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THE LIFE HISTORY AND ECOLOGY OF *HESPERIA NABOKOVI* IN THE DOMINICAN REPUBLIC (LEPIDOPTERA: HESPERIIDAE)

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ABSTRACT.— The life history and ecology of *Hesperia nabokovi* (Bell & Comstock), the only species of this genus outside the Holarctic Region, is described; egg, larval and pupal characters confirm its generic assignment. The complete life cycle takes 94 days.

KEY WORDS: *Atalopedes*, *Calisto*, Haiti, Gramineae, *Hesperia comma*, Hispaniola, immature stages, Nymphalidae, *Oarisma stillmani*, Satyrinae.

Fig. 1. Habitat for *Hesperia nabokovi* adults, 1km SE Monte Cristi (50ft elev.), near the northern Dominican Republic coast. (photo by T. C. Emmel, 7 Jun 1989)

The holarctic genus *Hesperia* embraces 19 species across the North American continent and the Old World temperate regions. Only one species (*Hesperia comma* Linnaeus) occurs in Europe and Asia, but it ranges as far south as North Africa. Thirteen of the nineteen species, including *Hesperia comma*, occur in western North America (MacNeill, 1964). The genus was long thought to be exclusively temperate. This traditional view (MacNeill, 1975) was challenged upon the inclusion of a nineteenth species in the genus, when Burns (1986) moved a very large yellowish skipper found in the Dominican Republic, *Hesperia nabokovi* (Bell & Comstock), from the genus *Atalopedes* to the genus *Hesperia*, on the basis of numerous anatomical features, especially the male and female genitalia.

While the early stages of the other species have been well described, the life history of *Hesperia nabokovi* has remained unknown to date. In early June 1988, one of us (TCE) was able to collect living females in the Dominican Republic, confine one of these and obtain an egg which was reared through by the second co-author (JFE) in California on a substitute grass foodplant. The purpose of this paper is to describe the elements of the life history and present some ecological notes on the biology of this fascinating Caribbean member of the genus *Hesperia*.

DISTRIBUTION AND HABITAT

The known distribution of *Hesperia nabokovi* is restricted to three general regions on the island of Hispaniola (Schwartz, 1989). The three areas are widely separated geographically and are divided topographically from each other by high mountain ridges. These regions are: 1) the Cul de Sac-Valle de Neiba plain and the extreme western edge of the Llanos de Azua, from Thomazeau and Fon Parisien in Haiti in the west to Canoa in the east; 2) the Peninsula de Barahona in the south; and 3) the western Valle de Cibao near Monte Cristi in northwestern Dominican Republic. These habitats are characteristically xeric lowland thorn scrub, with a bunchgrass, *Uniola virgata* (Gramineae), occurring there in close association with the butterfly. Another unusual skipper, the small skipperling *Oarisma stillmani* Bell and Comstock, is also found there. Schwartz (1989) records *Hesperia* specimens taken at elevations from sea level to 214 meters. The seasonal distribution includes February, April, May, June, July, August, September, and October. Most captured specimens and observational notes of adults have been taken in August and October by Schwartz and his co-workers.

As part of a June 4-11, 1988 expedition to the Dominican Republic with a group of lepidopterists, including several skipper specialists (C. Don MacNeill and Marc C. Minno), we visited previously reported localities for this skipper between 1-4km southeast of Monte Cristi on June 7. The first location we stopped at — 1km southeast of Monte Cristi on Carretera 1 — was located at 50ft above sea level and approximately 112km

northwest of the major city of Santiago. Four lepidopterists in the group took eight fresh *Hesperia nabokovi*, including males and females. The habitat in this area was low desert acacia scrub, with tussock bunchgrasses across the area (Fig. 1). We collected in this area from 1347 to 1515 hours.

