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REVISION OF NORTH AMERICAN *Colias hecla* LÉFEBVRE (Pieridae: Coliadinae)¹

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INTRODUCTION

This paper is a sequel to an earlier one (Ferris, 1981) in which preliminary comments were made about the distribution and subspecies of *Colias hecla* Lefebvre in North America. Herein these matters are now explored in detail and a new subspecies is described.

Colias hecla is a circumpolar species and both its distribution and taxonomy in North America have been in doubt for some time. Various forms of both *Colias alexandra* W. H. Edwards and *C. meadii* W. H. Edwards have been confused with *hecla* in southern Canada where their respective ranges overlap. This has led to erroneous records of *alexandra* and *meadii* from the high Arctic, and *hecla* from Wyoming. The currently known distribution of the various forms of *hecla* throughout North America is presented in Fig. 69.

Colias hecla is phenotypically very variable. Females are dimorphic and the "alba" form occurs frequently in some populations. Normal dorsal wing ground color is orange to yellow-orange, with black borders. Females of the "alba" form may have white or greenish-white as the wing ground color, or the ground may be tinted by orange, pink, or yellow. Ventrally the ground color in both sexes appears yellowish-green with varying amounts of melanic overscaling. Thus the color may vary from a bright yellow-green through bright moss-green and olive to a very dusky moss-green.

The two most variable characters are the DFW cell spot, shown in Fig. 1, and the VHW discal spot, shown in Fig. 2. The DFW cell spot varies more in the males than the females. It is generally pale, frequently red-orange colored, and varies in shape from crescentric to triangular. It may be absent in some specimens. In the females, this spot

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is normally black and pronounced, circular or elliptical in shape, and may have a light "pupil". The VHW discal spot varies equally in both sexes. It is frequently double, and is ringed by pink scales, usually produced distally as a pointed smear.

We now examine each of the taxa assigned to North American *hecla*. The remainder of this paper is devoted to taxonomic discussions, distribution data, and separation of *hecla* from similar species.

***Colias hecla hecla* Lefèbvre, 1836**

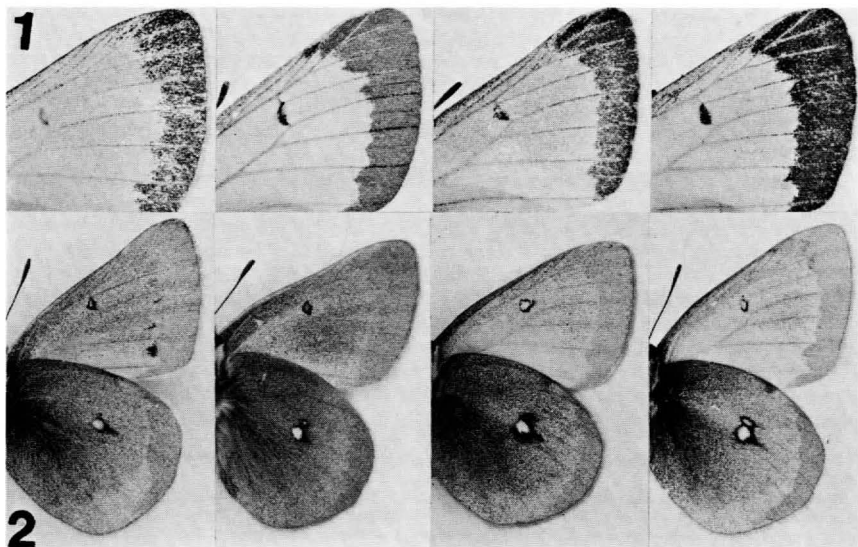
Original Description: Ann. Soc. Entomol. de France, 5: 383-387, 1836.

Type Locality and Location of Type: The type locality of *hecla* is slightly clouded. Contemporary authors state Greenland, while Lefèbvre clearly stated Iceland ("l'Islande") in the original description of the taxon. Perhaps Wolff (1964, p. 16) is correct in stating: "Greenland is the type locality of this species, although LEFEBVRE [sic] — not being familiar with geographical details of remote regions like these — named it after a volcano in Iceland." The location of the Holotype is unknown. It is not in Paris at the Muséum National d'Histoire Naturelle. Lefèbvre's collection was sold by a Parisian dealer in December, 1869 and the specimens are now scattered (*fide* Dr. Pierre E. L. Viette). I have made no further attempt to locate the Holotype, since it is not essential to the present discussion.

Freely translated from the French, the original description reads:

"Male. Dorsally the four wings are tawny-yellow which brightens and changes to sulfur-yellow along the costa of the FW, as well as along the anterior margin and base of the HW. Each wing is black-bordered; overscaled with yellow and finely interrupted by this color along the veins. There is a small black crescent on the FW disc, and a small tawny-rose orbicular spot on the HW disc. The base of each wing is overscaled with black, with some yellow hairs, and the fringe, of which the base is sulfur-yellow, is laved with pink from the apex to almost the sixth vein of the FW, and from the fifth vein almost to the anal angle on the HW.

"Ventrally the four wings are sulfur-yellow finely overscaled with black, which makes them appear greenish, with the exception of the base of the FW, which is pure yellow. The FW costa is bordered with pink and the disc marked by a small white-pupiled black spot, while on the VHW disc there is a small irregular ferruginous spot surcharged with



Figures 1-2: Variation in *Colias hecla* of DFW cell spot (1) and VHW discal spot (2).

a yellowish-white spot. There is a series of clear yellow spots along the terminal borders of the four wings which are hardly seen against the background. Finally the fringe is half pink and half yellow as above.

"The antennae are ferruginous-red, with brown clubs and tawny tips above and entirely ferruginous below.

"The hairs which cover the head and those of the collar are rose-violet. The rest of the corselet and abdomen is black and adorned with long whitish or yellowish hairs. The palpa and underside of the body are yellowish-greenish, as are the thighs [sic]. The legs and tarsae are pink.

"Female. Dorsally the FW are tawny-yellow overscaled with black along the costa and at the base only, with black veins; the HW are equally tawny, but completely overscaled with black, with the exception of the abdominal border, which is sulfur-yellow. The four wings are terminated by a blackish band marked by several sulfur-yellow spots, numbering seven on the FW and four on the HW. There is a tawny-pupiled large black FW discal cell spot, and a bright orange large irregular HW cell spot.

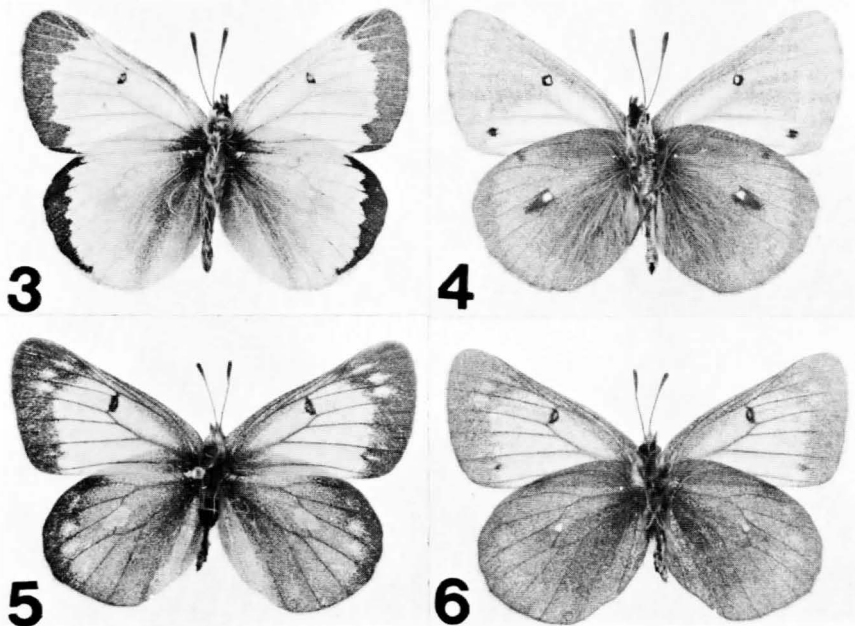
"Ventrally the FW are bright fulvous, with the costa and base greenish or sulfur-yellow overscaled with black, and a large terminal band of the same color, on which one sees weakly repeated the dorsal spots, the last of which is accompanied by a black spot. The veins are black, and the disc is also marked, as dorsally, by a yellow-pupiled black spot.

