HYPERASPIS BINOTATA, A PREDATORY ENEMY OF THE TERRAPIN SCALE

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INTRODUCTION

One of the most effective enemies of lecanium scales is the coccinellid beetle *Hyperaspis binotata* Say. Its economic importance was impressed on the writer during the seasons of 1912 and 1913, when he was studying the life history and control of the terrapin scale (*Eulecanium nigrofasciatum* Pergande). Throughout the spring and early summer the larvæ, conspicuous by their flocculent covering, could be found in large numbers feeding upon the immature scales and overturning the adult scales. The adult beetles do not feed upon the mature scales, but they destroy the young and also attack aphides, or plant lice, and other soft-bodied insects. In view of the economic importance of this beetle a study of its life history was undertaken at the suggestion of Dr. A. L. Quaintance, in charge of Deciduous Fruit Insect Investigations, Bureau of Entomology. The work was begun in the summer of 1912 and completed in 1913.

HISTORICAL SUMMARY

Very little has been written about *Hyperaspis binotata*. Say (1, p. 303),[1] in 1826, described the male under the present name, and the female as *Coccinella normata*. G. R. Crotch (2, p. 380) considered the form with the subapical red spot as a variety of *H. signata* Olivier, and gave as synonyms *H. binotata* Say, *H. normata* Say, and *H. leucopsis* Melsheimer.

T. L. Casey (3, p. 124), in 1899, considered *H. binotata* Say as a distinct species and gave the following synonymy: *H. signata* Le Conte, *H. normata* Say, *H. affinis* Randall, and *H. leucopsis* Melsheimer.

J. G. Sanders (4, p. 3), in 1905, mentions *H. binotata* as a valuable predatory enemy of *Pulvinaria* spp. J. B. Smith (5, p. 606; 6, p. 570), in the same year, reported the same species as reducing an infestation of *Pulvinaria* spp. at Montclair, N. J., from 500 to 1,000 scales to a leaf to about one dozen scales to a leaf.

S. A. Forbes (7), in his annual report for 1908, mentions the species as one of the principal enemies of *Pulvinaria* spp. in Illinois. In 1910, W. S. Blatchley (8, p. 523), gives a key to the species of Hyperaspis found in Indiana and remarks that *H. binotata* Say is "a variety of *H. signata* Oliv., having the subapical spot lacking, color and structure otherwise exactly as in that species." W. E. Britton (9, 8), in 1914, treats this species,

[1] Reference is made by number to "Literature cited," p. 203.

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mentioning it as a great destroyer of the cottony maple scale (*Pulvinaria vitis* Linnaeus) and stating that it feeds upon both the woolly maple-leaf scale (*Phenacoccus acericola* King) and the tulip scale (*Eulecanium tulipiferæ* Cook).

These references bring the history of the species down to the date of the present paper, which deals with the life history and habits of the species when feeding upon the terrapin scale.

DISTRIBUTION

H. binotata occurs in most of the territory east of the Mississippi River and extends west of this river in some States to the semi-arid region. It is most abundant in the Atlantic States from Connecticut to Maryland, but is common from New Jersey to Illinois. All localities known to the writer are indicated upon the map (fig. 1).