We then moved on to a locality 4km southeast of Monte Cristi, where we collected from 1518 to 1618 hours. This location, at 70ft elevation above sea level, was similar scrub vegetation but had larger acacias. Here, the bunchgrasses were found under the shade of the acacias and contained resting *Calisto* satyrids. Along with the *Calisto* were two specimens of *Hesperia nabokovi*, including a female taken by James L. Nation, Jr., which was kept alive for eggs. The female was set up that evening in a small jar with samples of bunchgrass and green lawn grasses. It laid one egg two days later, which was successfully reared through to the adult stage (Fig. 3).

DESCRIPTION OF THE LIFE HISTORY

EGG: The female captured on June 7 (at 4km SE Monte Cristi) laid one egg on June 9. The egg hatched on June 17, or 8 days after oviposition.

The egg is shaped like a typical *Hesperia* egg, but somewhat larger in size, resembling a truncated cone with a basal diameter of 1.5mm and a height of 0.9mm. The diameter of the top of the egg is 0.5mm. The initial color after oviposition is shining creamy white, but this coloration changes to a dull white with a grayish cast within 24 hours. The egg surface is very smooth, with no reticulation showing even under the scanning electron microscope (see accompanying figures).

FIRST INSTAR LARVA: The head capsule's maximum width is 0.65mm and the greatest dorsoventral height is 0.72mm. It is shiny black over the entire surface. There are relatively few, small punctures scattered across the frontal and lateral surfaces. Few setae are present except in the labrum area.

The body is dull olive green in color, with lighter tan flushes across the first thoracic segment and the posterior two abdomenal segments. The ventral surfaces of the thorax and abdomen, as well as the prolegs, are a light olive green. The body surfaces are smooth to the naked eye. There are two whitish or light olive dorsolateral lines running the full length of the larva, almost joining on the last two segments. The length of the mature first instar larva is 5.2mm.

The first instar molted on June 22, or 5 days after eclosion.

SECOND INSTAR LARVA: The head capsule's maximum width is 0.96mm and the greatest dorsoventral height is 1.01mm. The ground color of the head capsule is a warm brown. Starting in the center of the top of the head and sweeping downward along either side of the mid frontal suture are two orange stripes. These stripes broaden as they flare ventrolaterally on either of the brown frontal triangles above the labrum. The setal pattern on the head capsule is shown in the accompanying SEM photograph. The entire surface of the head capsule dorsal to the orange bands is punctuated with deep, regularly spaced pits.

The ground color of the body is dull dark olive green. The anterior portion of the segment is somewhat lighter in color, approaching a tannish brown in some areas. The dorsal portion of the two abdomenal segments immediately behind the last proleg-bearing segment is notably tannish in ground color. The entire surface is covered with lighter colored, short tubercles and short setae. There are two very faint, lighter-colored dorsolateral lines running the posterior half of the larva. The length of the mature second instar larva is 7.7mm.

The second instar molted on June 28, or 6 days following the first molt.

THIRD INSTAR LARVA: The head capsule's maximum width is 1.45mm and the greatest dorsoventral height is 1.56mm. The ground color of the head capsule is a warm brown, marked by the same orange pattern as in the second instar. The orange pattern in the "cheek" area does flare more laterally in the third instar. The entire head capsule surface is deeply pitted and is covered with short setae as illustrated in the accompanying SEM photograph.

The ground color of the body is dull dark olive green. Light-colored small tubercles bearing short setae cover the surface; these are arranged in obvious, closely spaced vertical (dorsal-ventral) rows. The length of the mature third instar larva is 11.6 mm.

The third instar larva molted on July 6, or 8 days following the second molt.

FOURTH INSTAR LARVA: The head capsule's maximum width is 2.04mm and the greatest dorsoventral height is 2.26mm. The ground color and pattern of orange striping are as in the third instar. The entire head capsule surface is pitted, with elevated ridges now noticeable in the areas immediately above the labium and mandibles, and with a covering of short setae arranged as illustrated in the accompanying SEM photograph.

The ground color of the body in this instar is a dull purplish brown. Light tan tubercles bearing short setae cover the surface in more-or-less dorsal-ventral rows. The length of the mature fourth instar larva is 18.8mm.

The fourth instar larva molted on July 12, or 6 days following the third molt.

