Systematics of Moths in the Genus *Catocala* (Lepidoptera: Noctuidae). V. Neotypification of Names in the Nearctic Fauna

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Abstract

Nine previously published neotype designations in the noctuid moth genus *Catocala* are reviewed for compliance with the International Code of Zoological Nomenclature. Eight of the designations are found to have not fulfilled one (75.3.2) of the seven qualifying conditions of Article 75.3 when these were originally published, and are redesignated herein. The eight *Catocala* names involved are *connubialis* Guenée, *dollii* Beutenmüller, *grotiana* Bailey, *irene* Behr, *micronympha* Guenée, *stretchii* Behr, *texanae* French and *walshii* Edwards. The ninth neotype designation, for *calphurnia* Henry Edwards, is considered valid as originally published.

Keywords

Taxonomy, nomenclature, neotypes, noctuids, *Catocala*, Noctuidae, International Code of Zoological Nomenclature

Introduction

As part of ongoing revisionary work on moths in the erebid genus Catocala Schrank, we previously designated nine neotypes in three separate articles (Gall and Hawks 2002, 2010; Hawks 2010). In recent email discussions with International Commission on Zoological Nomenclature commissioners, it was noted to L. Gall that two of the designations appeared to be incomplete and hence invalid, and this in turn prompted scrutiny of all the designations. Herein, we present reassessments of those nine Catocala neotype designations, and republish those designations that did not satisfy all requirements of Article 75.3 of the International Code of Zoological Nomenclature (ICZN 1999) at the time of publication in Gall and Hawks (2002, 2010) and Hawks (2010).

Materials and Methods

In the first of the articles cited above we presented nomenclatural protocols for working with Nearctic *Catocala* types (Gall and Hawks 2002:234–238, 241–242, 253–256), including the recognition of type material, prioritization among available syntypes and invocation of procedures for particular authors/institutions that maximize fidelity to and harmonization with taxonomic decisions made by previous workers in the genus. Our general process for neotypification was stated in the context of an array of closely related species that feed as larvae on willows (*Salix*) and poplars (*Populus*) (Gall and Hawks 2002:234):

In most species of Nearctic *Catocala* there is complex individual variation in wing pattern, as well as parallel polymorphs that occur in both closely and more distantly related species.... Because these willow/poplar feeders also tend to have the most tangled nomenclatural histories, we feel it is imperative to fix all the involved names firmly. Thus, in this paper, we have designated a neotype for any available name that refers to a willow/poplar feeding taxon for which original type material is apparently no longer extant.

Three neotypes were hence designated in Gall and Hawks (2002) for the names *Catocala walshii* W.H. Edwards (1864), *C. connubialis* Guenée (1852) and *C. micronympha* Guenée (1852). The same nomenclatural protocols were referenced and followed in Gall and Hawks (2010) and Hawks (2010), in which an additional six neotypes were designated for *C. grotiana* Bailey (1879), *C. irene* Behr (1870), *C. stretchii* Behr (1870), *C. texanae* French (1902), *C. ophelia* var. *dollii* Beutenmüller (1907) and *C. calphurnia* Henry (Hy.) Edwards (1880).

Institutional abbreviations used are: AMNH, American Museum of Natural History, New York, New York, USA; ANSP, Academy of Natural Sciences of Philadelphia, Philadelphia, Pennsylvania, USA; CMNH, Carnegie Museum of Natural History, Pittsburgh, Pennsylvania, USA; NHM, Natural History Museum, London, United Kingdom; USNM, National Museum of Natural History, Smithsonian Institution, Washington, DC, USA; YPM ENT, Division of Entomology, Peabody Museum of Natural History, Yale University, New Haven, Connecticut, USA.

Neotype Designations

There are seven qualifying conditions to Article 75.3 that need to be met during neotypification. After reviewing these Catocala neotype designations, we consider that all nine designations fulfilled six of the seven conditions when originally published, viz., 75.3.1 and 75.3.3 to 75.3.7. We also consider that eight of the nine designations did not fulfill the conditions for 75.3.2 when originally published: "a statement of characters that the author regards as differentiating from other taxa the nominal species-group taxon for which the neotype is designated, or a bibliographic reference to such a statement" (ICZN 1999:84). Although the quote above implicitly indicates our process for neotypification was character based, each of the eight designations nevertheless did not explicitly discuss differentiating character(s). The one neotype designation we consider complete as published is that of C. calphurnia (Hawks 2010:16). The other eight neotype designations are discussed and republished below, in alphabetical order by taxon. We provide these eight neotype designations here for the express purpose of clarifying the taxonomic status of the respective names and for stabilizing the Nearctic Catocala nomenclature.