"The entire VHW is greenish or sulfur-yellow overscaled with black, with a ferruginous discal spot, of which the upper part is marked by a large opaque white dot, accompanied by a much smaller and hardly visible one.

"The fringe of the four wings is entirely pink as before in the males.

"The antennae, head, palpi, body and feet are as in the male."

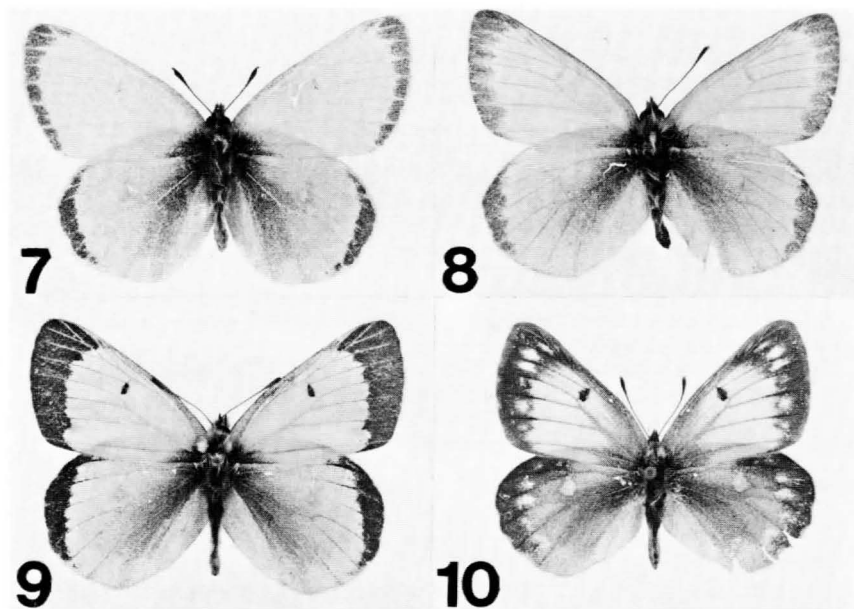
Figs. 3-6 illustrate a typical pair of *hecla* from Greenland. The dorsal ground color can be characterized as lying between Spectrum Orange and Orange Yellow (Smithe #17,



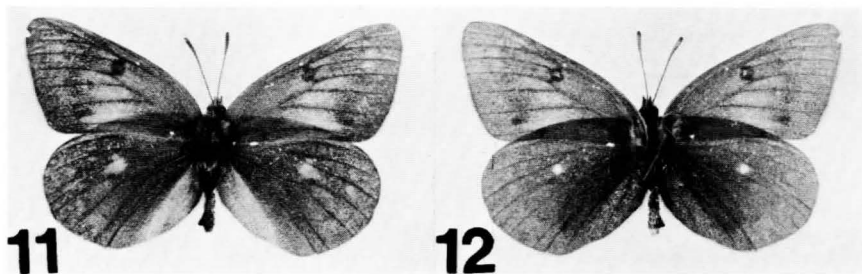
Figures 3-6: Typical *Colias hecla hecla* from Greenland. 3-4, ♂, D (3), V (4), 7 mi. NE Narssaq, 8.viii.80, 5900'. 5-6, ♀, D (5), V (6), 1 mi. NE Narssaq, 10.viii.80, 1000', R. Holland collector.

18). Ventrally the ground color is variable mossy-green as described previously. *C. hecla* exhibits considerable variation in maculation. Discal spot variation has been discussed previously and is illustrated in Figs. 1-2. Figs. 7-9 show typical variation in the width of the dorsal black wing borders of the males. Such variation is typical in North American *hecla* and may be environmentally induced rather than of genetic origin. Fig. 10 represents an "alba" female in which the dorsal ground color is pale greenish-white.

Figs. 11-12 depict an extremely melanic female. Such specimens are not uncommon. Variation in female *hecla* and aberrant specimens are discussed in a subsequent section.



Figures 7-10: Maculation variation in Alaskan *C. h. hecla*. 7-8, Narrowbanded ♂ forms from McKinley N.P., 20.vii.31 (AMNH) (7), 23.vii.31 (LACMNH) (8). 9, Typical ♂ from central Alaska, mi. 108 Steese Hwy., 3900', 2.vii.79. 10, ♀ "alba" form, Murphy Dome, NW Fairbanks, 25.vi.71.



Figures 11-12: Melanic ♀ *C. h. hecla*, Spence Bay, N.W.T., D (11), V (12).

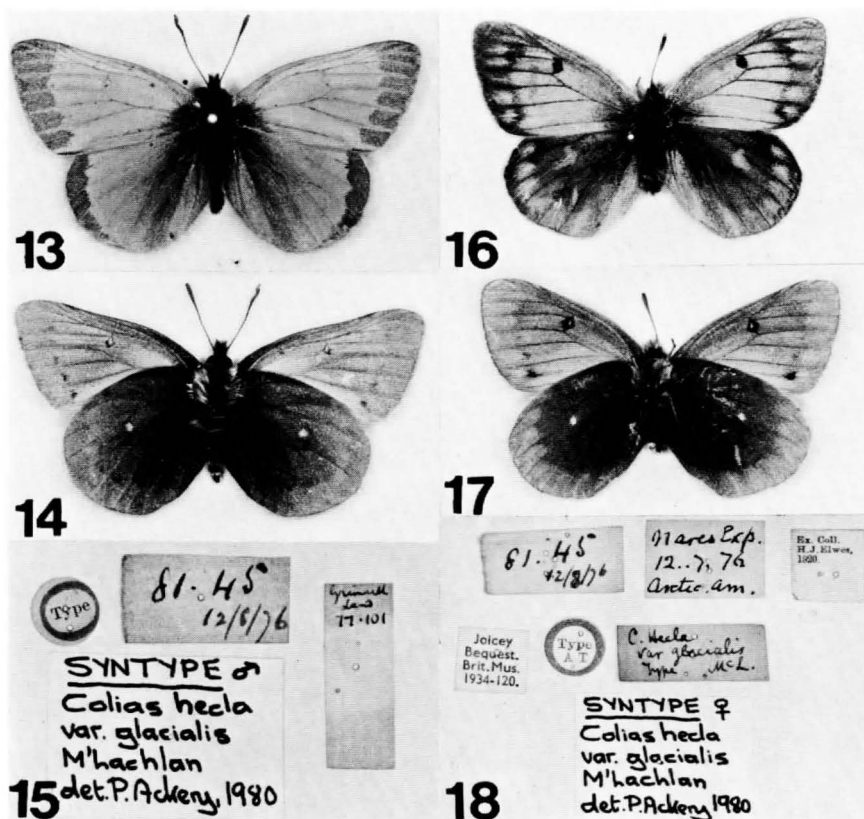
Colias hecla glacialis M'Lachlan, 1878 (= *C. hecla hecla* Lefèbvre, 1836)

Original Description: J. Linnean Soc., London, 14: 108.

Type Locality: 81°45' N. Lat (Grinnell Land, Ellesmere Is.).