FIFTH INSTAR LARVA: The head capsule's maximum width is 2.82mm and the greatest dorsoventral height is 3.03mm. The ground color and general pattern of orange striping are as in the fourth instar, except that now there are thin black lines separating the orange banding into three separate elements on each side of the midline of the head: a vertical thin orange stripe down the top half of the head capsule, an irregularly margined orange band extending 45° to the side across the bottom half of the head capsule, and an orange dot in the lower corner of the black frontal triangle on the capsule, just above the labium. The patterns of deep pits in the head capsule surface and elevated ridges, along with short curved setae, are shown in the accompanying SEM photograph.

The ground color of the fifth instar's body is a dull purplish brown. The entire surface is dotted in vertical rows and irregular groupings of light tan tubercles bearing very short setae. The

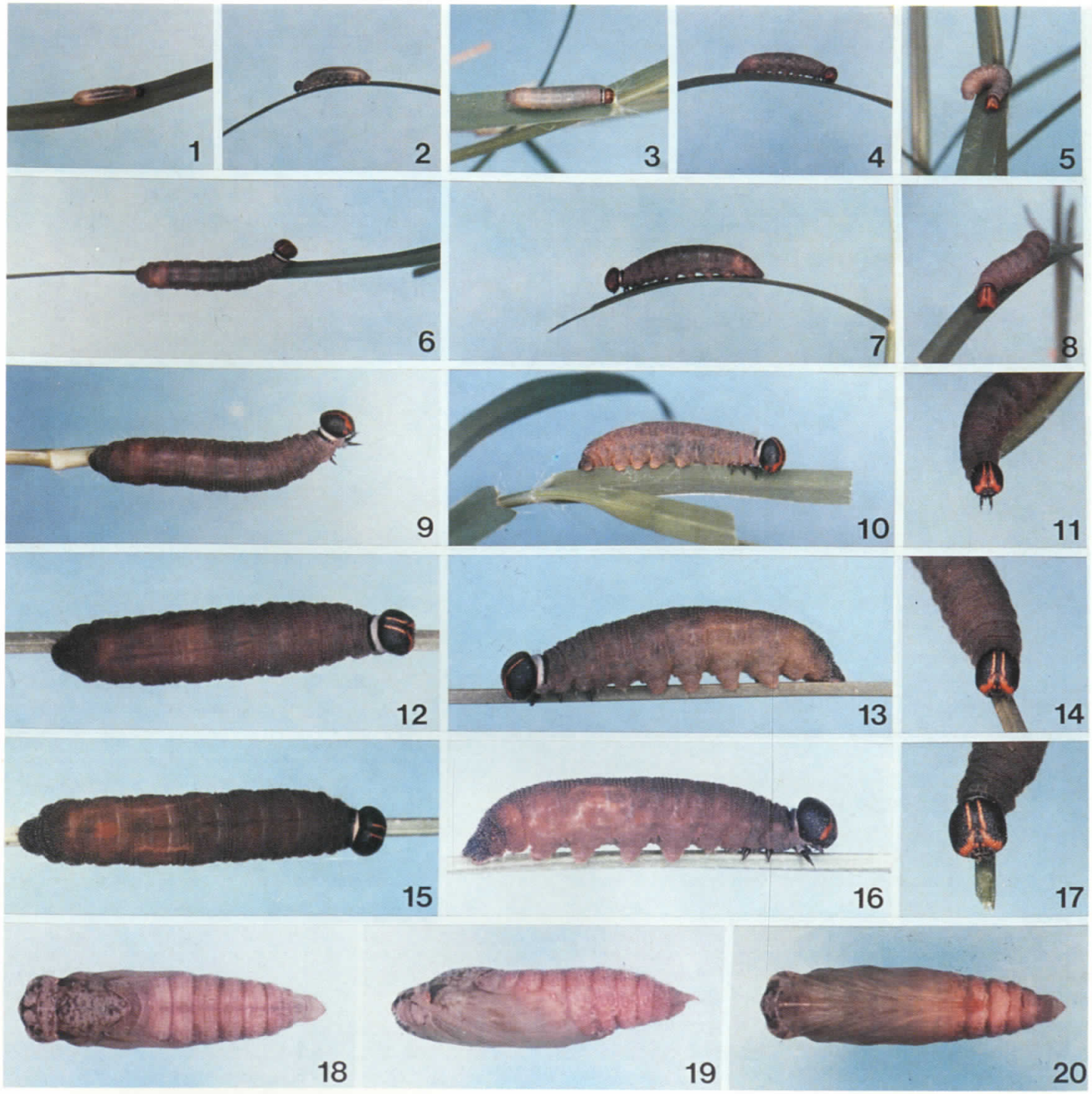

