Volume 6 **18 April 2005** **Number 2**

The Taxonomic Report

OF THE INTERNATIONAL LEPIDOPTERA SURVEY

IMMATURE STAGES OF *COLIAS OCCIDENTALIS SULLIVANI* FROM OREGON (LEPIDOPTERA: PIERIDAE)

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ABSTRACT: The immature stages of *Colias occidentalis sullivani* Hammond and McCorkle are described and figured. The larval host is *Lathyrus rigidus* White.

Additional keywords: *alexandra, christina*, Harney County, head capsule, larva, ova, pupa.

Colias occidentalis sullivani was described in 2003 by Paul Hammond and Dave McCorkle. The type locality is near Ten Cent Lake in Harney County, Oregon. The immature stages reared in this study were from the type locality.

MATERIALS AND METHODS

Oviposition: Three females were observed ovipositing on *L. rigidus*. All three eggs were placed on or near new growth at the ends of the plant stems. Therefore, the newly hatched larvae would have tender growth readily available**.**

Sprigs of the hostplant were put into water in a small container and then placed inside a gallon size plastic container with a chiffon cover. Females collected at the type locality in May 2002 were put into the gallon container for ovipositing. At first, indirect sunlight was tried but the females did not respond by ovipositing. Some *Colias* species will oviposit under incandescent light but the *sullivani* females did not. When the container was placed in direct sunlight, about 100 eggs were readily obtained. Each was oviposited singly on leaves of the larval hostplant. Care was taken to not let the container overheat. The sprigs remained in water and the eggs were left in place until shortly before hatching.

Rearing: Cut stems of the hostplant were placed in water in a small container and put inside a plastic container with a chiffon cover. Just before the eggs were to hatch, the leaves with the eggs were placed among the stems of the hostplant for rearing. The newly hatched larvae could easily find the fresh leaves. When the cut stems needed to be replaced, the leaves the larvae were on were placed among fresh stems and leaves. The majority of the larvae were reared on *L. rigidus*. A few larvae were reared on *Lathyrus brachycalyx* Rydberg which was obtained near Salt Lake City.

The larvae used for measurements were set aside on the leaf they were on after they quit eating and were preparing to molt. After the larvae molted, they were placed on fresh stems.

Diapausing larvae were put into a small plastic container which had many holes for air circulation. The container with the larvae was put into a screen cage in a shady spot in the yard until there was snow in the mountains – which was in November in the Wasatch Mountains near Salt Lake City. Then the container was put in a cage in the snow for the winter. The post diapause larvae take a few days to start eating after put into room temperature. Many larvae did not survive the winter.

Observations: Morphological observations and measurements of the eggs, first instar larvae and head capsules were made with the aid of a stereomicroscope and a 0.1 mm scale. Length measurements of the second instar and larger were made with a millimeter scale. Measurements of the head capsule width are of the molted head capsule. Measurements of the length were made at pre-molt time (except the fifth instar). Length of the fifth instar larvae is given for the mature larvae during the most common resting position. When feeding, the larvae are often longer. N=10 for the egg, head capsule, and length measurements.

DESCRIPTION

Eggs: The eggs (Fig. 3) are typical of the genus *Colias*. The eggs are fusiform in shape, 0.48 mm wide (range 0.46 to 0.50) and 1.35 mm long (range 1.20 to 1.47). Each egg has longitudinal ribs with small transverse ridges. The top is rounded and contains the micropyle. Eggs are creamy white when oviposited and become orange with a creamy tip within 2 days. Prior to hatching the eggs exhibit a black tip, the head of the larvae can be seen through the shell. Eggs hatch in about 5 days at room temperature.

Larvae: *C. o. sullivani* has five larval instars. The larvae have one lateral stripe on each side. Second through fifth instar are similar and differ only in size, there is one exception which is noted in fourth instar. Also, the fourth instar larvae are dark blue or purplish just after molting but become green when feeding and growing. The appearance of the first, fourth and fifth instars and pupa is described.

First instar: Neo-natal body: brown then turns yellow green in a few hours. Head: black with tiny white hairs. Body: yellow green and more yellowish posterior; mid-dorsal stripe: dark brown, faint, and yellowish posterior; on each side of the body there are three white hairs on each segment except first segment which has five white hairs; many black dots on yellow body under 40 X magnification; thoracic legs: black, spiracles: black. Length: 3.5 mm (range, 3.4 to 3.7). Head width: 0.36 mm (range, 0.35 to 0.37).

Second instar: Length: 5.46 mm (range, 5.0 to 5.9). Head width: 0.56 (range, 0.53 to 0.58).

Third instar: Diapause length: 7.34 mm (range, 6.8 to 7.8). Post diapause length: 4.81 mm (range, 4.5 to 5.1). Molt length: 8.03 mm (range, 7.5 to 8.5). Head width: 0.81 mm (range, 0.78 to 0.85).

