





https://doi.org/10.11646/zootaxa.5071.2.3 http://zoobank.org/urn:lsid:zoobank.org:pub:31D8526A-85B8-4483-B414-EBF3ADA86399

Revision of the genus *Jethsura* Cameron, 1902 (Hymenoptera: Ichneumonidae: Ichneumoninae: Phaeogenini)

BRANDON CLARIDGE

Utah State University, 5305 Old Main Hill, Logan, UT, 84322, USA brandonclaridge1@gmail.com;
https://orcid.org/0000-0002-2222-326X

Abstract

The genus Jethsura Cameron is revised. Jethsura euthenia **sp. nov.**, Jethsura gondawindua **sp. nov.**, and Jethsura serpentina **sp. nov.** are newly described from Colombia, and Jethsura rubricauda **sp. nov.** is described from Mexico. Jethsura pyriformis (Provancher) from the Nearctic region is redescribed. Species images, distribution maps and an illustrated key is provided.

Key words: Neotropical region, parasitoid wasp, taxonomy

Introduction

Jethsura Cameron (Ichneumonidae, Ichneumoninae, Phaeogenini) is a monotypic parasitoid wasp genus that occurs in the Nearctic region (Yu *et al.* 2016), although the type species, *J. pyriformis* (Provancher), has been reported once in the Palearctic region in Finland (Ranin 1982). *Jethsura* was formerly placed in the subtribe Notosemini (Diller 1981; Selfa & Diller 1994). However, Santos *et al.* (2021) abandoned the subtribal classification of Phaeogenini and it is likewise not recognized here.

Biological information for *J. pyriformis* is unknown, although the structure of the metasomal apex suggests that *Jethsura* attacks the larval stage of its host. *Jethsura pyriformis* has a thin, needle-like ovipositor, similar to amblypygous species in other ichneumonine tribes which are known to attack larvae (see, for example, Hinz 1983, Heinrich 1960, Hilpert 1992, Santos *et al.* 2021). Unlike true amblypygous species, however, *J. pyriformis* does not have an elongated hypopygium that covers the ovipositor. Instead, the ovipositor is mostly enclosed within the seventh metasomal tergite (Fig. 4G). Given the apparent functional significance of a needle-like ovipositor in larval parasitism, the ovipositor morphology may be more indicative of attacking larvae than the specific structure protecting it.

In addition to *J. pyriformis*, three undescribed *Jethsura* species occur in Colombia and one in Mexico. The metasomal apex of these species is similar to *J. pyriformis*, and they are therefore also likely larval parasitoids. Three of the new Neotropical species are herein described as part of a taxonomic revision of *Jethsura*. A well-illustrated species key, species images, and distribution maps are provided. Although it is outside the scope of the present work to supply a key to the New World Phaeogenini genera, a generic diagnosis of *Jethsura* is provided which differentiates it from co-occurring genera, including several undescribed Neotropical genera.

Materials and methods

Morphological terminology follows Bennett *et al.* (2019). "MS1" refers to the first metasomal segment and "T2", "T3", etc. refer to the corresponding metasomal tergites. The adjective "normal" is used when describing the body length and dimensions of the mesosoma, propodeum, legs, and hind femur and refers to the approximately average dimensions of such structures seen in *Jethsura* and the majority of Phaeogenini genera. Specifically, the normal

states are: body moderately long (body length $5-7\times$ mesosomal height, mesosoma $2.0-2.5\times$ as long as wide, propodeum approximately $1.0\times$ as long as wide, legs moderately long (length of hind tibia $1.3-1.7\times$ length of T2), and hind femur nearly cylindrical except posterior face partially flattened. In *Jethsura serpentina* and *Jethsura* sp. X these structures significantly deviate from the normal condition and are noted in the key and taxonomic treatments. The mandibular index (MI) refers to the ratio of the length of the mandible from the base to ventral notch divided by the width at $0.3\times$ from the base. Females are described in full, while only variation in structure and coloration are noted for males.

Images were taken with a Canon 1200D body, a Canon EF-S 60mm macro lens for habitus images and a Venus Optics Laowa 25mm Ultra-Macro lens for higher magnification images. Image stacking was performed with Helicon Focus 7 and processed in the web-based photo editor Photopea (photopea.com). Figures were assembled in LibreOffice Draw 5.4.4.2. Distribution maps were generated in the open-source software QGIS 3.6.2 (QGIS Development Team).

Specimens examined were deposited in the following collections:

CNCI	Canadian National Collection of Insects, Agriculture Canada: Ottawa, Ontario, Canada
EMUS	Entomology Museum, Utah State University: Logan, Utah, U.S.A
IAVH	Natural History Museum of the Alexander Humboldt Institute: Bogotá, D.C., Colombia

Taxonomy

Jethsura Cameron, 1902

Jethsura Cameron, 1902: 373. Type species: Jethsura ferruginea Cameron. Monotypic and original designation.

Generic diagnosis. *Jethsura* is distinguished by the combination of the following characters: 1) mandible slightly narrowed to moderately wide and nearly unidentate, with the ventral tooth greatly reduced and represented only by a small notch; 2) dorsal face of propodeum usually with carinae obsolete (moderately to weakly-developed in *J. pyriformis*); 3) gastrocoelus and thyridium of T2 varying from subobsolete to moderately well-developed but always narrower than interthyridial interval; 4) males without tyloids; and most notably, 5) female with T6 anteriorly constricted. The latter character is unique among phaeogenine genera, and thus makes the females instantly recognizable. Males of *J. pyriformis* superficially resemble a few species of *Stenodontus*, particularly several undescribed species in Mexico and the southwestern U.S.A. *Jethsura pyriformis* males can be readily distinguished from these species by the broader, bidentate mandible as opposed to the narrower, sickle-shaped, unidentate mandible in *Stenodontus*.