Fig. 2. Life history stages of *Hesperia nabokovi*.— FIRST INSTAR: 1) dorsal and 2) lateral views; SECOND INSTAR: 3) dorsal, 4) lateral, and 5) head capsule frontal views; THIRD INSTAR: 6) dorsal, 7) lateral, and 8) head capsule frontal views; FOURTH INSTAR: 9) dorsal, 10) lateral, and 11) head capsule frontal views; FIFTH INSTAR: 12) dorsal, 13) lateral, and 14) head capsule frontal views; SIXTH INSTAR: 15) dorsal, 16) lateral, and 17) head capsule frontal views; PUPA: 18) dorsal, 19) lateral, and 20) ventral views.

length of the mature fifth instar larva is 26.4mm.

The fifth instar larva molted on July 25, or 13 days following the fourth molt.

SIXTH INSTAR LARVA: The head capsule's maximum width is 3.14mm and the greatest dorsoventral height is 3.38mm. The ground color and general pattern of orange markings are identical to those of the fifth instar's head capsule. The surface is deeply pitted; these punctuations are surrounded by raised ridges with a covering of short curved setae, as illustrated in the accompanying SEM photograph.

The ground color of the final instar's body is dark, dull purplish brown; this coloration darkens even more on the dorsal areas of all segments, and across the entire surface of the two