Catocala connubialis Guenée, 1852:105-106

The relevant publication history and rationale for neotype designation for *connubialis* was discussed

at length by Gall and Hawks (2002:257-259). A summary is as follows: Guenée's connubialis was based on a painting by the early American naturalist John Abbot; the identity of connubialis remained unresolved through the 1870s, despite the monographic works of Grote (1872), Strecker (1873-1877) and other early Catocala workers; Hulst (1884:34), citing a letter to him from A.G. Butler of the Natural History Museum, was the first to claim to know the identity of connubialis, and published the name sancta Hulst to replace it, erroneously believing that descriptions based on paintings were invalid; Hulst's lectotype of sancta at the American Museum of Natural History matches a specimen at the NHM marked in Butler's hand as type of the variety "Catocala/connubialis var./Type Walker"; Hulst's assessment of connubialis was subsequently followed, albeit grudgingly (see Smith 1893:334). We previously stated (Gall and Hawks 2002:259): "Because (a) no Abbot painting unequivocally attributable to connubialis has been located, (b) the original description of connubialis is also consistent with some infrapopulational morphs of Guenée's micronympha, (c) no type for micronympha has been located, and (d) the early Nearctic Catocala workers had trouble differentiating the small yellow-hindwinged species, we consider it essential to fix the name *connubialis* firmly." Despite the variable and partially overlapping wing patterns known for connubialis and micronympha, there are forewing characters that can be used for separation. First, the forewing postmedial band of micronympha has two distinct outwardly projecting and often prominently marked teeth at veins M1/M2 that are longer than the teeth elsewhere on the band, and the band above vein M1 to the costa is sharply offset basally; in connubialis all the teeth in the band are of more coequal length and prominence, and not sharply offset basally above vein M1. Second, the subterminal line in connubialis is typically boldly marked and edged with black from the anal angle through the costa (may be difficult to discern in infraspecific forms "pulverulenta" and "broweri"), with the teeth of coequal length; in *micronympha* the subterminal line is inconspicuous throughout, notably above vein M1 where a diffuse, wide, sinuous whitish shade occurs rather than defined teeth. Third, in micronympha the sinuous whitish shade above vein M1 typically contrasts with the surrounding



FIGURE 1. Neotype specimens for Nearctic *Catocala* moths along with their labels. **A**, *C. connubialis* Guenée (front of label, left; reverse of label, right). **B**, *C. dollii* Beutenmüller. **C**, *C. grotiana* Bailey. **D**, *C. irene* Behr. **E**, Additional label for *C. dollii* (front of label, left; reverse of label, right).

darker ground color; in *connubialis*, contrast with the ground color in that area is minimal and often lacking. The NHM specimen that we previously selected as the *connubialis* neotype has the forewing characteristics of *connubialis* as noted above, and to clarify application of the name we hereby designate it as NEOTYPE for *connubialis* Guenée and figure it along with its label (Figure 1A). The label reads: "United States/-? [and on the reverse:] Catocala connubialis var. / Type Walker." The type locality remains "Amerique septentrionale [southern USA]" per Guenée's original description because the neotype bears no more specific label data. We recognize *Catocala micronympha* Guenée as a distinct species.