Key to species of Jethsura

1.	Body primarily brownish-red (Fig. 5A, 6A). Female flagellum with yellowish-white banding from flagellomeres 7/8–12/13
	(Fig. 5A). Dorsal face of propodeum with carinae distinct (Fig. 5E)
-	Primarily black with at least head and mesosoma black (e.g. Figs 1A, 7A). Female flagellum black and without yellowish-
	white banding (e.g. Figs 1A, 7A). Dorsal face of propodeum with carinae obsolete (e.g. Figs 1E, 7E)2
2.	Head and mesosoma black with metasoma primarily brownish-red (Figs 7A, 8A). Gastrocoelus and thyridium of T2 subobso-
	lete (Fig. 7F)
-	Head, mesosoma, and metasoma black (e.g. Figs 1A, 9A). Gastrocoelus and thyridium of T2 well-developed (e.g. Figs 1E,
	9F)
3.	Body elongate and strongly laterally flattened (Figs 9A, 10A). Mandible broad (Fig. 9D)
-	Body of normal length, not strongly laterally flattened (e.g. Figs 1A, 2A). Mandible moderately wide (Fig. 1D) or slightly nar-
	rowed (Fig. 3D)
4.	Mesopleuron smooth with a few coarse punctures (Fig. 9B)
-	Ventral 0.6 of mesopleuron longitudinally rugulose, dorsal 0.4 smooth and coarsely punctate (Fig. 10B)
	Jethsura species X.
5.	Mandible black with dark reddish apex (Figs 1D, 2C). Clypeus and supraclypeal area slightly convex in profile (Fig. 1B). In
	female, head slightly tapering ventrally (Fig. 1C) J. euthenia sp. nov.
-	Mandible brown to light brown with dark brown apex (Figs 3D, 4C). Clypeus and supraclypeal area nearly flat in profile (Fig.
	3B). In female, head nearly quadrate (Fig. 3C)

Jethsura euthenia sp. nov.

Figs 1–2, 12 urn:lsid:zoobank.org:act:66A98690-15A1-4345-8144-4FC0E8E24747

Diagnosis. *Jethsura euthenia* is similar to *J. gonawindua*, both being overall black and with the mesosoma not laterally flattened. The black mandible with a dark reddish apex is sufficient to distinguish *J. euthenia* from the latter species which has a brown to light brown mandible with a dark brown apex. Additionally the head morphology differs significantly between the two species. In anterior view, the head in *J. euthenia* is slightly longer and tapers ventrally and the clypeus and supraclypeal area are slightly convex in profile. In males, however, the differences in head morphology are less pronounced.

Description. Female (Fig. 1A–H). Body length: 6.9–8.1 mm; fore wing length: 4.4–4.9 mm.

Color. Primarily black with few yellow and yellowish-white markings and partially brownish legs. Head black, except for mandibular brown with black base and dark reddish-brown apex, paraocular area with narrow light yellowish mark medially dorsal to antennal base and at dorsolateral corner (25% of specimens with venterolateral corner brownish). Antenna black, except for pedicel apically brownish. Mesosoma black, except for dorsal margin of pronotum and tegula yellowish-white. Fore leg: coxa varying from entirely black to black and brownish anteriorly; trochanter black, except for apex brownish laterally; trochantellus brown; femur anteriorly brownish-yellow, except for basal 0.3 dark brown, posteriorly dark brown, except for apical 0.2; tibia brownish-yellow ventrally, darker dorsally; tarsus reddish-brown except tarsomere 5 dark brown to dark reddish-brown. Mid leg: coxa varying from entirely black to black and brownish anteriorly; trochanter black, except for apex anteriorly brownish; trochantellus brown; femur dark brown, except for anteriorly with apical 0.2 brownish-yellow, posteriorly varying from entirely dark brown to apical 0.1 brownish-yellow; tibia brownish-yellow, dark dorsally; tarsus reddish-brown except tarsomere 5 dark brown to dark reddish-brown. Hind leg: coxa black; trochanter black; trochantellus dark brown; femur dark brown to black except for apical 0.1 brownish; tibia brownish-yellow becoming brown dorsally; tarsomeres 1–4 reddish-brown with brownish-yellow bases; tarsomere 5 dark brown. MS1 black. T2-7 black with lateral and posterior margins light brownish. Wing: membrane clear; basal 0.1 of wing with veins white, remaining sections brown.

Head. Slightly tapering ventrally. Mandible moderately wide (MI: $\sim 3.2\times$). Clypeus and supraclypeal area slightly convex in lateral view. Clypeus smooth and moderately to coarsely punctate with punctures separated by $0.5-1.8\times$ their diameter. Supraclypeal area smooth and densely punctate with punctures varying from subadjacent to separated by $0.3\times$ their diameter, 50% of specimens with dorsal punctures confluent forming rugulae submedially. Gena smooth and finely punctate with punctures separated by $1.5-2.5\times$ their diameter. Supra-antennal area smooth and finely to moderately punctate with punctures subadjacent to separated by $0.3\times$ their diameter, 20% of specimens with some punctures confluent and forming transverse rugulae. Vertex smooth and finely, sparsely punctate with punctures separated by $1.0-3.0\times$ their diameter, denser medially. Hypostomal and occipital carinae meeting before mandible. Antenna with 24 flagellomeres.

Mesosoma. Of normal width, not laterally flattened. Pronotum varying from smooth and finely punctate dorsally to primarily rugulose and smoother anterodorsally. Propleuron smooth with fine, dense, shallow punctation. Mesonotum smooth with anterior 0.1 very finely, densely punctate, remainder moderately punctate with punctation varying considerably in size and density. Scutellum smooth and sparsely punctate with punctures separated by 1.0– 2.0× their diameter. Mesopleuron smooth and varying from densely, coarsely punctate with punctures subadjacent to densely punctate-rugulose. Speculum smooth and finely to moderately punctate. Ventral division of metapleuron smooth and sparsely to densely punctate. Propodeum: of normal width, length and width nearly equal; evenly rounded mediolaterally; dorsal face smooth and varying from densely, coarsely punctate to punctate-rugulose laterally becoming smoother medially; posterior face varying from rugulose to punctate-rugulose; carinae obsolete, except for pleural carina, posterior transverse carina, and median longitudinal carina posterior to posterior transverse carina subobsolete. Legs of normal length. Hind femur normal, not anteroposteriorly flattened.

Metasoma. MS1 smooth, postpetiole varying from moderately to densely, coarsely punctate, medially nearly impunctate. T2 smooth and with moderately dense punctation varying from fine to coarse. Gastrocoelus well-developed. Thyridium well-developed; narrow, $0.7-0.8\times$ as wide as interthyridial width; distant from T2 anterior margin by $0.2\times$ tergite length. T3-7 smooth and varying from moderately to finely punctate with punctation becoming sparser and finer posteriorly.