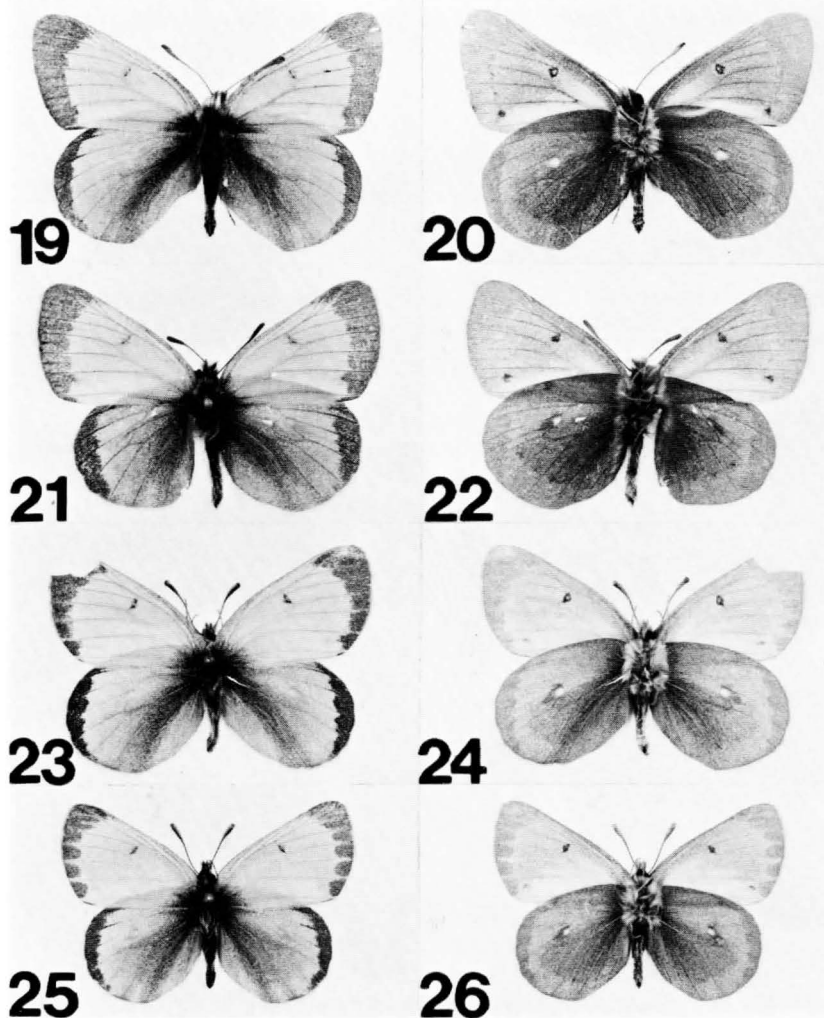
Location of Types: British Museum (N.H.), London.

Two of the five original specimens are illustrated with their labels in Figs. 13-18. The Syntype labels were added by Philip Ackery in 1980 at the time that I requested photographs of the specimens. It appears that M'Lachlan selected the male shown in Figs. 13-15 as the Holotype, since the "Type" label accompanies that specimen. The label "Type/A T" accompanying the female specimen shown in Figs. 16-18 is presumed to mean Allotype. M'Lachlan did not designate a Holotype or Allotype in his description of *glacialis*. The type series consists of two males and a female from 81°45' N. Lat., a female from Hayes Sound, 79° N., and a newly emerged and crippled male from Discovery Bay. The first four specimens were collected on 12 August, 1876, and the fifth on 18 July, 1876.



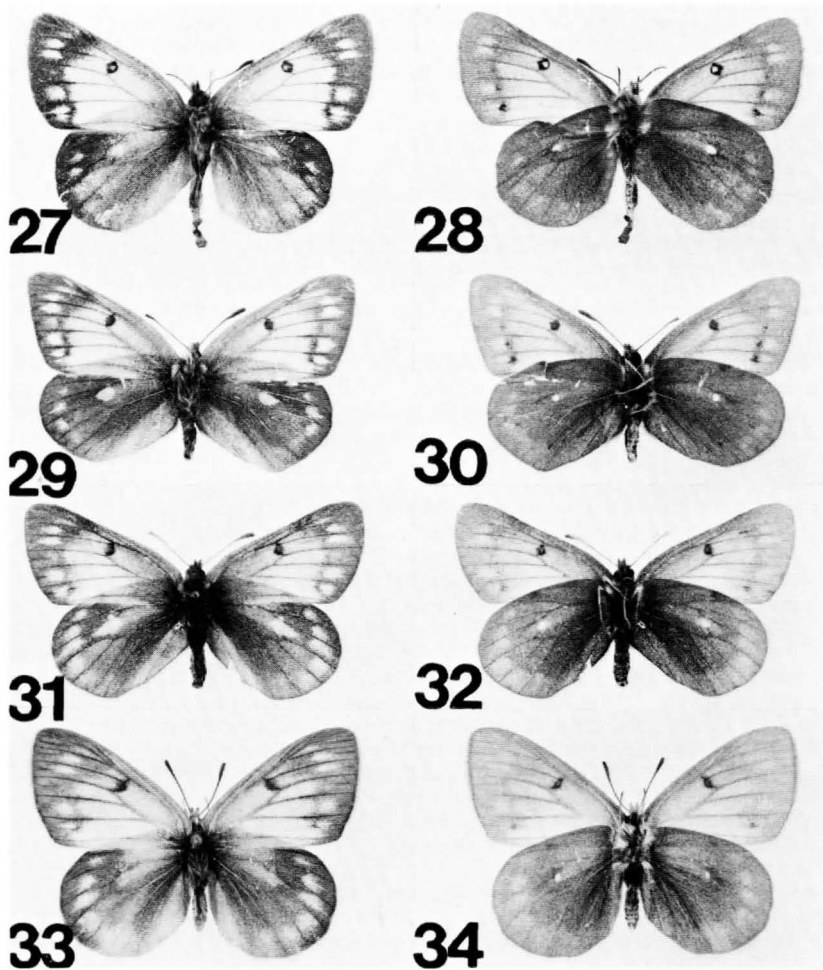
Figures 13-18: *Colias hecla glacialis* (= *h. hecla*). 13-15, Syntype ♂, D (13), V (14), and specimen labels (15). 16-18, Syntype ♀, D (16), V (17), and specimen labels (18). Original color transparencies courtesy British Museum (N.H.).

Diagnosis: M'Lachlan's description of *glacialis* is brief, and he generally states how his new taxon differs from Lefèbvre's description of *hecla*. As major differences, he cites the paler and orange ground color dorsally of *glacialis*, and the fact that the ventral surfaces are more smoky-greenish than in *hecla*. Based upon the color transparencies examined and reproduced in black-and-white as Figs. 13-18, *glacialis* has a much more dusky or melanic aspect than nominate *hecla*. This prompted me to state in a previous paper (Ferris, 1981) that *glacialis* appeared to represent a valid subspecies. As discussed immediately below, it now appears that *glacialis* falls within the normal variation of *hecla*, and represents a junior synonym of *hecla*, as so placed by dos Passos (1964).



Figures 19-26: Typical ♂ *C. h. hecla* from Ellesmere Is., 30.vii.66. 19-20, Eureka, 22.vii.53, D (19), V (20). 21-22, Hazen Camp, 81°49' N, 71°18' W, D (21), V (22). 23-26, Tranquary Fiord, 18.vii.63, D (23, 25), V (24, 26). All specimens are from the Canadian National Collection, Ottawa.

Variation: Figs. 19-34 show the dorsal and ventral aspects of four males and four females of *hecla* from Ellesmere Island, the type locality of *glacialis*. The reader should compare these specimens against those of typical *hecla* shown in Figs. 3-12. Additional material, not illustrated herein, was also examined. It appears that the type specimens of *glacialis* are atypical of Ellesmere Is. material, and simply represent melanic variants. On this basis, *glacialis* must be sunk as a junior synonym of *hecla*.



Figures 27-34: Typical ♀ *C. h. hecla* from Ellesmere Is., 19.vii.66. 27-28, Hazen Camp, 81°49' N, 71°18' W, D (27), V (28). 29-30, Eureka, 21.vii.53, D (29), V (30). 31-32, Eureka, 5.vii.53, "alba" form, D (31), V (32). 33-34, Tranquary Fiord, 18.vii.63, D (33), V (34). All specimens are from the Canadian National Collection, Ottawa.

Colias hecla groenlandica Rühl, 1895 (= *Colias hecla hecla* Lefébvre, 1836)

Original Description: Die palaearktischen Grossschmetterlinge und ihre Naturgeschichte. Vol. 1, p. 158. Ernst Heyne, Leipzig, 1895.