Catocala ophelia var. dollii Beutenmüller, 1907:940

The relevant publication history and rationale for neotype designation for *dollii* was discussed briefly by Gall and Hawks (2010:50). The entire original description states "Male. - Head and thorax dark gray and considerably darker than in C. ophelia. Fore wings heavily overlaid with black scales, making the lines and spots less distinct than in C. ophelia. Subreniform pale, scaled with brown. Transverse lines the same as C. ophelia. Habitat - Colorado. A single specimen of this odd variety is in the collection of Mr. Jacob Doll." Barnes and McDunnough (1918) claimed to have figured the holotype, but the Doll specimen labeled as type at the Smithsonian's National Museum of Natural History is a female and bears a label written in 1932 by F.H. Benjamin stating "prob. spurious type." Benjamin apparently did not resolve this problem to his satisfaction as several other specimens at the AMNH and USNM bear labels written by him inquiring as to the status of the dollii holotype. Beutenmüller (1907: 939-940) correctly elevated ophelia Hy. Edwards from the synonymy of verrilliana Grote, and discussed characters distinguishing these two species, including the brown shading throughout the forewings and strongly marked, sinuate black postmedian band. However, the heavy black forewing scaling cited in the original description for dollii is sometimes seen in verrilliana as well as in a third species in this complex, C. violenta Hy. Edwards, which occurs in sympatry with both ophelia and verrilliana. Barnes and McDunnough (1918:37) discussed the nuances of separating these three species, even noting that the type of werneri Biedermann (placed as a synonym of verrilliana) had the hind wing pattern of verrilliana but a darkly shaded forewing more consistent with violenta; they further stated their "figure [of werneri] on plate VIII, figure 16 is not accurate, our own photograph giving a better idea of the maculation." We designated and illustrated the lectotype for werneri (Gall and Hawks 2010:74, fig. 45), and this specimen has heavy black scaling over much of the forewings. Moreover, recent molecular data suggest that there may be more than one species under the current concept of verrilliana (R. Borth and H. Kons, pers. comm.). These several issues underscore the importance of clarifying all names in this species complex. We previously selected for the dollii neotype the USNM female from Arizona labeled as type, and also as "prob. spurious type" by Benjamin. The forewings of this female do not have particularly heavy black scaling. Among the specimens at the

AMNH is a male from Colorado with more black scaling than the USNM female, and it also bears the longest and most detailed of the various labels written by Benjamin (see Figure 1E). This male exhibits the characteristics cited above for *dollii*, and to clarify application of the name we hereby designate it as NEOTYPE for *dollii* Beutenmüller and figure it along with its four labels (Figure 1B and E). The first three labels read: "Glenwood / Spgs, Col."; "Aug. / 16-23"; "O. Buchholz / Collection." The type locality is hereby modified from Colorado [USA] to Glenwood Sp[rin]gs, Colorado [USA] on the basis of the neotype labels. The name *Catocala dollii* Beutenmüller is a synonym of *Catocala ophelia* Hy. Edwards.

Catocala grotiana Bailey, 1879:21-22

The relevant publication history and rationale for neotype designation for grotiana was discussed briefly by Gall and Hawks (2010:50), wherein we stated: "We have been unable to locate a specimen labeled as type, and the Bailey collection is apparently lost. Although usage of the name grotiana has been largely consistent during the last century... the name refers to a member of the taxonomically difficult and variable western species...." Bailey's original description indicates, "...my specimen is a ♂ in good condition, and was taken in Colorado." The species with which grotiana can be confused is briseis W.H. Edwards, and the grotiana original description provided several distinguishing characters, notably: the white shading in the subterminal area on the forewing is conspicuous and much broader in grotiana than in briseis; the hind wing inner black band terminates before the anal angle in grotiana and extends there in briseis; the red ground color of the hind wings is distinctly more pink in grotiana than in briseis; and grotiana averages several millimeters larger in wingspan than briseis. There is relatively little sexual variation/dimorphism in either grotiana or briseis, and hence we had previously selected a female from the AMNH bearing only the label "Colorado" as neotype for grotiana. However, there is also a more comprehensively labeled male grotiana from Colorado at the AMNH and both specimens match the character differences noted above for grotiana. To clarify application of the name, we hereby designate the male as NEO- TYPE for *grotiana* Bailey and figure it along with its four labels (Figure 1C). The labels read: "Catoc. / Groteana. [sic] / Bailey"; "Edw Coll"; "No. 12652 / Collection / Hy. Edwards."; "Colorado." The type locality remains Colorado [USA]. We recognize *Catocala grotiana* Bailey as a distinct species.

Catocala irene Behr, 1870:24-25

The relevant publication history and rationale for neotype designation for *irene* was discussed by Gall and Hawks (2010:57). The original description states "Ft. Tejon, one specimen" (Behr 1870:24). Barnes and McDunnough (1918:22) stated, "According to Hy. Edwards, who had opportunities of examining the type specimen (since destroyed) the typical form is the one with rather even brown primaries...a specimen of this form, marked 'true to type,' exists in the Hy. Edwards' Collection in The American Museum of Natural History, New York." Henry Edwards (1880:56-57) described three varieties of irene (valeria Hy. Edw., volumnia Hy. Edw., and virgilia Hy. Edw.), the first two of which Barnes and McDunnough treated, respectively, as a race and possible race or full species. Among the western willow/poplar-feeding species, the substantial brown shading on the forewings separates *irene* from californica Edw., cleopatra Strecker, and semirelicta Grote. Although some specimens of irene with ochre rather than brown shadings are lighter and similar to faustina Strecker, the following differences occur: the forewings of irene lack both the pinkish suffusion and raised scales commonly found on *faustina*; the forewings of *faustina* are thinner and more elongated compared to irene; the margins of the hind wing black bands are more scalloped in *irene* than in *faustina*; and the hind wing red ground color tends toward orange in *irene*, and toward pink in *faustina*. In discussing volumnia, Barnes and McDunnough (1918:22) stated, "we have similar ones before us from San Diego County and it is possible that these may be closer to the typical form, described from Fort Tejon, San Bernardino County, California, than those identified as such by Henry Edwards, whose material came largely from Mendocino County, California, a much more northern locality" (note that in the 1800s, Ft. Tejon was located near the extreme western edge of San