FIGURE 1. *Jethsura euthenia* **sp. nov.** female holotype. A. Habitus. B. Mesosoma, lateral view. C. Head, frontal view. D. Mandible, venterolateral view. E. Propodeum, dorsolateral view. F. MS1–2, dorsolateral view. G. Metasomal apex, lateral view. H. Metasoma, dorsolateral view. Scale bars: 5.0 mm (A); 1.0 mm (B–H).

Male (Fig. 2A–C). Body length: 6.9–8.1 mm; fore wing length: 4.4–4.9 mm. As in female except for: postpetiole of MS1 moderately to densely punctate, 10% of specimens with some punctures confluent becoming irregular longitudinal rugulae; T2–7 densely punctate with punctures separated by 0.3–0.5 their diameter and becoming sparser posteriorly. Antenna with 26 flagellomeres.



FIGURE 2. *Jethsura euthenia* **sp. nov.** male paratype. A. Habitus. B. Head, frontal view. C. Mandible, ventral view. Scale bars: 5.0 mm (A); 1.0 mm (B–C).

Material examined. *Holotype*: Colombia • 1♀; Boyacá, SFF Iguaque, Cabaña Mamarramos; 2855m; 5°25'N, 73°27'W; 23.v.–08.vi.2000; P. Reina; P. Reina; M. 149; IAVH.

Paratypes: Colombia • 36♂♂, 3♀♀; same collection data as holotype; 19.iv.–0.6.v.2000; M.55; IAVH • 10♂♂, 4, same collection data as preceding; EMUSENT00004089, EMUSENT00004021, EMUSENT00003574, EMUSENT00004386, EMUSENT00004082, EMUSENT00004382, EMUSENT00003759, EMUSENT00003999, EMUSENT00004201, EMUSENT00003513, EMUSENT00003545, EMUSENT00004267, EMUSENT00003884, EMUSENT00003966 • 38중중, 5우우; same collection data as holotype; 06–23.v.2000; M.74; IAVH • 3중중, 3♀♀; same collection data as preceding; EMUSENT00003632, EMUSENT00003932, EMUSENT00003674, EMUSENT00003725, EMUSENT00004360, EMUSENT00003944 • 19∂∂, 5♀♀; same collection data as holotype; 23.v.–08.vi.2000; M.149; IAVH • 633, 299; same collection data as preceding; EMUSENT00003788, EMUSENT00004334, EMUSENT00004206, EMUSENT00004419, EMUSENT00004385, EMUSENT00003572, EMUSENT00004261, EMUSENT00004477 • 1♂; same collection data as holotype; SFF Iguaque, La Planada; 2850m; 23.v.–08.vi.2000; M.152; IAVH • 19♂♂, 6♀♀; same collection data as holotype; 08–25.vi.2000; M.184; IAVH • 1 \bigcirc ; same collection data as preceding; EMUSENT00003663 • 7 \bigcirc \bigcirc ; same collection data as holotype; 13-30.vii.2000; M. 380; IAVH • 10づご; same collection data as holotype; 30.vi-.17.vii.2000; M. 390; IAVH • 1233, 799; same collection data as holotype; 01-23.ix.2000; M.614; IAVH • 133, 19; same collection data as preceding; EMUSENT00003460, EMUSENT00003733 • 31♂♂, 8♀♀; same collection data as holotype; 23.ix.– 11.x.2000; M.752; IAVH • 1♀; same collection data as preceding; EMUSENT00004447 • 3♂♂; same collection data as holotype; 04–21.xii.2002; M.1080, IAVH • 6♂♂, 2♀♀; Boyacá, SFF Iguaque; 5°25'12"N, 73°27'24"W; 2855m; 16.iii.–01.iv.2000; P. Reina; IAVH • 21♂♂, 9♀♀; Boyacá, SFF Iguaque, Cabaña Mamorramos; 5°25'12"N, 73°27'24''W; 2855m; 17.viii.–15.ix.2000; P. Reina; IAVH • 1233.299; same collection data as preceding; 25.vi–

13.vii.2000; IAVH • 5 \Diamond \Diamond , 5 \Diamond \Diamond ; same collection data as preceding; 28.ii.–16.iii.2000; M. 4; IAVH • 2 \Diamond \Diamond , 3 \Diamond \Diamond ; same collection data as preceding; 01–18.iv.2000; M. 24; IAVH.

Distribution. Known only from type locality (Fig. 12).

Etymology. Noun in apposition from Greek meaning abundance due to the large number (relatively) of specimens collected.

Comments. At the type locality, *J. euthenia* can be locally abundant as one Malaise trap yielded 46 males and 9 females within a three-week period.

Jethsura gonawindua sp. nov.

Figs 3–4, 12 urn:lsid:zoobank.org:act:0AB93066-4A28-45B8-A593-E272FE2A3168

Diagnosis. Similar to *J. euthenia,* although differentiated from the latter based on the primarily brown to light brown mandible, flatter clypeus and supraclypeal area in lateral view, and subquadrate head.

Description. Female (Fig. 3A-H). Body length: 6.9 mm; fore wing length: 4.0 mm.

Color. Primarily black with a few yellow and yellowish-white markings and partially brownish legs. Head black, except for mandibular brown to light brown with black base and dark brown apex, paraocular area with narrow light yellowish mark medially dorsal to antennal base and at dorsolateral corner (25% of specimens with venterolateral corner brownish). Antenna black, except for pedicel apically brownish. Mesosoma black, except dorsal margin of pronotum and tegula yellowish-white. Fore leg: coxa varying from entirely dark brown to black, 50% of specimens with brownish mark anterolaterally; trochanter dark brown to black with brownish apex; trochantellus brown; femur anteriorly brownish-yellow, except for basal 0.3 dark brown, posteriorly dark brown, except for apical 0.2 brownish-yellow; tibia brownish-yellow ventrally becoming brownish dorsally; tarsus dark reddish-brown, except for tarsomere 5 dark brown. Mid leg: coxa varying from black to dark brown; trochanter dark brown to black with brownish apex; trochantellus brown; femur dark brown except for anteriorly with apical 0.2 brownish-yellow, posteriorly varying from entirely dark brown to apical 0.1 brownish-yellow; tibia brownish-yellow ventrally becoming brownish dorsally; tarsus dark reddish-brown, except for tarsomere 5 dark brown. Hind leg: coxa and trochanter black; trochanter black; trochantellus brown; femur dark brown to black except for apical 0.1 brownish; tibia brownish-yellow ventrally; tibia brown to reddish-brown; tarsus varying from reddish-brown to dark reddish-brown, 50% of specimens with tarsomeres 1–3 paler basally. MS1 black. T2–7 black with lateral and posterior margins brownish, 50% of specimens with anterior margins of T4–6 with brownish semi-circular marks. Wing: membrane clear; basal 0.1 of wing with veins white, remaining sections brown.