Rühl actually credited the name *groenlandica* to his co-worker Lampa. Translated from the German, the entire description of this taxon reads:

"*C. hecla* Lef. . . .

"var. *groenlandica* Lamp. Ground color more washed out. Distribution: Labrador, Greenland." No type specimen is designated, nor is there any indication of placement of specimens. At best, *groenlandica* represents one of the many varietal forms of *hecla hecla*. The taxon *groenlandica* should really be classified as an infraspecific name having no standing under the Code of the I.C.Z.N. dos Passos (1964) treated the name as a junior synonym of *hecla*.

Colias hecla chrysothemoides Verity, 1911 (= *Colias hecla hecla* Lefébvre, 1836)

Original Description: Rhopalocera Palearctica. Vol. 1. Firenze, p. 239, 1911.

Type Locality: "Territoire de Barren", 67°40' N, 114°30' W (vic. Coppermine River, N.W.T., Canada).

Location of Type: Unknown. A male and female Syntype were illustrated by Verity.

The female illustrated by Verity exhibits some DHW melanic suffusion characteristic of the normal variation within *C. hecla hecla*. Locality alone places *chrysothemoides* as a junior synonym of *hecla*, and not *hela* as designated by dos Passos (1964).

Colias hecla hecla - Form Names

The name that has caused the most confusion is *pallida*, credited to Skinner. A female specimen was figured on plate II, Vol. 3, no. 3 of Entomological News for March, 1982. The plate is a demonstration illustration for a new method of specimen reproduction. The caption for the plate, which appears on page 3, simply states: "4, *Colias hecla* var. *pallida*, nom. in litt.;" The name has been credited to Skinner on the basis that he was the editor of the journal.

Also in 1892, Henry Skinner and Levi Mengel published a description of "*Colias hecla pallida* n. var. ♀ Ent. News, Vol. 3, No. 3, pl. 2, fig. 4." in the Proceedings of the Academy of Natural Sciences of Philadelphia, Vol. 44, pages 156-157. The specimens representing form "*pallida*" were collected in Greenland in 1891. Entomological specimens were taken at three localities on the west coast of Greenland: McCormick Bay, Herbert Island, Disco, but the collection site for fm. "*pallida*" is not specified. Since Skinner's (?) plate predates the Skinner and Mengel paper, it seems best to credit the name to Skinner. In any case, "*pallida*" represents the female "*alba*" form of *C. hecla hecla*. It is an infraspecific name with no standing under the Code of the I.C.Z.N.

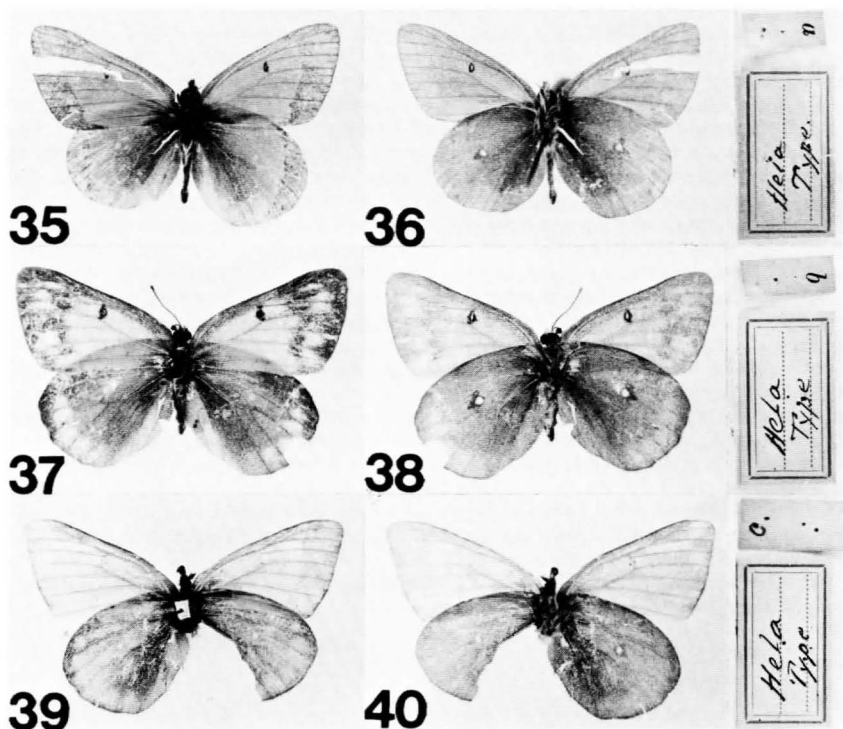
In 1934, Francis Hemming demonstrated that *Colias hecla* var. *pallida* Skinner was invalid since the name had been used previously to describe *Colias erate* ab. *pallida* Staudinger, 1861. Hemming proposed the name *palamedes* to replace *pallida*. Thus *palamedes* Hemming, 1934 = *pallida* Skinner, 1892. In any case, this argument is purely academic since infraspecific names are involved.

Gillham and Ehrlich (1954) have also discussed the problems associated with the authorship of *pallida* Skinner.

Flight Period: 30 May - 20 August (museum specimens); typically late June - July.

Distribution: The range of *Colias hecla hecla* is shown as a series of solid black circles in Fig. 69. It does not occur in western Europe, where it is replaced by ssp. *sulitelma* Aurivillius, 1890. Pending further study, the eastern Siberian race is assigned to nominate *hecla*. The subspecies *hecla* occupies the northern range of the species in North America. Two additional subspecies, subsequently discussed, occupy the western coast of Hudson Bay, and the northern Rocky Mountains.

Variation in Colias hecla hecla: Expanse of FW Costa: ♂ 17-26.5 mm; ♀ 21-26 mm. The "alba" female form appears to occur generally throughout the range of *hecla*, but it is definitely more common in Alaska than eastward. The narrow-bordered male form (Figs. 7-8, 23, 25) also occurs throughout *hecla*'s range. As noted previously, it is probably of environmental rather than genetic origin.



Figures 35-40: Type series of *Colias hecla hecla*. 35-36, "Type a" ♂, D (35), V and labels (36). 37-38, "Type b" ♀, D (37), V and labels (38). 39-40, "Type c" ♀, D (39), V and labels (40). See text for discussion. All specimens are placed in the Strecker Collection at the Allyn Museum of Entomology.

Colias hecla hecla Strecker, 1880

Original Description: Bull. Brooklyn Ent. Soc., 3(5): 33-34, 1880.

Type Locality: "A considerable distance above Fort Churchill on west coast of Hudson's Bay."

Location of Types: Strecker Collection, on permanent loan to the Allyn Museum of Entomology, Sarasota, Florida.

The three type specimens, a male and two females, are shown in Figs. 35-40.

Diagnosis: Strecker's description of *hela* could apply equally to Lefebvre's description of *hecla*. In comparing *hela* to *hecla*, Strecker comments: "This is allied to *Hecla*, Lefvr., *Meadii*, W.H. Edw., and *Boothii*, Curt., but is nearer, in all save its greater size, to the first, and may be a variety of it. . . . It further differs from the Greenland and Lapland forms of *Hecla* in the shape of the wings, especially in the ♂, in the much greater presence of blackish scales on upper surface, and in the absence of the paler green border of the under side of secondaries in ♀."

Generally speaking, *hela* has a somewhat more dusky aspect dorsally in both sexes than *hecla*. Ventrally it is brighter green and the VHW discal cell spot is more frequently double than in *hecla*. Typical specimens are shown in Figs. 41-48. Size variation is extreme in *hela* and this subject will be discussed below.

Variation: Both size and coloration in *hela* appear to depend upon environmental conditions. This is especially noted in specimens from Churchill, Manitoba. Museum material collected in 1930, 1933, and 1939 is considerably larger and more brightly colored than specimens examined from other years. They are also larger and brighter than *hela* from other geographic localities.