Bernardino County, in what is now Kern County). The specimen we previously selected as neotype for irene was the AMNH male marked "true to type" and collected in Mendocino, California, but given the comments by Barnes and McDunnough, we here select a male from Yale Peabody Museum of Natural History collected in Lebec, California (the existing town near the site of Ft. Tejon). The Yale Peabody Museum male (catalog no. YPM ENT 778772) shows the characteristics for *irene* as noted above, and to clarify application of the name we hereby designate it as NEOTYPE for irene Behr and figure it along with its label (Figure 1D). The label reads "July 7, 1929 / Lebec, Calif / Kern Co." The type locality is hereby amended from Ft. Tejon [California, USA] to Lebec, Kern Co[unty], Calif[ornia, USA] on the basis of the neotype label. We recognize Catocala irene Behr as a distinct species.

Catocala micronympha Guenée, 1852:102

The relevant publication history and rationale for neotype designation for micronympha was discussed at length by Gall and Hawks (2002:260). A summary is as follows: no Guenée specimens labeled by him as *micronympha* have been located in institutional collections, but several Guenée specimens of micronympha do exist that are labeled by him with other names (e.g., amasia J.E. Smith); the identity of *micronympha* remained unresolved through the 1870s, despite the monographic works of Grote (1872), Strecker (1873-1877) and other early Catocala workers; Hulst (1884:34) was the first to claim to know the identity of micronympha, listing fratercula Grote as a synonym, but offering no justification for this placement of micronympha, stating only "an extraordinarily variable species, atarah [an unavailable infrasubpecific name] is slightly lighter than type form"; Hulst's placement of micronympha was correctly protested by Grote (1891:281) but nevertheless used in Smith's (1893:332-333) catalogue and subsequently in the literature. We previously stated (Gall and Hawks 2002:260): "Because (a) we have not located the *micronympha* holotype, (b) Hulst's placement of micronympha was made without substantiating published evidence, (c) the original description of micronympha is consistent with some infrapopulational morphs of connubialis, and (d) the early Nearctic Catocala workers



FIGURE 2. Neotype specimens for Nearctic *Catocala* moths along with their labels. **A**, *C. micronympha* Guenée. **B**, *C. stretchii* Behr. **C**, *C. texanae* French. **D**, *C. walshii* Edwards.

had trouble differentiating the small yellow-hindwinged species, we consider it essential to fix the name micronympha firmly." In the neotype designation for *connubialis* appearing earlier in this paper, we described forewing characters that separate micronympha and connubialis. The specimen at the AMNH that we previously selected as neotype shows the forewing characteristics of micronympha as noted earlier, and to clarify application of the name we hereby designate this specimen as NEOTYPE for micronympha Guenée and figure it along with its label (Figure 2A). The label reads "USA: Georgia: Liberty Co. / St. Catherines Island / May, 1991 / Rozen, Quinter & Sharkov." The type locality is hereby amended from Amerique Septentrionale (= southern USA) to S[ain]t Catherines Island, Liberty Co[unty], Georgia, USA, on the basis of the neotype label. We recognize Catocala micronympha Guenée as a distinct species.