Head. Subquadrate. Mandible slightly narrowed (MI: $\sim 3.5 \times$). Clypeus and supraclypeal area nearly flat in lateral view. Clypeus smooth and coarsely, sparsely punctate with punctures denser along margins. Supraclypeal area smooth and moderately punctate with 0.2–0.8× their diameter. Gena smooth and finely punctate with punctures separated by 1.0–3.0× their diameter, denser posteriorly. Supra-antennal are smooth and moderately punctate with punctures separated by 0.5–1.5× their diameter. Vertex smooth and finely, sparsely punctate with punctures separated by 1.0–3.0× their diameter, denser medially. Hypostomal and occipital carinae meeting before mandible. Antenna with 27 flagellomeres.

Mesosoma. Of normal width, not laterally flattened. Dorsal 0.6 of pronotum smooth and finely, sparsely punctate with punctures denser at margins, anterior 0.4 rugulose. Propleuron smooth and finely, sparsely punctate with punctures separated by $2.0-4.0\times$ their diameter. Mesonotum smooth, very finely, sparsely punctate anteromedially, remainder moderately punctate with punctures separated by $0.2-1.0\times$ their diameter, sparser laterally. Scutellum smooth and moderately punctate with punctures separated by $1.0-1.5\times$ their diameter. Mesopleuron smooth, dorsal 0.3 moderately punctate with anterodorsal corner rugulose, ventral 0.7 with punctation coarser and denser with some punctures forming rugulae. Speculum smooth and finely punctate. Ventral division of metapleuron smooth and coarsely, densely punctate with punctures sparser anteriorly and posteriorly at margin denser with some punctures confluent forming rugulae. Propodeum: of normal width, nearly equal in length and width; evenly rounded mediolaterally; dorsal face smooth and densely coarsely punctate laterally with punctures adjacent to subadjacent becoming sparser medially, posterior face rugulose; carinae obsolete except for pleural carina, posterior transverse carina, and median longitudinal carina posterior to posterior transverse carina subobsolete. Legs of normal length. Hind femur normal, not anteroposteriorly flattened.



FIGURE 3. *Jethsura gonawindua* **sp. nov.** female holotype. A. Habitus. B. Mesosoma, lateral view. C. Head, frontal view. D. Mandible, venterolateral view. E. Propodeum, dorsolateral view. F. MS1–2, dorsolateral view. G. Metasomal apex, lateral view. H. Metasoma, dorsolateral view. Scale bars: 5.0 mm (A); 1.0 mm (B–G).

Metasoma. MS1 smooth and postpetiole moderately punctate with punctate denser anteriorly and laterally and sparser medially and posteriorly. T2 smooth and varying from finely to moderately punctate becoming sparser and finer near posterior margin. Gastrocoelus well-developed. Thyridium well-developed; narrow, 0.6× as wide as inter-thyridial width; distant from T2 anterior margin by 0.2× tergite length. T3–7 smooth and varying from moderately to finely punctate with punctation becoming sparser and finer posteriorly.

Male (Fig. 4A–C). Body length: 6.6-7.0 mm; fore wing length: 4.3-4.4 mm. As in female except for: metasoma more densely punctate with punctures separated by $0.5-1.0\times$ their diameter. Antenna with 26–27 flagellomeres.



FIGURE 4. *Jethsura gonawindua* **sp. nov.** male paratype. A. Habitus. B. Head, frontal view. C. Mandible, ventral view. Scale bars: 5.0 mm (A); 1.0 mm (B–C).

Material examined. *Holotype*: Colombia • 1♀; Magdalena, PNN Santa Marta, El Ramo; 2500 m; 10°48;N, 73°39'W; 29.i.–15.ii.2001; J. Cantillo; M.1283; IAVH.

Paratypes: Colombia • 1 \bigcirc ; same collection data as holotype; IAVH • 1 \circlearrowright , 2 \bigcirc \bigcirc ; same collection data as holotype; 30.iii.–05.v.2001; 2200 m; M.1749; IAVH • 2 \bigcirc \bigcirc ; same collection data as preceding; EMUSENT00004004, EMUSENT00004180 • 1 \bigcirc ; Magdalena, PNN Santa Marta, El Ramo; 2400m; 10°48'N, 73°39'W; 25.v.–09.vi.2000; I. Uribe; IAVH • 1 \circlearrowright ; Magdalena, PNN Santa Marta, El Ramo, La Estacion; 2200 m; 10°46' N, 73°39' W; 31.vii–15.viii.2000; J. Cantillo; M. 603; IVAH • 1 \circlearrowright ; same collection data as preceding; 15–31.viii.2000; M. 606; EMUSENT00004559 • 2 \circlearrowright \circlearrowright ; same collection data as preceding; 31.viii.–15.ix.2000; M. 633; IAVH • 3 \circlearrowright \circlearrowright ; same collection data as preceding; EMUSENT00005148, EMUSENT00004769.

Non-type material: 1⁽²⁾; Boyaca, SFF Iguaque, Lagunillas; 2855m; 5°25'N, 73°27'W; 28.iii.-16.iv.2001; P. Reina; M. 1515; IAVH.

Distribution. All but one specimen was collected at the type locality in the Sierra Nevada de Santa Marta National Natural Park (PNN Santa Marta) (Fig. 12). The only specimen not from this locality was apparently collected in the Iguaque Flora and Fauna Sanctuary (SFF Iguaque) which was extensively sampled by Malaise trapping for several years. Due to the geographic isolation of the Sierra Nevada de Santa Marta mountain range and the high levels of endemicity in the native fauna (Todd & Carriker 1922; Hernández-Camacho *et al.* 1992), the record from SFF Iguaque is suspect and has been excluded from the distribution map. It may be the result of mislabeling during mounting or mishandling the Malaise trap samples. Alternatively, the specimen may have indeed been collected in SFF Iguaque which further sampling of the region could corroborate.

Etymology. The species name refers to the type locality and honors the indigenous Kogi community that live within the Sierra Nevada de Santa Marta National Natural Park. Specifically Gonawindua is the place name used for Pico Cristóbal Colón and a general term for the surrounding region by the Kogi people.