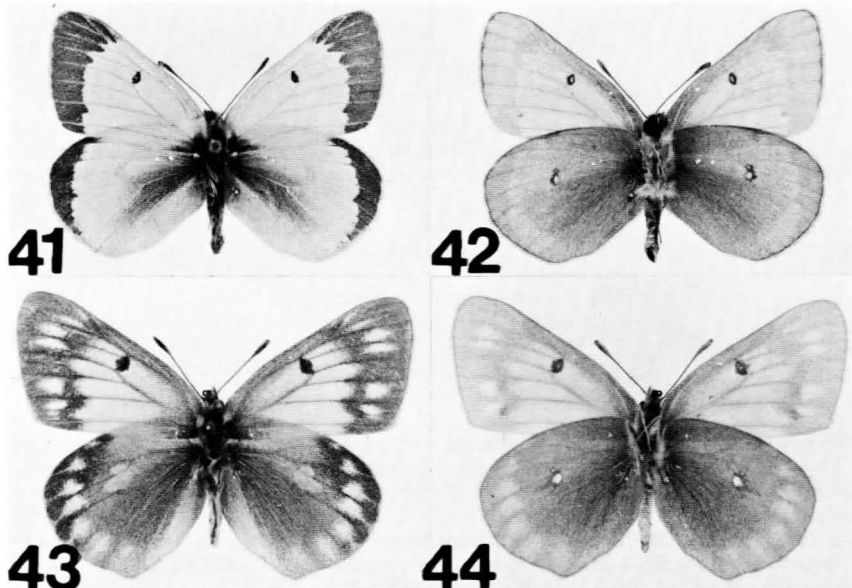
The type locality for *hela* is frequently cited as Churchill, Manitoba (Fort Churchill is located three miles from Churchill), although I suspect that the true type locality, based upon Strecker's comment, is in the vicinity of Eskimo Point, Northwest Territories, where *hela* appears to be common. Specimens from Eskimo Point and Baker Lake, N.W.T. tend to be slightly smaller and darker than Churchill specimens, particularly those from Baker Lake. On the order of eight-hundred specimens of *hela* were examined in the course of this study.

Flight Periods: 25 June - 17 August (museum specimens); typically late July.

Distribution: *C. hecla hela* is restricted to the west coast of Hudson Bay as shown in Fig. 69. It perhaps evolved as a consequence of climatic conditions associated with the Wisconsin glaciation. To some extent, its range parallels that of one of the races of barren-ground caribou, *Rangifer tarandus groenlandicus* (Linnaeus), although this animal ranges more widely west of Hudson Bay than does *hela* (Allen, 1979). Perhaps similar isolating mechanisms are involved. Generally speaking, *C. hecla* in North America, in its various forms, and caribou occupy nearly identical ranges.

Variation in *Colias hecla hela*: Possible annual variation at Churchill has been discussed above. Figs. 35-48 illustrate the normal range of variation in maculation; aberrants do occur. While pale specimens have been recorded in both sexes, the "alba" female form appears to be very rare in *hela*, if it occurs at all. Expanse of FW costa: ♂ 18.5-25.5 mm; ♀ 18.5-25 mm.

A rather striking form of *C. hecla* is found in the Rocky Mtns. of Alberta northward into British Columbia. It is described below.

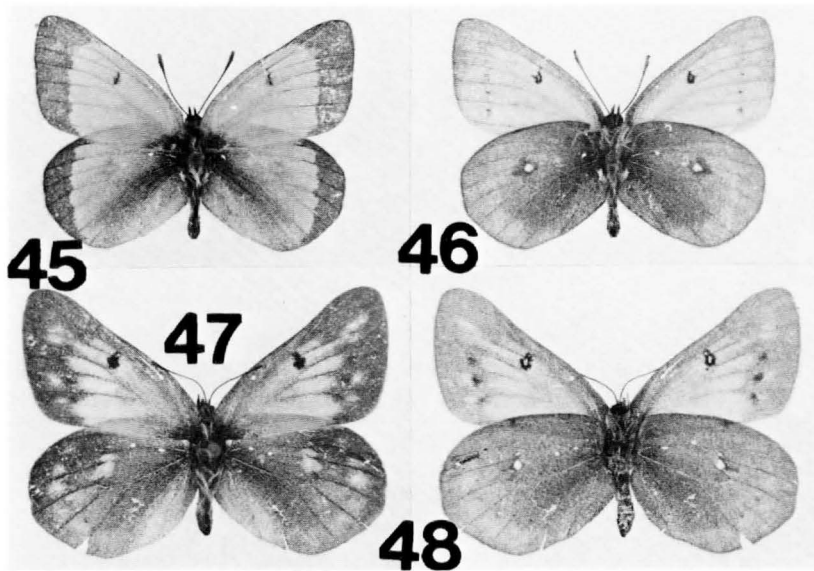


Figures 41-44: Typical *C. h. hela* from Churchill, Manitoba. 41-42, ♂, 15.vii.73, D (41), V (42). 43-44, ♀, 24.vii.33, (AMNH), D (43), V (44).

***Colias hecla canadensis* Ferris new subspecies**

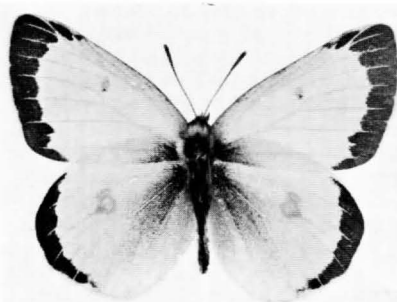
Types and Location: This subspecies is described from 69 ♂ and 8 ♀. The male Holotype was collected at mile 209, Alaska Highway, British Columbia, Canada on 10 June, 1963 by John A. Legge, Jr., and is placed in the collection of the Allyn Museum of Entomology, Sarasota, Florida. It is illustrated in Figs. 49-50. The paratypes are placed as follows: Allyn Museum of Entomology. 1 ♂, same data as Holotype; Alaska Highway in British Columbia: 1 ♂, mi. 126, 9.vi.50; 9 ♂, mi. 140, 9.vi.50; 1 ♂, mi. 146, 9.vii.48; 3 ♂, mi. 160, 8.vi.50; 1 ♂, 1 ♀, mi. 163, 6.vii.48; 10 ♂, 1 ♀, mi. 163, 8.vi.50; 2 ♂, mi. 174, 9.vi.50; 1 ♂, mi. 222, 9.vi.63; 1 ♂, mi. 228, 10.vi.63; 1 ♂, 1 ♀, mi. 409, 6.vii.48. 1 ♂, Ft. Vermillion, Alta., 4.vi.25. 2 ♂, 27 mi. N. Meikle River, Alta., 6.vi.50; 17 ♂, same locality, 30.vi.50. C.D. Ferris Collection. Alaska Highway in British Columbia: 1 ♀, mi. 148, 18.vi.71; 1 ♂, mi. 163, 8.vi.50; 1 ♀, mi. 211, 18.vi.71. 3 ♂, Pink Mtn., S. of mi. 143 Alaska Hwy., B.C., 1.vii.76. 1 ♂, 27 mi. S. Meikle River, Alta., 30.vi.50. American Museum of Natural History. 1 ♂, mi. 371 Alaska Hwy., B.C., 21.vi.68. Canadian National Collection. 1 ♂, Nordegg, Alta., 4.vi.19. J.A. Ebner Collection. 1 ♂, 1 ♀ fm. "alba", Nordegg, Alta., 16.vi.63. J.A. Legge, Jr. Collection. 3 ♂, Steen River, Alta., 16.vi.66; Alaska Hwy., B.C.: 2 ♂, mi. 206.5, 14.vi.62; 1 ♂, mi. 200, 10.vi.63; 1 ♂, mi. 223, 7.vi.63; 1 ♂, mi. 226, 7.vi.63; 1 ♂, mi. 226, 9.vi.63; 1 ♂, 1 ♀, mi. 228, 9.vi.63; 1 ♀, mi. 200, 10.vi.63. Several additional paratypes will be placed in the Canadian National Collection. Several paratypes are shown in Figs. 51-56.

Diagnosis and Description: This subspecies is the palest in color of all North American *Colias hecla*.