Fourth instar: Hairs: on second and third instar, all are white; on fourth instar, black on upper part of head and body and white on lower part. Length: 14.2 mm (range, 13.2 to 15.3). Head: width 1.34 mm (range, 1.28 to 1.45).

Fifth instar: Head: green with many black spots which bear black or white hairs; eyes and mandibles black. Body: green with many black spots which bear short black or white hairs, hairs are black dorsally and white ventrally on body and head; thoracic legs: green with a bit of brown on the outside; mid-dorsal stripe: dark green except near head where it is light green; lateral stripe: white with a bit of pink on some segments; spiracles: white; black spots on body ringed with light green. Length: about 30 mm. Head width: 2.5 mm (range, 2.45 to 2.6).

Pupa: Head: green with front a darker green, light green horizontal line in middle of head. Body: green, lighter green posterior: mid-dorsal stripe: dark green; lateral stripe: light green and is expressed on wing case; spiracles: light green; sublateral stripe: brown on three segments immediately behind wings; small black spot between lateral stripe and sublateral stripe on two segments immediately behind wings. Length: 19.9 mm (range, 18.0 to 21.5); width: .49 mm (range, 4.5 to 5.5); height: (dorsal to ventral) 6.1 mm (range, 5.5 to 6.5). As the pupae develop the colors and patterns of the adult become visible. The posterior end of the pupa is attached to a silk pad on the substrate and the body is held loosely to the substrate with a silk girdle.

Behavior: First through third instar larvae eat the spongy mesophyll from the leaf and leave the veins and membrane. The first three instar larvae rest on the upperside of a leaf along the mid vein. Fourth and fifth instar larvae eat the entire leaf. Partially grown third instar larvae diapause. Diapausing larvae become light brown. Post-diapause larvae slowly turn green as they feed. Mature larvae leave the hostplant and wander off to pupate. Occasionally one will pupate on a stem of the hostplant in the rearing container.

RESULTS

There was considerable loss of pre-diapause larvae due to unknown reasons. *Colias* larvae are very susceptible to disease so that may have been part of the problem. There were 24 larvae reared on *L. rigidus* and three on *L. brachycalyx* that diapaused. Fifteen of the *L. rigidus* larvae and one of the *L. brachycalyx* larvae survived winter diapause and began eating in the spring. Eleven adults were obtained from the *L. rigidus* reared larvae and one from the *L. brachycalyx* reared larva.

The one post-diapausal larva reared on *L. brachycalyx* began eating 15 April, pupated 2 May, and the adult emerged on 11 May. This adult was the largest of all the reared adults. It is a female equal in size to the smallest wing caught adult female in my collection. Therefore, this adult is 9 percent smaller than the norm. The average of all reared adults is 10.5 percent smaller than the wing caught adults.

Ken Hansen, Jacque Wolfe, and I attempted to rear three subspecies of *C. occidentalis (chrysomelas, occidentalis & sullivani)* on *Hedysarum mackenziei*. In all attempts, the larvae died before becoming second instar. This evidences that *C. occidentalis* cannot use *H. mackenziei* as a larval host.

DISCUSSION

The cut stems of *Lathyrus* and *Vicia* do not transport water to the leafs very well. This seems to be the case with many other legumes as well. The larvae feeding on cut stems of the two *Lathyrus* species used would start to leave the plant and wander around the container two or three days after they were given freshly cut stems. This indicated that they were getting discontented with the condition of the plant. This is probably the reason for the small size of the adults. After four or five days the leaves of the plant seemed to be in good condition, but apparently they were not good enough for the larvae. Therefore, it would be preferable to use growing plants; either planted or potted hostplants would probably suffice.

In 2003, some larvae were placed on *L. rigidus* at the type locality and a sleeve put over the plant. Ten diapausing larvae were later recovered. These larvae all entered diapause in the second instar. 2003 had a dry spring and the eggs were oviposited after the middle of the flight. The plant leaves probably desiccated so early that the larvae could not continue beyond second instar. The rearing indicates that the larvae will not exceed third instar even if they still have edible plant.

The larvae of *Colias occidentalis chrysomelas* (pers. comm. Ken Hansen, Jacque Wolfe) and *C. o. pseudochristina* (pers. comm. J. Harry, J. Wolfe) turn light brown when they diapause. This evidences that *sullivani* is indeed a subspecies of *occidentalis.*

The larvae of *Colias alexandra edwardsi* (pers. Obs. J. Harry), *christina krauthi* (pers. comm. J. Wolfe), and *christina kluanensis* (pers. Obs. J. Harry) do not turn brown when they diapause. This indicates that they are not conspecific with *occidentalis.* Since the larvae of no other North American *Colias* change color when they diapause; this is considered to be a significant genetic character.

