 W. fulgida (stained)
ARCTB543-08 W. reimona																		
ASARC520-11 W. reimona	1.12																	
ASARC519-11 W. reimona	1.12	0.00																
ARCTB544-08 W. reimona	0.16	0.96	0.96															
ARCTB542-08 W. reimona	0.16	0.96	0.96	0.00														
ASARC517-11 W. reimona	0.96	0.48	0.48	0.80	0.80													
ARCTB541-08 W. reimona	0.96	1.12	1.12	0.80	0.80	0.96												
ARCTB539-08 W. porioni	1.28	1.12	1.12	1.12	1.12	0.96	0.96											
ARCTB540-08 W. porioni	1.28	1.28	1.28	1.28	1.28	0.96	0.96	0.00										
ARCTB538-08 W. porioni	1.28	1.12	1.12	1.12	1.12	0.96	0.96	0.00	0.00									
RFEWA200-17 W. fulgida (stained)	5.62	5.45	5.45	5.45	5.45	5.27	5.28	4.93	4.93	4.93								
RFEWA359-17 W. fulgida (white)	5.62	5.45	5.45	5.45	5.45	5.27	5.28	4.93	4.93	4.93	0.00							
RFEWA405-18 W. fulgida (white)	5.62	5.45	5.45	5.45	5.45	5.27	5.28	4.93	4.93	4.93	0.00	0.00						
RFEWA492-18 W. fulgida (white)	5.62	5.45	5.45	5.45	5.45	5.27	5.28	4.93	4.93	4.93	0.00	0.00	0.00					
RFEWA503-18 W. fulgida (white)	5.62	5.45	5.45	5.45	5.45	5.27	5.28	4.93	4.93	4.93	0.00	0.00	0.00	0.00				
RFEWA522-18 W. fulgida (white)	5.80	5.62	5.62	5.62	5.62	5.45	5.45	5.11	5.11	5.11	0.16	0.16	0.16	0.16	0.16			
RFEWA524-18 W. fulgida (stained)	5.45	5.27	5.27	5.27	5.27	5.10	5.11	4.76	4.76	4.76	0.16	0.16	0.16	0.16	0.16	0.32		
RFEWA530-18 W. fulgida (stained)	5.62	5.45	5.45	5.45	5.45	5.27	5.28	4.93	4.93	4.93	0.00	0.00	0.00	0.00	0.00	0.16	0.16	

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