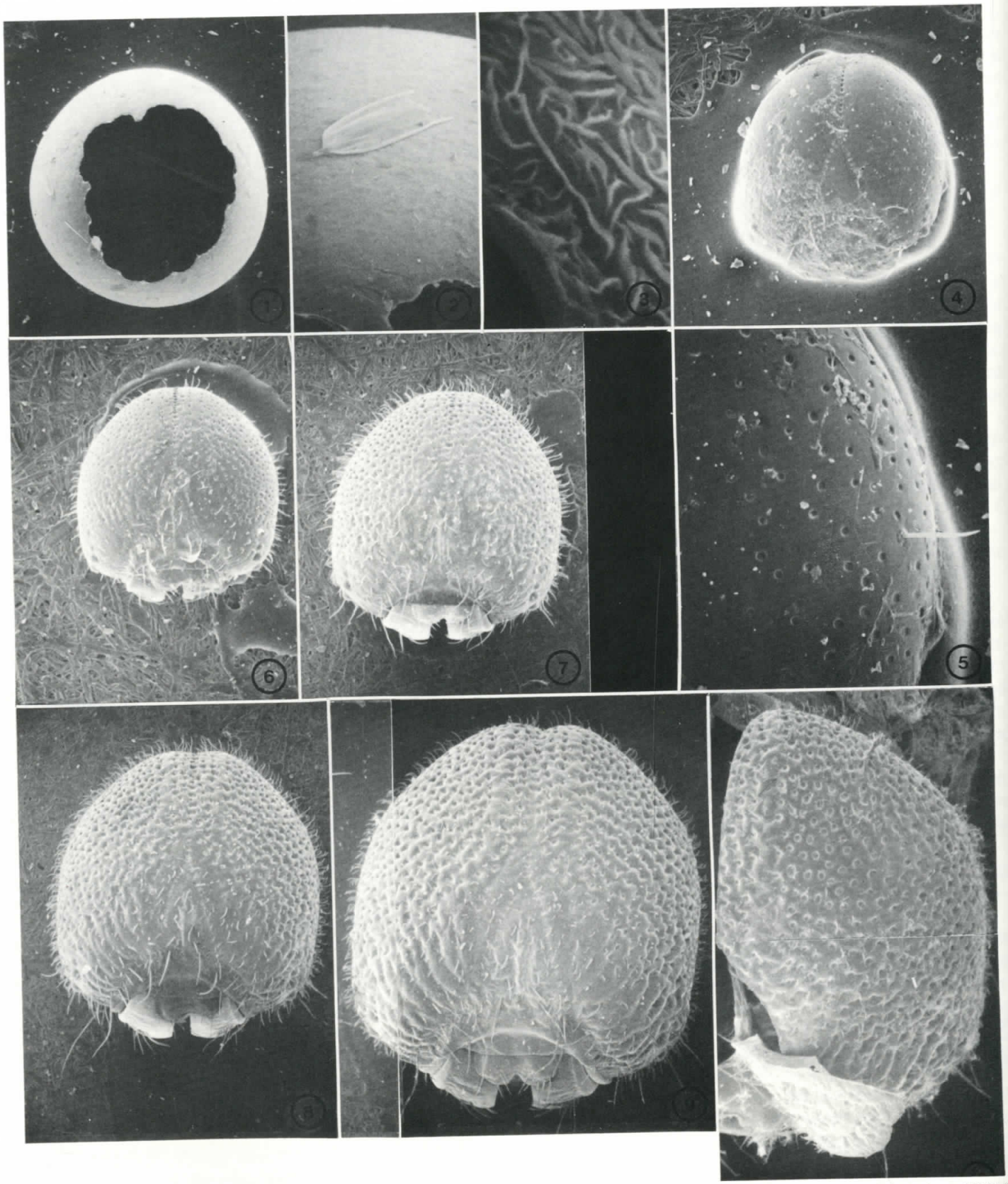

Fig. 3. Scanning electron microscope views of the egg and head capsules of the six larval instars of *Hesperia nabokovi*: 1) EGG: top view of hatched egg (50X); 2) View of egg surface and adult scale (250X); 3) Highly magnified view of egg surface (5000X); 4) FIRST INSTAR head capsule (75X); 5) Detail of capsule surface (250X); 6) SECOND INSTAR head capsule (50X); 7) THIRD INSTAR head capsule (30X); 8) FOURTH INSTAR head capsule (30X); 9) FIFTH INSTAR head capsule (30X); 10) SIXTH INSTAR head capsule [right half] (30X). Linear measurements given in text accounts. (Photographs taken on a Hitachi SEM Model S415A, by P. J. Eliazar and T. C. Emmel)

most posterior abdominal segments. The upper half of the body is dotted in vertical rows of light tan tubercles bearing very short setae. These tubercles and setae are arranged more loosely on the lower (ventral) half of the body, and occur very densely across the last two abdominal segments. The length of the mature sixth instar larva is 30.2mm.

The sixth instar larva molted to a pupa on August 10, or 29 days following the fifth molt.

PUPA: No larval shelter or silken cocoon was constructed for a pupation site. The pupa lacks any conspicuous covering of glaucous bloom. The total pupal length is 21.6mm and the dorsal width of the pupa across the front of the wing cases is 5.3mm.

The head is light, dull, olive green in ground color. Dark olive green mottling occurs on the dorsal and ventral surfaces, but not on the eyes or on the antennae beyond the first three antennal segments. The head is almost as wide (4.8 mm) as the thorax. The dorsal surface of the thorax is light olive green with extensive mottling of several darker shades of olive green. The wing cases are very light olive green and lack mottling. All the abdominal segments are light brown in ground color, with darker segmental junctions and lighter spiracles.

Short, straight, white setae occur on the dorsal and frontal surfaces of the head, and on the dorsum of the thorax. Finer and denser white setae cover all surfaces of the abdominal segments.

The pupa produced an adult male on 29 Aug, or 19 days after pupation.