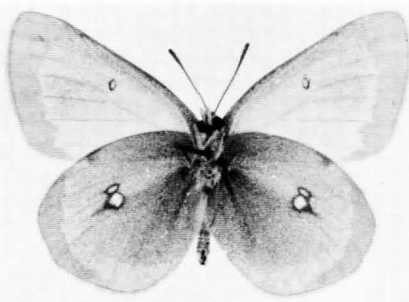


Figures 45-48: *C. h. hecla* from Baker Lake, N.W.T. 45-46, ♂, 7.vii.70, D (45), V (46). 47-48, ♀, 6.vii.74, D (47), V (48).

Holotype male. Forewing costa 24 mm. WINGS. Ground color intermediate between Spectrum Orange and Orange Yellow (Smithe #17, 18) dorsally, with some pinkish iridescence; ventrally the ground color is Orange Yellow lightly dusted by black scales giving a slightly greenish aspect. There is some basal dusting of dark scales D and V. Dorsally the veins are concolorous with the ground color, with some dark dusting basally; ventrally they exhibit some dark overscaling. The wing borders are black interrupted by the orange-yellow veins. The DFW cell spot is elliptical, orange colored with a few black scales, and moderately faint. This spot V is black-rimmed with a pupil concolorous with the wing color. The DHW discal spot is Chrome Orange (#16), while V this spot is double with opalescent whitish pupils, and rimmed by Vinaceous (#3) to Ferruginous (#41) scales. The spot is produced or smeared only slightly distally. There is a dark irregular spot just beyond the VHW mid-costa. The fringes are predominately Vinaceous D and V with some Spectrum Yellow (#55) at the FW tornus and HW outer angle. HEAD. Antennae approximately 40% of FW costa length; shaft pink, club with dark scales dorsally, pale orange-yellow and nearly unscaled ventrally, tip pale orange-yellow. Palpi yellow, pink-tipped, with a few interspersed black hairs. Eyes brown and



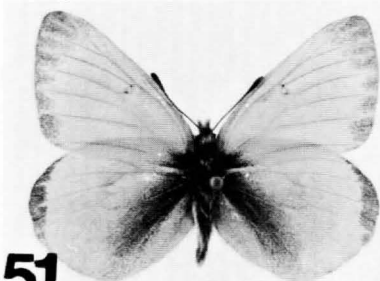
C. hecla canadensis Ferris
Holotype male



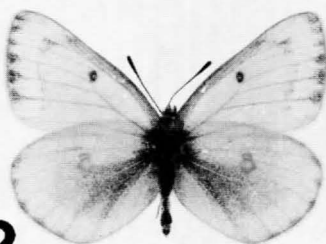
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MI. 209. B.C.
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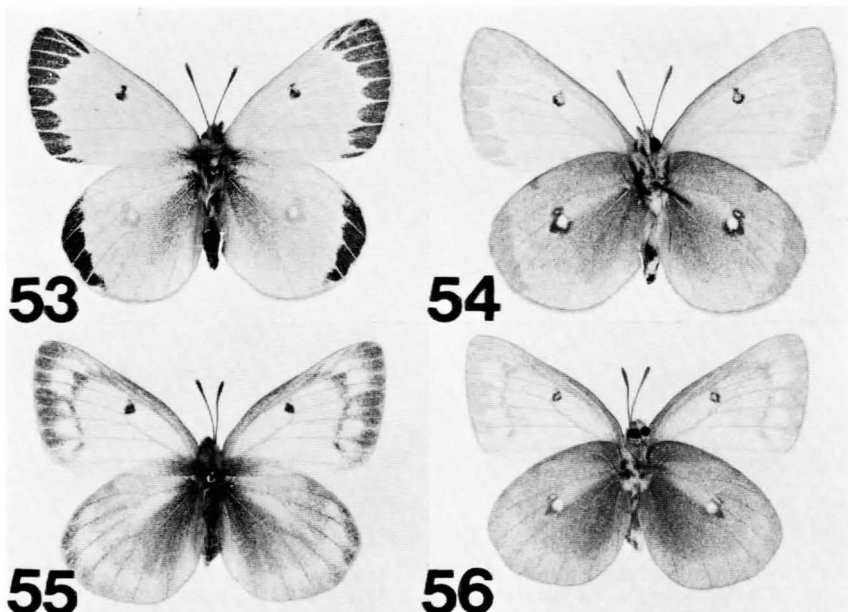
Figures 49-52: *Colias hecla canadensis*, new subspecies. 49-50, Holotype ♂, D and type label (49), V and locality label (50). 51, narrow-bordered ♂, Pink Mountain, mi. 143 Alaska Hwy., B.C., 1.vii.76. 52, ♀, mi. 211 Alaska Hwy., B.C., 18.vi.71.

smooth. Frons covered with pink hairs, some yellow basally, with interspersed ferruginous hairs. THORAX. Black, dorsally covered with pink hairs rostrad, pale yellowish-white hairs caudad; ventral thoracic hairs are yellow. LEGS. Femur yellow shading to pink; tibia and tarsomeres pink. ABDOMEN. Black and lightly covered with moderately long yellow hairs dorsally; densely covered with short yellow hairs ventrally.

Females. Because the females are dimorphic, no Allotype is designated. A normal female is shown in Fig. 52 and a fm. "alba" female is shown in Fig. 55. In the normal form, the dorsal ground color is Spectrum Yellow (#55) shaded discally by Orange Yellow (#18). The black scales that comprise the dark wing borders are very sparsely placed producing a charcoal-gray rather than black aspect to the markings. The DHW discal spot is Spectrum Orange (#17). The VFW cell spot is white or pale-yellow pupiled and ringed by dark brown scales. In all other respects, the coloration of the females resembles that of the males, except that the ventral ground color is somewhat paler.

The "alba" female form is generally similar to the normal form with several exceptions. The dorsal and VFW ground color is pale greenish-white, and the dark markings are more pronounced. The DFW cell spot is dark and pronounced; the DHW discal spot is Orange Yellow (#18) with a few darker scales. The VHW ground color is yellow and the VFW show apical yellow shading. The body vestiture is similar to the normal form, except that the yellow hairs are replaced by very pale yellow and silvery-white hairs. Dorsally the thoracic hairs are pink rostrad and silver-white caudad.

Variation: The FW costa varies as follows: 21-25 mm (males); 21-25 mm (females). The DFW cell spot varies as in typical *hecla*; the VHW discal spot is normally double and varies in the amount of distal smearing of the ferruginous scales. The major variation in the males relates to the dorsal black borders as shown in Figs. 49, 51, and 53. The two factors involved are width and the amount that the venous pale scaling intrudes into the borders. These features show clearly in the illustrations. Except for dimorphism, the females are fairly uniform in facies.



Figures 53-56: *C. h. canadensis* from Nordegg, Alberta, 16.vi.63. 53-54, ♂, D (53), V (54). 55-56, ♀, "alba" form, D (55), V (56). Specimens in J.A. Ebner Collection.

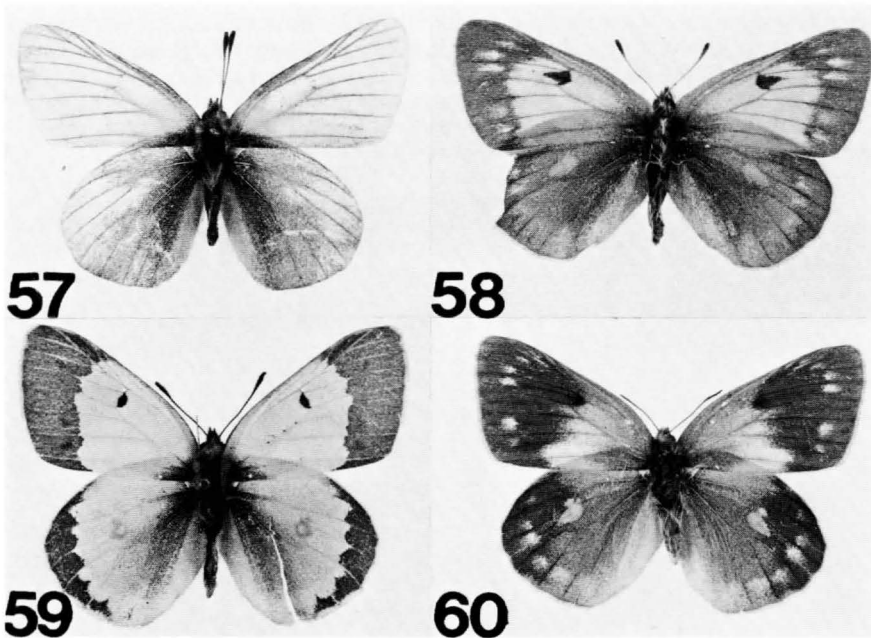
Flight Period: 4 June - 6 July (museum specimens).