Jethsura pyriformis (Provancher)

Figs 5–6, 11

Ischnus pyriformis Provancher, 1875: 109. Lectotype: Q [University of Laval Entomology Collection, Quebec, Canada]: Designated by Gahan & Rohwer (1917). Not examined.

Jethsura ferruginea Cameron, 1902: 374. Holotype: ♀ [Natural History Museum, London, UK]: Synonymized by Townes (1961). Not examined.

Diagnosis. Among *Jethsura* species, *J. pyriformis* is immediately recognizable by the overall brownish-red color, whereas at least the head and mesosoma are black in other species. *Jethsura pyriformis* shares a striking superficial resemblance to an undescribed *Stenodontus* species that it co-occurs with in southeastern Arizona. *Jethsura pyriformis* can be differentiated from this undescribed *Stenodontus* by the anterior constriction of T6 and the shorter first flagellomere in females, and the bidentate mandible with a highly reduced ventral tooth in both sexes. In *Stenodontus*, the mandible is always unidentate without a trace of a ventral tooth.

Description. Female (Fig. 5A-H). Body length: 8.0-9.9 mm; fore wing length: 4.4-5.3 mm.

Color. Overall brownish-red with highly variable yellowish marks on mesosoma and black along mesosomal sclerite margins. Head brownish-red, except for dark red mandibular apex, medial paraocular area varying from yellowish to brownish-red and supra-antennal area infrequently (5% of specimens) dark brown to black medially. Antenna: scape and pedicel brownish-red; F1/2 usually anteriorly brownish-red and brown posteriorly, infrequently entirely black; F2/3–F6/8 black; F7/8–12/13 yellow-white to yellow; F13/14–28/29 black. Mesosoma brownish-red, except the following areas yellowish to varying degrees: anterior margin of pronotum with yellowish color stronger anteriorly, posterodorsal corner of pronotum, subalar ridge, and scutellum; approximately 10% of specimens with these areas entirely brownish-red. Legs brownish-red, except for approximately 20% of specimens with fore and middle coxae yellowish anteriorly and tarsomere 5 of fore, middle and hind legs dark brown. Metasoma brownish-red. Wing: membrane clear; basal 0.1–0.2 of wing with veins white, remaining sections brown.

Head. Head subquadrate. Mandible moderately wide (MI: $\sim 3.0\times$). Clypeus smooth and coarsely punctate with punctures separated by $0.5-1.0\times$ their diameter. Supraclypeal area densely, coarsely punctate with punctures separated by $0.2-0.5\times$ their diameter laterally, sparser and finer medially. Gena smooth and finely punctate with punctures separated by $1.5-3.0\times$ their diameter, denser posteriorly. Supra-antennal area smooth and densely, finely punctate with punctures separated by $0.2-0.8\times$ their diameter. Vertex smooth and finely densely punctate medially becoming sparse laterally. Hypostomal and occipital carinae meeting at or slightly before mandibular base. Antenna with 28–29 flagellomeres.

Mesosoma. Of normal width, not laterally flattened. Dorsal 0.5 of pronotum smooth and densely punctate at margins, ventral 0.5 rugulose-punctate. Propleuron smooth and finely, densely punctate with punctures subadjacent. Mesonotum smooth, anterior 0.3 finely, densely punctate becoming denser and indistinct anteriorly, remainder densely punctate with punctures separated by 0.2–1.0× their diameter. Scutellum smooth and moderately punctate with punctures adjacent to sub-adjacent, some confluent forming transverse rugulae, sparser on speculum. Ventral division of metapleuron densely punctate with punctures adjacent to subadjacent. Propodeum: of normal width, slightly wider than long; weakly rounded mediolaterally; dorsal face densely punctate to partially rugulose-punctate laterally becoming smooth or coriaceous anteromedially; posterior face densely rugulose-punctate; pleural carina well-developed, remainder obsolete to subobsolete except for median longitudinal carina well-developed posteriorly and posterior transverse carina well-developed laterally. Legs of normal length. Hind femur normal, not anteroposteriorly flattened.

Metasoma. MS1 smooth and varying from sparsely punctate to moderately punctate, usually with postpetiole sparser. T2 smooth and densely punctate with punctures separated by $0.5-1.0\times$ their diameter, posterior margin

impunctate. T3–7 densely punctate, except for impunctate posterior margins and becoming smoother at posterior tergites. Gastrocoelus varying from shallow to well-developed. Thyridium subobsolete; narrow, $0.4-0.5 \times$ as wide as interthyridial width; distant from T2 anterior margin by $0.2-0.3 \times$ tergite length.



FIGURE 5. *Jethsura pyriformis* (Provancher) female (EMUSENT00005002). A. Habitus. B. Mesosoma, lateral view. C. Head, frontal view. D. Mandible, venterolateral view. E. Propodeum, dorsolateral view. F. MS1–2, dorsolateral view. G. Metasomal apex, lateral view. H. Metasoma, dorsal view. Scale bars: 5.0 mm (A); 1.0 mm (B–H).

Male (Fig. 6A–C). Body length: 7.3–9.6 mm; fore wing length: 4.6–5.9 mm. As in female, except for: head yellow with supra-antennal area black medially, gena varying from yellow with posterior margin reddish-brown to nearly entirely reddish-brown, and occiput black; yellowish-white markings on mesosoma much more extensive with the entirety of ventral and dorsal margins of pronotum, subalar ridge, and tegula yellowish-white; propleuron and anterior 0.2 of mesopleuron usually yellowish-white and propodeum usually with posterior submedial yellow-ish-white marks; black areas around mesosomal sutures more extensive and pronotum medially black; head wider than in female; clypeus narrower than female.



FIGURE 6. *Jethsura pyriformis* (Provancher) male EMUSENT00004746. A. Habitus. B. Head, frontal view. C. Mandible, ventral view. Scale bars: 5.0 mm (A); 1.0 mm (B–C).

Material examined. Non-type material: See supplementary file.

Distribution. Widely dispersed in the Nearctic region from Newfoundland, Canada to Saltillo, Mexico and from the eastern seaboard to central Colorado and southeastern Arizona (Fig. 11).