ADULT: The large and stunning, orange and brown adults of *Hesperia nabokovi* have been described in detail by Burns (1987) and earlier in the original description (Bell & Comstock, 1948). Both male and female genitalia, illustrated in detail by Burns (1987), place the species clearly in the genus *Hesperia* rather than *Atalopedes*. The stigma on the male's forewing likewise shows *Hesperia* affinities, with a dark gray microandroconial mass enclosed by two rows of large, wide, silvery-gray scales to form a conspicuous arc. This is flanked by narrow, dark apical and lower brush patches, and an outward, broad, dark poststigmal patch. The male is bright orange on the upperside, with a dark outer margin and very narrowly darkened veins on both wings. Ventrally, the male is principally dull orange, with very narrow dark margins. The orange overscaling obscures the paler orange spots and macular band on the ventral surface of the secondary. The male is illustrated in color for the first time in this paper. The length of the forewing of this freshly-emerged reared male is 16.0mm, which is below the lower end of the size range (17.1-21.5mm) recorded by Burns (1987) from 10 specimens of both sexes available to him. The female (our specimens too worn to illustrate) is darker, with more brown coloring in its pattern and spotting.

GENERATION TIME (egg to imago): 94 days.

ACKNOWLEDGMENTS

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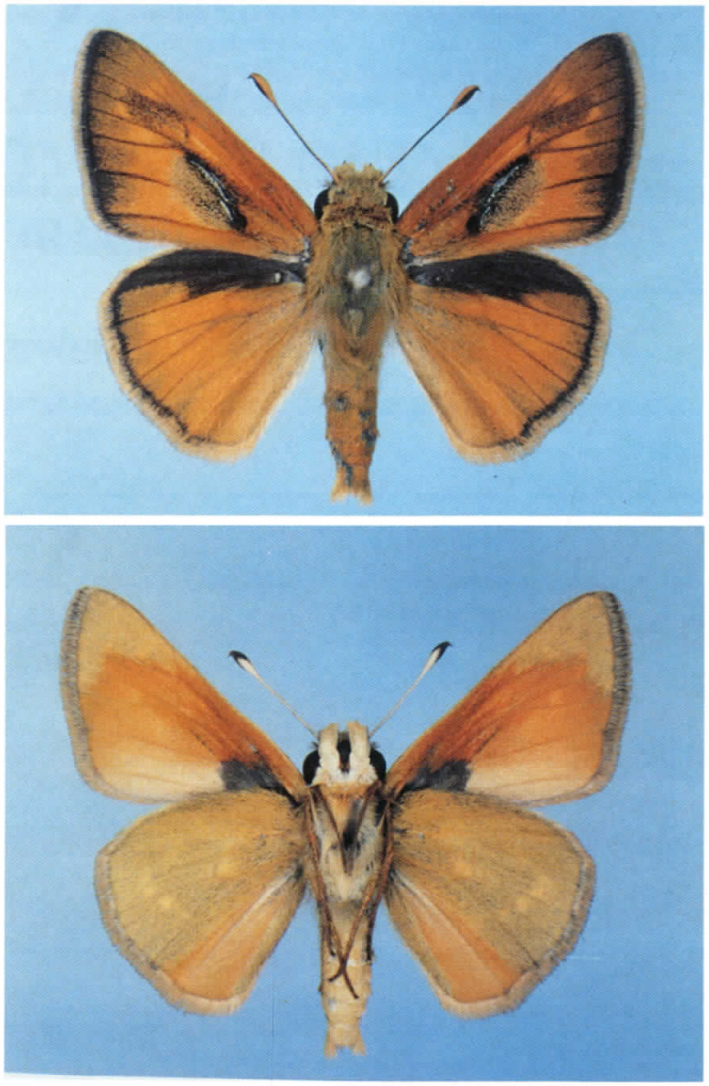

Fig. 4. Male adult (front and venter) of *Hesperia nabokovi*, reared from an egg laid by a female obtained at the Monte Cristi population site on 7 Jun 1989.

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