ACKNOWLEDGEMENT

Thanks are extended to Dave McCorkle for reviewing this manuscript and providing helpful suggestions.

REFERENCE

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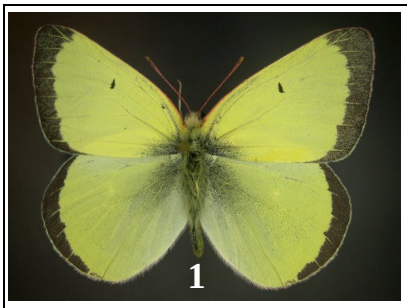

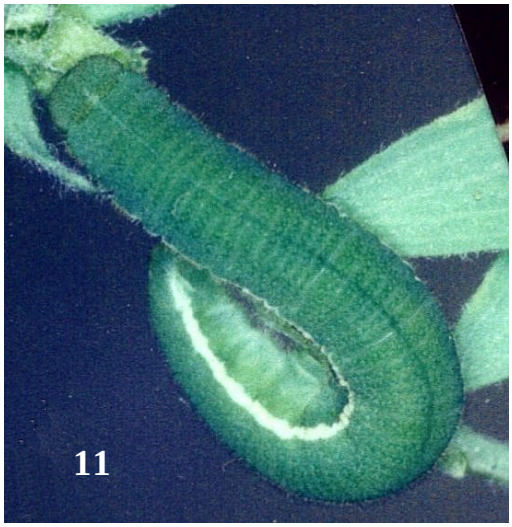

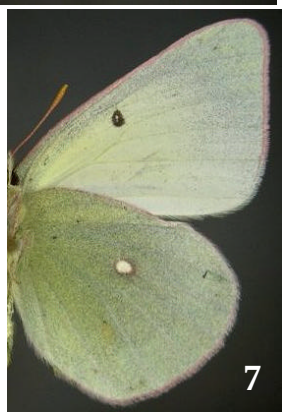

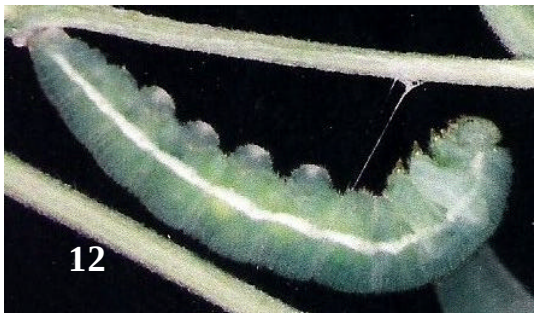

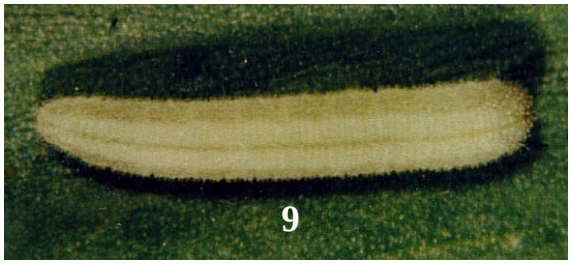

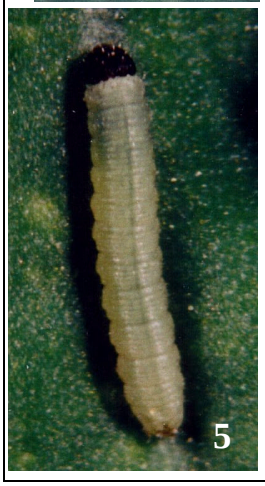

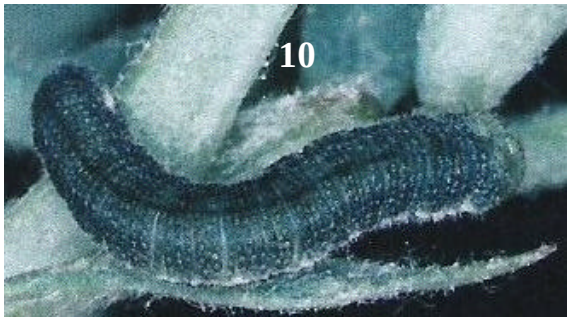

Figs. 1-14. Developmental stages of *Colias occidentalis sullivani*. **Figs. 1/6.** Male: topotype, D/V. **Figs. 2/7.** Female: topotype, D/V. **Fig. 3.** Ova after three days. **Fig. 4.** Larva in process of hatching. **Fig. 5.** First instar larva. **Fig. 8.** Second instar larva. **Fig. 9.** Diapausing third instar larva. **Fig. 10.** Newly emerged fourth instar larva. **Fig. 11.** Fifth instar larva. **Fig. 12.** Prepupa. **Fig. 13.** Pupa. **Fig. 14.** Pupa with female adult ready to emerge. All photographs by Jack Harry. Figs. 1 & 2 actual size. D: dorsal. V: ventral.