The presence of *J. pyriformis* in the Palearctic should be considered with caution. Two specimens identified by Erich Diller were reported from Hirvensalmi and Tuusula, Finland by Ranin (1982). Only the former specimen could be found at the Finnish Museum of Natural History (J. Paukkunen pers. comm.) and its identity as *J. pyriformis* was confirmed via examination of the specimen images. Given the occurrence of *J. pyriformis* as far north as Newfoundland, Canada, it is plausible that it may occur in Finland, although the lack of further specimens (E. Diller pers. comm.) collected in recent decades may indicate that the Finnish specimens were part of an adventive population that has since been extirpated.

Comments. *Jethsura pyriformis* exhibits considerable chromatic variation in both males and females but particularly in the former. In males, the black areas along the mesosomal sutures and the yellowish-white markings are especially variable. The extent of these black and yellowish-white markings is negatively correlated. For instance, one exceptional male has a predominantly black mesosoma with the typical yellowish-white markings replaced by brownish-red markings. More frequently, males are overall lighter in color with yellowish-white markings more extensive and occasionally with yellowish-white marks appearing in irregular places like the third lateral area of the propodeum. Despite the range of *J. pyriformis* spanning over 25 degrees of latitude, no geographic signal in either color or size was observed.

Jethsura rubricauda sp. nov.

Figs 7–8, 11 urn:lsid:zoobank.org;act:82464EA0-0266-49CA-89F5-07BB00DC0182

Diagnosis. Easily differentiated from other known *Jethsura* species by the black head and mesosoma and brown-ish-red metasoma.

Description. Female (Fig. 7A–H). Body length: 8.0–8.1 mm; fore wing length: 4.8–4.9 mm.

Color. Black head and mesosoma with limited yellowish-white to yellowish marks and brownish-red metasoma. Head black, except for mandible dark brownish-red with darker base and paraocular area yellowish-white medially from antenatal base to median ocellus and posterodorsal corner, in one specimen the left side with paraocular area venteromedially ventral to antennal base yellowish and venterolateral corner with faint impression of yellowish mark. Antenna black. Mesosoma black, except for the following areas yellowish-white: medial 0.3 of ventral margin of pronotum, posterior 0.8 of dorsal margin of pronotum, tegula, and small mark on subalar ridge. Legs: coxae, trochanters, and trochantelli dark brown to black; fore femur anteriorly with basal 0.3 dark brown and apical 0.7 brownish-yellow, posteriorly dark brown; mid and hind femur dark brown except, for brown apex; fore and mid tibiae anteriorly brownish-yellow, posteriorly yellowish-brown to brown; hind tibia reddish-brown at base becoming dark brown apically; tarsi with tarsomeres 1–4 reddish-brown and tarsomere 5 dark reddish-brown, tarsomeres 1–4 of hind tarsus lighter basally. Metasoma reddish-brown, except for holotype with large mottled brownish mark on T2. Wing: membrane clear; basal 0.1–0.3 of wing with veins white, remaining sections brown.

Head. Slightly tapering ventrally. Mandible moderately wide (MI: $\sim 3.1\times$). Clypeus smooth and coarsely punctate with punctures separated by $0.5-1.5\times$ their diameter. Supraclypeal area densely punctate with punctures adjacent forming transverse rugulae dorsally, punctures becoming coarser and sparser laterally. Gena smooth and finely punctate with punctures separated by $2.0-4.0\times$ their diameter, denser posteriorly. Supra-antennal are smooth and moderately punctate with punctures separated by $0.5-1.5\times$ their diameter. Vertex smooth and finely punctate with punctures separated by $1.0-3.0\times$ their diameter, denser medially. Hypostomal and occipital carinae meeting immediately before mandibular base. Antenna with 26 flagellomeres.

Mesosoma. Of normal width, not laterally flattened. Pronotum smooth and moderately punctate with punctures sparser anterodorsally, coarser ventrally. Propleuron smooth and finely, densely punctate with punctures separated by $0.5-1.0\times$ their diameter. Mesonotum smooth and sparsely punctate with punctures separated by $1.0-3.0\times$ their diameter, anterior 0.1 with punctation denser. Scutellum smooth and sparely punctate with punctures separated by $2.0-4.0\times$ their diameter. Mesopleuron smooth and densely punctate, dorsal 0.3 with punctures separated by $0.5-1.0\times$ their diameter. Speculum finely and sparely punctate, ventral 0.6 denser with punctures adjacent to subadjacent and some confluent forming longitudinal rugulae. Ventral division of metapleuron smooth coarsely, densely punctate with punctures subadjacent, posteriorly some punctures confluent and forming rugulae. Propodeum: of normal width, nearly equal in length and width; dorsal face moderately convex, surface sculpture smooth and coarsely, punctation sparser medially; posterior face punctate-rugose; carinae obsolete, except for pleural carina posterior transverse carina well-developed, median longitudinal carina posterior to posterior transverse carina subobsolete. Legs of normal length. Hind femur normal, not anteroposteriorly flattened.

Metasoma. MS1 smooth, postpetiole moderately, coarsely punctate laterally and impunctate to sparsely punctate medially. T2 smooth and finely to moderately punctate with punctures separated by $1.0-4.0\times$ their diameter, sparser posteriorly. Gastrocoelus shallow, subobsolete. Thyridium essentially obsolete, only indicated by faint impression; narrow, $0.2-0.3\times$ as wide as interthyridial width; distant from T2 anterior margin by $0.2\times$ tergite length. T3 smooth and finely, sparsely punctate. T4–7 smooth and nearly impunctate except for very fine, shallow, sparse punctures.

Male (Fig. 8A–C). Body length: 8.0 mm; fore wing length: 5.5 mm. As in female, except for: yellowish-white or yellowish areas on head and mesosoma of female white in male; white marks on paraocular areas posteroventrally and posterodorsally; MS1 smooth and finely, densely punctate with punctation on postpetiole sparser medially; T2–7 finely, densely punctate with punctures separated by $0.5-1.0\times$ their diameter. Antenna with 29 flagellomeres.

Material examined. *Holotype*: Mexico • 19; Durango, 10 mi W El Salto; 9000 ft.; 12.iv.1964; W. R. M. Mason; CNCI.

Paratypes: Mexico • 1 \bigcirc ; same collection data as holotype; 23.vi.1964 • 1 \bigcirc ; same collection data as holotype; 07.vi.1965.

Distribution. Known only from type locality (Fig. 11).

Etymology. Formed by *rubri*- (Latin) meaning red and *cauda* (Latin) meaning tail and refers to the distinctive red metasoma.