Distribution: As seen from Fig. 69, the known range of *C. hecla canadensis* is restricted to western Alberta, extreme NE British Columbia and extreme SW Northwest Territories. In NW British Columbia and the southern Yukon Territory, a cline exists between *canadensis* and nominate *hecla*, the northern limits of which appear to be in the vicinity of Mayo Lake and Dawson. The northeastern limit to the range of *canadensis* is not known. I have not been able to examine material from Great Slave Lake, shown as the open circle in Fig. 69. Based upon its known distribution, I would expect to find this butterfly in the extreme SW portion of the N.W.T.

Variation and Aberrations in *Colias hecla*

The main variations in *C. hecla* have been mentioned previously, namely size, shape and color of the DFW cell spot, configuration of the VHW discal spot, ventral ground color, and width of the dark borders in the males. Also in the males, there is some variability in dorsal ground color. Individual specimens that have yellowish FW or HW, or both, are not uncommon.

Several rather striking aberrations are shown in Figs. 57-60. Fig. 57 shows a male that is almost depauperate of scales. There is some basal orange scaling D, and slightly more scaling V. Fig. 58 shows a female in which the DFW cell spot is dense and produced distally. This aberration appears occasionally in the females. The male shown in Fig. 59 exhibits much enlarged borders and a very pronounced DFW cell spot. The female in Fig. 60 has very much enlarged borders.



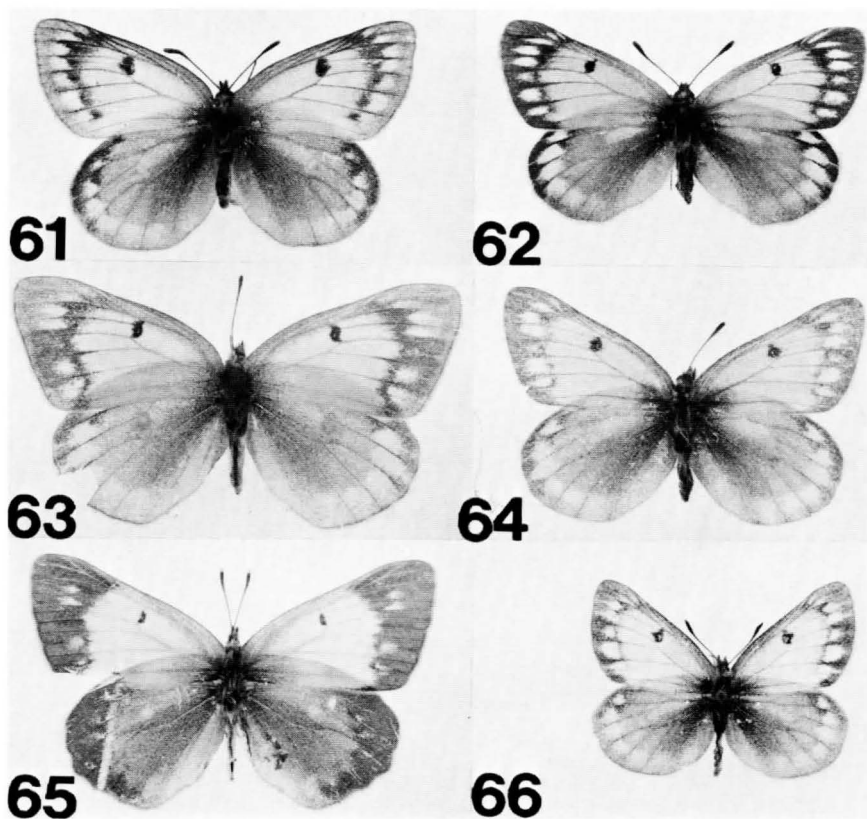
Figures 57-60: Dorsally aberrant forms of *C. hecla*. 57, *C. h. hecla* unscaled ♂, Repulse Bay, N.W.T., 5.viii.71 (AMNH). 58, *C. h. hecla* ♀, abnormal DFW cell spot, "Gorthaab", Greenland, 24.vii.08 (LACMNH). 59, *C. h. hecla*, wide-bordered ♂, Churchill, Manitoba, 17.vii.33 (AMNH). 60, *C. h. hecla*, *melanic* ♀, Ft. Churchill, Manitoba, 29.vii.39 (AMNH).

Figs. 61-65 demonstrate the typical variation in facies and size (all photos are at the same magnification) of *C. hecla hecla*. The specimen in Fig. 62 approaches the European *sulitelma* with yellow spots in the borders. Fig. 66 is a dwarfed fm. "alba" specimen from the Yukon cline.

Similar Species

Colias hecla has been confused with *C. alexandra* and *C. meadii*. Methods for separating *hecla* from its *alexandra* look-alike, *C. alexandra kluanensis* Ferris, have been described in detail in a previous publication (Ferris, 1981). Where sympatric, *C. hecla* normally flies earlier in the season than *alexandra*.

Males of *C. hecla* and *meadii* are easily separated, as can be seen from Figs. 67-68. There is a patch of androconial scales of the DHW costa in both subspecies of *meadii* that is absent in *hecla*. The species that are most likely to be confused are *C. hecla canadensis* and *C. meadii elis* Strecker. Females of *canadensis* are smaller and generally



Figures 61-66: Dorsal variation of ♀ forms of *C. hecla*. 61-63, *C. h hecla* from Alaska (AMNH). Slana, 3000', 28.vi.65, (61), Rampart, no date, (62), abnormally large specimen from Alfred Creek Camp, 15.vii.22, (63). 64, clinal form, Kluane Lake, Y.T., 19.vii.55, (AMNH). 65, *C. h. hecla*, Nome, Alaska, 17.vii.26, (AMNH). 66, small clinal "alba" form, Quill Creek, 2600', Kluane Lake, Y.T., 28.v.80.

much paler in color than *elis*. In addition, the VHW discal spot in *elis* is usually small and single, not large and double as in *canadensis*. Normally *elis* flies at higher elevations and later in the season than *canadensis*. At the present time, I have no records of localities where these two species are sympatric. *C. h. canadensis* is normally on the wing in June; *C. meadii elis* is typically on the wing in late July and August.

CONCLUSION

Three subspecies of *Colias hecla* are recognized in North America based upon the diagnostic characters cited above. Fig. 69 illustrates the distribution of these entities. A synonymy is shown below:

COLIAS hecla Lefèbvre, 1836

h. hecla Lefèbvre, 1836

glacialis M'Lachlan, 1878

groenlandica Rühl, 1895

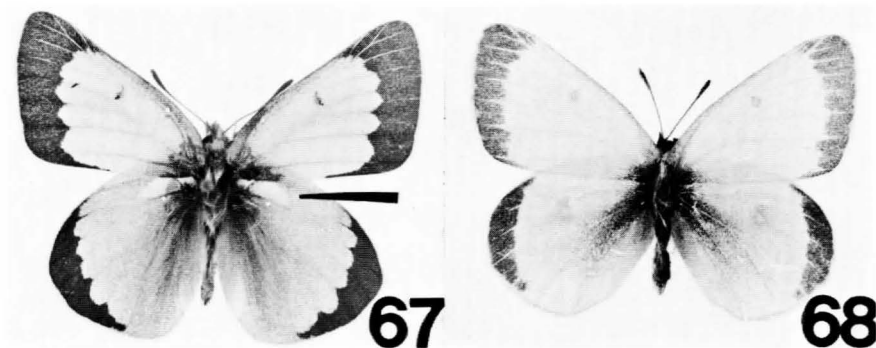
chrysothemoides Verity, 1911

form ♀ "pallida" Skinner (?), 1892

"palamedes" Hemming, 1934

h. hela Strecker, 1880

h. canadensis Ferris, 1982



Figures 67-68: Comparison of *C. meadii meadii* ♂ from Park Co., Wyoming (67) and *C. hecla hecla* ♂ from mi. 109 Steese Hwy., Alaska (68). Pointer indicates androconial patch of *C. meadii*.