Catocala stretchii Behr, 1870:24

The relevant publication history and rationale for neotype designation for stretchii was discussed by Gall and Hawks (2010:69-70). The original description states "One specimen, collected by Mr. Stretch, at Virginia City." Barnes and McDunnough (1918:30) indicated "The type of stretchi being lost, there only remains a specimen in the H. Edwards collection marked 'true to type'; this, however is from Havilah, Kern County." They compared this "true to type" specimen at the AMNH to others from Truckee, California, as well as specimens of portia Hy. Edw. and sierrae Beutenmüller, and concluded that all were conspecific; in turn, these are all synonyms of junctura Walker (see Gall and Hawks 2002, 2010). In junctura, the hind wing black band tapers at its distal end and commonly terminates in a prominently upturned "hook," and, in the

central Sierras, this character in conjunction with the larger wingspan and typically evenly mousy gray forewings can be used to separate junctura from other western willow/poplar-feeding species. The specimen we previously selected as neotype for stretchii was the AMNH female marked "true to type," from Havilah, California, but we here select a male from YPM collected in the mountains immediately above the historic type locality of Virginia City, Nevada. This YPM male (catalog no. YPM ENT 778780) shows the characteristics cited above for junctura and is similar to the "true to type" specimen, and to clarify application of the name we hereby designate it as NEOTYPE for stretchii Behr and figure it along with its label (Figure 2B). The label reads "NEVADA: Storey Co. / Ophir Grade, 6500 ft / 23-VII-1966." The type locality is hereby amended from Virginia City [Nevada, USA] to Ophir Grade, Storey Co[unty], Nevada [USA], on the basis of the neotype label. The name Catocala stretchii Behr is a synonym of Catocala junctura Walker.

Catocala texanae French, 1902:98

The relevant publication history and rationale for neotype designation for *texanae* was discussed by Gall and Hawks (2010:70). The original description of *texanae* appeared at the end of a paper otherwise focused on yellow-hind winged species of Catocala, and stated: "Before closing this I want to speak of the Junctura group. The more I see of the Arizona specimens, the more satisfied I am that the Texan form is separate from both that occur in Arizona. There are two forms there: one that is even reddish gray, that should be known as Babayaga, Strecker; the other one is a more broken light and dark reddish gray, and this is Arizonae, Grote. The Texan form is a larger insect than either of the Arizona forms, of an even greenish gray, and may be known as Texanae." No types of texanae are known, and French likely never labeled any specimens as type. His statement above does not allow discrimination of *babayaga* from *arizonae* (= *junctura*), but it nominally serves to separate *texanae* from the other two taxa. The species with which texanae can be most readily confused is junctura. However, in texanae the wingspan averages slightly larger than junctura, and the forewing ground color of texanae is dusted with blue/green, unlike junctura (or babayaga).

Additionally, the forewing maculation of texanae is more obscure than in many specimens of junc*tura*, giving *texanae* an indistinct and "fuzzier" appearance, and where both species co-occur the hind wing black band tends to be proportionately slimmer than in junctura. The YPM female (catalog no. YPM ENT 719311) that we previously selected as neotype for texanae exhibits the characteristics of texanae as noted above, and to clarify application of the name we hereby designate it as NEOTYPE for *texanae* French and figure it along with its two labels (Figure 2C). The labels read: "Uvalde Co / Texas"; "Catocala / texanae / French / Det. / A. E. Brower 1941." The locality is hereby amended from Texas [USA] to Uvalde Co[unty], Texas [USA], on the basis of the neotype labels. We recognize Catocala texanae French as a distinct species.

Catocala walshii W.H. Edwards, 1864:509-510

The relevant publication history and rationale for neotype designation for walshii was discussed by Gall and Hawks (2002:240-241). The original description is vague, with the comment on the forewings being the least ambiguous: "Expands three inches. Primaries yellowish brown, clouded between the transverse lines with grey; markings indistinct, but similar to unijuga "The generalized original description and the inability to locate type material proved problematic to the early Catocala workers, with Grote's (1873:163) comment being representative: "Catocala Walshii, Edwards, is still unknown to me. I believe the types perished in the Chicago fire. It must be nearly allied to unijuga. Mr. Edwards' description of the fore wings...is not exhaustive, but it contains nothing contradicting Walker's description of junctura." Grote's (1873) statement is the origin for subsequent placement of walshii as a synonym of junctura (see, e.g., Hulst 1884:48), and later Grote (1883:12) elaborated in further detail his reasons for considering walshii conspecific with junctura, and discussed the persistent confusion of identifications in this species complex. Smith's (1893:346) comment that *junctura* "has made as much bad blood as almost any other American noctuid, and even now the synonymy above given will probably be questioned by some" remains apt to this day, and underscores the need for clarification of all names in this group. Cresson claimed to have presented types of walshii to the American Entomological Society in 1879, but if true, these are either not readily identifiable among specimens at the Academy of Natural Sciences of Philadelphia and Carnegie Museum of Natural History or are no longer extant, and the current location of other Edwards types similarly remains uncertain (see discussion in Gall and Hawks 2002:235–238, 240). Assuming the type locality of "Taken by Mr. B. D. Walsh in Southern Illinois" is accurate (Edwards often did not clearly delimit type localities, and, for example, the type locality stated for marmorata Edwards is demonstrably in error by more than 1,500 km), this narrows the possible identity of walshii to four comparably sized species: unijuga Walker, meskei Grote, parta Guenée and junctura. Among these four species, only junctura consistently exhibits yellowish brown coloration in the forewings. The specimen we previously selected as neotype for walshii was an old male at ANSP without locality information (in addition, due to an inadvertent error in digital assembly of plates, the specimen shown as the walshii neotype in Gall and Hawks 2002:238, fig. 1h is not the specimen that had been selected as neotype [fig. 1h is a specimen of texanae with an identical label]). Given the geographic complications, we here select a male from YPM known to have been collected in southern Illinois, at Elsah. This specimen shows the characteristics for walshii as noted above, and to clarify application of the name we hereby designate it as NEOTYPE for walshii Edwards and figure it along with its label (Figure 1D). The label reads "ELSAH, ILL. / VIII-13-38. / C. L. REMING-TON." The type locality is hereby amended from Southern Illinois [USA] to Elsah [Jersey County], Ill[inois, USA], on the basis of the neotype label. The name Catocala walshii Edwards is a synonym of Catocala junctura Walker.