FIGURE 7. *Jethsura rubricauda* **sp. nov.** female holotype. A. Habitus. B. Mesosoma, lateral view. C. Head, frontal view. D. Mandible, ventral view. E. Propodeum, dorsolateral view. F. MS1–2, dorsolateral view. G. Metasomal apex, lateral view. H. Metasoma, dorsal view. Scale bars: 5.0 mm (A); 1.0 mm (B–H).



FIGURE 8. *Jethsura rubricauda* **sp. nov.** male paratype. A. Habitus. B. Head, frontal view. C. Mandible, ventral view. Scale bars: 5.0 mm (A); 1.0 mm (B–C).

Jethsura serpentina sp. nov.

Fig. 9, 12 urn:lsid:zoobank.org:act:8007935D-B445-499E-93D2-888B5EAE9AF5

Diagnosis. *Jethsura serpentina* and a putative undescribed species from Valle de Frailejón in Chingaza National Natural Park (*Jethsura* sp. X) are both characterized by an elongated habitus, broad mandible, and laterally compressed mesosoma. As such, they are easily differentiated from other *Jethsura* species. *Jethsura serpentina* is distinguished from *Jethsura* sp. X by the entirely smooth and coarsely punctate mesopleuron. A few punctures are nearly confluent and form very weak rugulae but the mesopleuron is never longitudinally rugulose as in *Jethsura* sp. X.

Description. Female (Fig. 9A-H). Body length: 8.9-9.4 mm; fore wing length: 5.1-5.4 mm.

Color. Primarily black with few yellow and yellowish-white markings and partially brownish legs. Head black, except for mandibular apex dark brownish-red, light yellowish along either entire length of medial paraocular area (25% of specimens) or interrupted ventral to antenatal base (50% of specimens) or absent ventral to antennal base (25% of specimens), and light yellowish ovoid to subtriangular marks at dorsolateral and venterolateral corners of paraocular area. Antenna: scape and pedicel black; flagellum black to dark brown basally, apical ³/₄ reddish-brown ventrally. Mesosoma black, except for the dorsal margin of pronotum, tegula, and subalar prominence yellowish-white, 25% of specimens with anterolateral yellowish-white marks on scutellum. Legs: coxae and trochanters black, 75% of specimens with fore and mid coxae brownish anterolaterally; femora dark reddish-brown with bases and apices light brown and apical 0.3–0.4 of fore and mid femora yellowish-brown anteriorly; tibiae brownish-red to reddish-brown with fore and mid tibiae lighter anteriorly; fore and mid tarsi brownish-red to reddish-brown; hind tarsomeres 1–4 reddish-brown to brownish-red and tarsomere 5 dark reddish-brown with bases yellowish-white becoming reduced toward apical tarsomeres. MS1 black. T2–varying from primarily black with minor, mottled light reddish-brown marks laterally to narrowly black dorsally and laterally light reddish-brown with mottled black marks. Wing: membrane clear; basal 0.2 of wing with veins white, remaining sections brown.



FIGURE 9. *Jethsura serpentina* **sp. nov.** female holotype. A. Habitus. B. Mesosoma, lateral view. C. Head, frontal view. D. Mandible, ventral view. E. Propodeum, dorsolateral view. F. MS1–2, dorsolateral view. G. Metasomal apex, lateral view. H. Metasoma, dorsal view. Scale bars: 5.0 mm (A); 1.0 mm (B–H).

Head. Distinctly longer than wide, not tapering ventrally. Mandible broad (MI: $\sim 2.1 \times$). Clypeus and supraclypeal area slightly convex in lateral view. Clypeus smooth and coarsely, sparsely punctate with punctures separated by 1.0–4.0× their diameter. Supraclypeal area smooth and coarsely punctate with 0.5–2.0× their diameter. Gena smooth and finely, sparsely punctate with punctures separated by $3.0-6.0\times$ their diameter. Supra-antennal are smooth and finely punctate with punctures separated by $0.5-1.0\times$ their diameter. Vertex smooth and finely, sparsely punctate with punctures separated by $3.0-5.0\times$ their diameter. Antenna with 23–24 flagellomeres.

Mesosoma. Narrow, elongated and laterally flattened. Dorsal 0.6 of pronotum smooth and finely, sparsely punctate with punctures denser at margins, anterior 0.4 rugulose. Propleuron smooth and finely, sparsely punctate with punctures separated by $3.0-6.0\times$ their diameter. Mesonotum smooth, very finely, sparsely punctate anteromedially, punctation denser and coarser laterally and especially dorsomedially. Scutellum smooth and sparsely punctate with punctures separated by $2.0-5.0\times$ their diameter. Mesopleuron smooth and punctation varying from sparse and fine anterodorsally becoming coarse and dense ventrally and posteroventrally to relatively coarse throughout with some punctures forming weak rugulae and denser ventrally and posteroventrally. Speculum smooth with at most a few scattered punctures. Ventral division of metapleuron smooth and coarsely, sparsely punctate anterodorsally becoming densely punctate posteroventrally. Propodeum: narrow and elongate, $1.4\times$ as long as wide; dorsal face strongly rounded transversely, surface sculpture smooth dorsally becoming coarsely punctate laterally and rugulose-punctate posterolaterally; posterior face densely rugulose-punctate; carinae obsolete. Legs short. Hind femur anteroposteriorly flattened.

Metasoma. MS1 anteriorly smooth and impunctate, postpetiole smooth and with a few scattered punctures medially becoming sparsely to moderately punctate laterally. T2 smooth and finely to moderately punctate with punctures separated by $0.5-2.0\times$ their diameter becoming sparser laterally and posteriorly. T3+ smooth and densely, finely punctate becoming obsolete posteriorly. Gastrocoelus shallow to moderately deep. Thyridium narrow, $0.5\times$ as wide as interthyridial width; distant from T2 anterior margin by $2.0-2.5\times$ thyridial length.

Male. Unknown.

Material examined. *Holotype*: Colombia • 1♀; Boyaca, SFF Iguaque, Lagunillas; 3380m; 5°25'N, 73°27'W; 09–24.ii.2001; P. Reina; M. 1272; IAVH.

Paratypes: Colombia • 1 \bigcirc ; same collection data as holotype • 1 \bigcirc ; same collection data as holotype; EMUSENT000003704 • 1 \bigcirc ; same collection data as holotype; 09–28.iii.2001; M.1511.

Distribution. Known only from type locality (Fig. 12).