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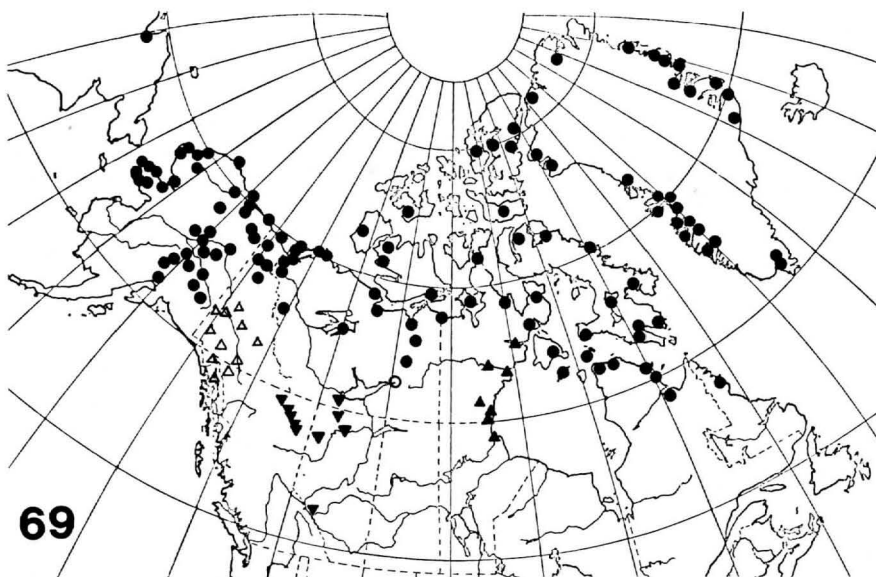


Figure 69: Distribution map for *C. h. hecla* in North America. Solid circles = *C. h. hecla*. Solid triangles = *C. h. hela*. Inverted solid triangles = *C. h. canadensis*. Open triangles = cline between *C. h. hecla* and *C. h. canadensis*. Open circle = material not available for examination.

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APPENDIX: MATERIAL STUDIED

Approximately 2,000 specimens were examined in the course of this study. To conserve space, only locality data are given. Some additional records are taken from season summaries published in the NEWS of the Lepidopterists' Society. *Colias hecla hecla*: ALASKA. Pt. Hope, Cape Lisburne, Pitmegea River, Ogotoruk Creek, Utukok River, Noluck Lake, Meade River (Atkasak), Umiat, Colville River delta, Itkilik River (46 min. E. Umiat), Anaktuvuk Pass region, Manushuk River (at Cobblestone Creek), Pt. McIntyre, Prudhoe Bay, Sagwon, Happy Valley, Kavik River, 69°41' N, 146°55' W (Schrader and Peters Lakes), Marsh Fork of the Canning River, Canning River (various localities), 10 mi. up Sadlerochit River, Okpilak River, Barter Is., Nuvugapak Pt., Beaufort Lagoon, Aichilik River (various localities), Kongakut River, E. side Demarcation Bay, Nome, head of Kivalina River, Noatak River valley (several localities), Wulik River (68°05'-10' N, 162°55'-163°30' W), Arrigetch Creek (Arrigetch Peaks), vic. Chandler Lake, 6 mi. SE Mt. Doonerak, Echooka Springs, upper Dietrich River (68°03' N, 149°40' W), vic. Galbraith Lake, Chandalar Shelf, Chandalar River at Red Sheep Creek, Hulahula River, NE of Wales, Shishmaref, mouth of Arctic River, Cape Espenberg, Bluestone River at Teller Road, Teller Road (various localities), Kigluik Mts. (various localities), vic. Harris Dome, Kougarok Road (several localities), Mt. Distin, head of Aurora Creek, 28 mile Council Road, Wiseman, Ray Mts., vic. Eagle Summit (several localities), McKinley Park (numerous localities), Denali Highway (numerous localities), Indian Pass Lake, mi. 24 Nabesna Road, Solo Creek, Lazy Mt. (nr. Palmer), Arctic Valley (Chugach Mts. nr. Anchorage), Collinson Pt., Nome, mi. 108-114 Steese Hwy., Cape Thompson, Peters Lake, Big Delta, mi. 113 Richardson Hwy., Summit Lake (Isabella Pass), Kaslah River, Beechey Point, Kotzebue, Arctic Basin, Pt. Barrow and

vicinity, Ft. Yukon, Alfred Creek Camp, Palmer, Rampart, Slana, Murphy Dome, Mentasta Jct. mi. 81.4 Glenn Hwy., Kitluk River 66°32-35' N, 164°22-26' W. NORTHWEST TERRITORIES (islands). ELLESMERE IS. Eureka, Hazen Camp, Tranquary Fd., Fosheim Pen. DEVON IS. AXEL HELBERG IS. 79°25' N, 90°45' W. BAFFIN IS. Cape Dorset, Lake Harbour, Lake Amitok, Pangnirtung, Nettling Lake, Clyde, Pond Inlet, Frobisher Bay, Cumberland Pen. (Sunneshine Fd., Moonshine Fd.). VICTORIA IS. Holman, Kuujua River valley. BANKS IS. Masik and Bernard Rivers, Egg River 72°26' N, 124°24' W, Shoran Lake, Big River, Kellett River, Sachs Harbour. KING WILLIAM IS. Goja Haven. SOUTHAMPTON IS. Coral Harbour. COATS IS. MELVILLE IS. NOTTINGHAM IS. RICHARDS IS. NORTHWEST TERRITORIES (mainland). Repulse Bay, Melville Pen., Pelly Bay, Spence Bay, Sawmill Bay (Great Bear Lake), Ft. McPherson, Perry River, Muskox Lake, Bathurst Inlet, Beechey Lake, Coppermine, Bernard Harbour, Reindeer Depot, Mackenzie Delta, Kidluit Bay, Hutchinson Bay, Inuvik, Tuktoyaktuk, Anderson River delta, Cape Parry, Atkinson Pt., Mason River, Whitefront Lake, Canoe Lake, Armstrong Pt. (Victoria Land), Godlin Lakes, Cambridge Bay, Aklavik. QUEBEC. Payne Bay (Bellin), Ft. Chimo, Ungava, Pt. Harrison, Diana Bay, Sagluc. LABRADOR. vic. Nain. YUKON TERRITORY. Old Crow, Herschel Is., Firth River, Sam Lake, British Mts. GREENLAND. Nedre Mid-sommer Sø, Sondrestrom Airbase, Qanaq (nr. Thule), vic. Narssaq, "Gorthaab". *Colias hecla hecla*: MANITOBA. Churchill, Ft. Churchill. NORTHWEST TERRITORIES. Eskimo Pt., Baker Lake, Chesterfield Inlet, Padlei, McConnel River, Wager Bay. *Colias hecla canadensis*: ALBERTA. Ft. Vermillion, Nordegg, 27 mi. N. Meikle River, Steen River. BRITISH COLUMBIA. Various localities along the Alaska Highway from mile 126 (Pink Mountain) to mile 409. Northwest Territories. Victoria Falls. *Colias hecla* clinal forms: ALASKA. Skagway. BRITISH COLUMBIA. Atlin, Kelsall Lake, Chilkat Pass. YUKON TERRITORY. Whitehorse, Alaska Highway along Kluane Lake, Haines Jct., Swim Lakes, Dawson, mile 1105 Alaska Highway.

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