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Literature Cited

- BAILEY, J.S. 1879. Catocala grotiana, n. sp. North American Entomologist 1:21–22.
- BARNES, W. AND J. MCDUNNOUGH. 1918. Illustrations of the North American species of the genus *Catocala*. Memoirs of the American Museum of Natural History 3:1–47.
- BEHR, H. 1870. Synopsis noctuidarum hucusque in California repertarum. Transactions of the American Entomological Society 3:23–28.
- BEUTENMÜLLER, W. 1907. New forms of Catocala. Bulletin of the American Museum of Natural History 23:935–940.
- EDWARDS, H. 1880. Notes upon the genus *Catocala*, with description of new varieties and species. Bulletin of the Brooklyn Entomological Society 3:53–62.
- EDWARDS, W.H. 1864. Descriptions of certain species of *Catocala*, found within the United States. Proceedings of the Entomological Society of Philadelphia 2:508–512.
- FRENCH, G.H. 1902. The yellow-winged species of Catocalae. Canadian Entomologist 34:95–98.
- GALL, L.F. AND D.C. HAWKS. 2002. Systematics of moths in the genus *Catocala* (Lepidoptera: Noctuidae). III. The types of William H. Edwards, Augustus R. Grote, and Achille Guenée. Journal of the Lepidopterists' Society 56:234–264.
- —2010. Systematics of moths in the genus *Catocala* (Lepidoptera, Erebidae). IV. Nomenclatorial stabilization of the Nearctic fauna, with a revised synonymic check list. ZooKeys 39:37–83.
- GROTE, A.R. 1872. On the North American species of Catocala. Transactions of the American Entomological Society 4:1–20.
- -1873. On the genus Catocala. Canadian Entomologist 5:161-164.
- —1883. New species and notes on structure of moths and genera. Canadian Entomologist 15:3–13, 23–31.
- —1891. On Catocala flebilis and C. fratercula. Canadian Entomologist 23:281.
- GUENÉE, A. 1852. Histoire Naturelle des Insectes. Species Général des Lépidoptères, Volume 7. Noctuelites, Volume 3. Paris: Roret. 442 pp.
- HAWKS, D.C. 2010. Review of the Catocala delilah species complex (Lepidoptera, Erebidae). ZooKeys 39:13–35.
- HULST, G.D. 1884. The genus *Catocala*. Bulletin of the Brooklyn Entomological Society 7:14–56.
- [ICZN] INTERNATIONAL COMMISSION ON ZOOLOGICAL NOMEN-CLATURE. 1999. International Code of Zoological Nomenclature. 4th ed. Padova, Italy: Tipografia La Garangola. 306 pp.
- SMITH, J.B. 1893. A catalogue bibliographical and synonymical of the species of moths of the lepidopterous superfamily Noctuidae found in boreal America. Bulletin of the United States National Museum 44:1–424.
- STRECKER, F.H.H. 1873–1877. Lepidoptera, Rhophaloceres and Heteroceres, indigenous and exotic; with descriptions and colored illustrations. Reading, PA: Owen's Steam Book & Job Printing. 143 pp.