Etymology. The species name is from the Latin adjective "*sepentinus*" meaning serpent-like and refers to the somewhat snake-like habitus.

Comments. The male of *J. serpentina* is unknown but could presumably be easily associated with the female at the type locality since *J. serpentina* and the putative undescribed species, *Jethsura* sp. X, are allopatric. Also, presumably the male of *J. serpentina* would be considerably elongated as in the female which would readily distinguish it from *J. euthenia* males.

Jethsura sp. X

Fig 10, 12

Diagnosis. This species is either closely related to or less likely conspecific with *J. serpentina*. They are nearly identical, except that in *Jethsura* sp. X the ventral 0.6 of the mesopleuron is longitudinally rugulose. The yellow markings on the head may be less extensive than in *J. serpentina* as well.

Comments. I have chosen to leave *Jethsura* sp. X undescribed, since an adequate description and images could not be provided. The lack of specimens also leaves some uncertainty as to whether *Jethsura* sp. X is conspecific or not with *J. serpentina*. The singleton representing this species was originally grouped with *J. serpentina* and was used in a whole-body DNA extraction. Upon further examination, the specimen was found to likely represent a new species. Unfortunately, the extraction process left it bereft of color and in a generally poor condition. Therefore, sufficient material was unavailable to provide a high-quality description and images.

Similar to *J. serpentina*, *Jethsura* sp. X was collected at high elevation above 3000 m. The collection data for the singleton of *Jethsura* sp. X are "Colombia, Cundinamarca, PNN Chingaza, Valle de Fraylejon, 4 31'N, 73 45'W, 3170m, 28.ii.–2.iii.2001, Elias & Amuifo, M. 1488".



FIGURE 10. *Jethsura* sp. X. A. Habitus. B. Mesosoma, lateral view. C. Head, frontal view. Scale bars: 5.0 mm (A); 1.0 mm (B–C).



FIGURE 11. Distribution of Jethsura pyriformis (Provancher) and Jethsura rubricauda sp. nov.



FIGURE 12. Distribution of *Jethsura euthenia* sp. nov., *Jethsura gonawindua* sp. nov., *Jethsura serpentina* sp. nov., and *Jethsura* sp. X.

Acknowledgments

I thank Juho Paukkunen of the Finnish Museum of Natural History for providing specimen images and Erich Diller of the Bavarian State Collection of Zoology for kindly noting that he has not seen additional European *J. pyriformis* specimens, besides those recorded by Ranin (1982). I thank Yanelia Mestre of the Organización Gonawindúa Tayrona for consenting to the use of Gonawindua as a species name. I would also like to thank John Jennings and David Wahl for their useful comments on the manuscript and my lovely wife, Olivia Claridge, for her assistance with the distribution maps.

References

- Bennett, A.M.R., Cardinal, S., Gauld, I.D. & Wahl, D.W. (2019) Phylogeny of the subfamilies of Ichneumonidae (Hymenoptera). *Journal of Hymenoptera Research*, 71, 1–156. https://doi.org/10.3897/jhr.71.32375
- Cameron, P. (1902) Descriptions of new genera and species of American Hymenoptera. *Transactions of the American Entomological Society*, 28, 369–377.
- Diller, E. (1981) Bermerkungen zur Systematik der Phaeogenini mit einem vorläufigen Katalog der Gattungen (Hymenoptera, Ichneumonidae). *Entmofauna*, 2, 93–111.
- Gahan, A.B. & Rohwer, S.A. (1917) Lectotypes of the species of Hymenoptera (except Apoidea) described by Abbé Provancher. *The Canadian Entomologist*, 49 (9), 298–308. https://doi.org/10.4039/Ent49298-9
- Heinrich, G.H. (1960) Synopsis of Nearctic Ichneumoninae Stenopneusticae with Particular Reference to the Northeastern Region (Hymenoptera): Part I Introduction, Key to Nearctic Genera of Ichneumoninae Stenopneusticae and Synopsis of the Protichneumonini North of Mexico. *Memoirs of the Entomological Society of Canada*, 92 (15) 5–87. https://doi.org/10.4039/entm9215fv

Hernández-Camacho, J.A., Hurtado-Guerra, R., Ortiz-Quijano, R. & Walschburger, T. (1992) Centros de endemismo en Colom-

bia. *In*: Halffter, G. (Ed,), *[La Diversidad Biológica de Iberoamérica]. Acta Zoológica Mexicana. Volume Especial 1992.* Instituto de Ecologia, A.C., Xalapa, Veracruz, pp. 175–190.

- Hinz, R. (1983) The biology of the European species of the genus *Ichneumon* and related species (Hymenoptera: Ichneumonidae). *Contributions of the American Entomological Institute*, 20, 151–152.
- Provancher, L. (1875) Les Ichneumonides de Québec. Naturaliste Canadien, 7, 109–121.
- QGIS Development Team. (2020) QGIS geographic information system. Open Source Geospatial Foundation Projects. Available from: http://qgis.osgeo.org (accessed 13 November 2021)
- Ranin, O. (1982) Zur Kenntnis der Phaeogenini-Fauna (Hymenoptera, Ichneumonidae) Finnlands. *Notulae Entomologicae*, 62, 147–150.
- Santos, B.F., Wahl, D.B., Rousse, P., Bennett, A.M.R., Kula, R. & Brady, S. (2021) Phylogenomics of Ichneumoninae (Hymenoptera, Ichneumonidae) reveals pervasive morphological convergence and the shortcomings of previous classifications. *Systematic Entomology*, 46, 704–724. https://doi.org/10.1111/syen.12484
- Selfa, J. & Diller, E. (1994) Illustrated key to the Western Palearctic genera of Phaeogenini (Hymenoptera, Ichneumonidae, Ichneumoninae). *Entmofauna*, 15 (20), 237–251.
- Todd, W.E. & Carriker, M.A. (1922) *The birds of the Santa Marta region of Colombia: a study in altitudinal distribution*. Carnegie Museum, Pittsburgh, 611 pp.

https://doi.org/10.5962/bhl.title.56257

- Townes, H.K. (1961) Annotated list of the types of Nearctic Ichneumonids in European museums. *Proceedings of the Washing*ton Academy of Sciences, 63, 103–113.
- Yu, D.S., van Achterberg, C. & Horstmann, K. (2016) Taxapad 2016. World Ichneumonoidea 2015. Taxonomy, Biology, Morphology and Distribution. Nepean, Ontario. [database on flash-drive]