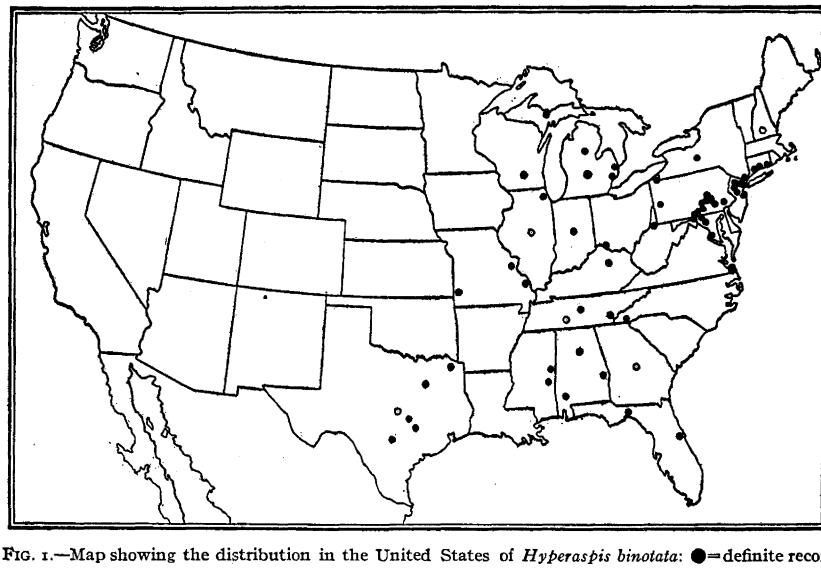

FIG. 1.—Map showing the distribution in the United States of *Hyperaspis binotata*: ●=definite record; ○=doubtful record.

HOSTS

H. binotata feeds upon honeydew, aphides, aphis eggs, and mealy bugs and other soft-bodied scales. The larvæ, so far as observed, feed upon scale larvæ and young scales. They seem to have preyed originally upon species of Pulvinaria, to the egg masses of which the larvæ have a superficial resemblance. The species thrives upon the terrapin scale and seems to be rather more abundant where it preys exclusively upon this scale.

DESCRIPTION OF LIFE STAGES

IMAGINAL STAGE

The adult (Pl. XXIV, fig. 1, 2) is a small hemispherical beetle which passes the winter in rubbish or under bark. It was described by Say (1) in 1826 from the male as follows:

"Black, lateral margin of the thorax and head yellow; each elytron with a rufous spot; body rounded-oval, convex, punctured, black, polished; head pale yellow, labrum and transverse line on the vertex piceous; thorax with a yellow margin extending for a short distance on the anterior margin; anterior margin with an obsolete yellowish line interrupted in the middle; elytron each with a rufous, orbicular, central spot."

EGG STAGE

The egg (Pl. XXIV, fig. 3), which was first obtained by the writer in 1913, is oblong-elliptical and somewhat depressed; 10 specimens measured from 0.6 to 0.775 mm. in length (average, 0.704 mm.) and from 0.218 to 0.4 mm. in width (average 0.312 mm.). In color it is light salmon, changing ultimately to ash-gray; the shell is membranous, becoming indented with age. Hatching takes place through a longitudinal slit on the upper surface.

LARVAL STAGE [1]

The first instar has characteristic markings, and represents a rather primitive type of coccinellid larva. The other instars are similar to the first, but they are covered by a white fleece of wax filaments which masks their characters.

FIRST INSTAR (Pl. XXIV, fig. 4).—Length 1.22 mm. (1.125 to 1.275 mm.), width 0.478 mm. (0.450 to 0.575 mm.); body grayish white, semiopaque, cylindrical, and tapering caudad. Head black, with a white trident spot over the epicranial and frontal sutures; three pairs of ocelli present; length 0.125 mm., width 0.225 mm. Thorax sparsely pilose, the segments each with a pair of black dots; prothorax with two black clouded areas surrounding, but mainly cephalad of the dots. Abdominal segments each with a row of eight hairs and a pair of long lateral setæ; ninth segment black above; tenth segment, the so-called anal lobe, retractile.

SECOND INSTAR (Pl. XXIV, fig. 3, *a*).—Length 2.5 mm. (1.3 to 2.75 mm.), width 1.08 mm.; body yellowish white, pubescent and covered with a white fleece. Head black with the trident spot mildly obscured; length 0.175 mm., width 0.325 mm. Thorax white, immaculate; legs gray, marked with black. Abdomen devoid of conspicuous lateral setæ.

THIRD INSTAR.—Length 2 to 3.38 mm., mostly 2.5 mm.; width 0.9 to 1.75 mm., mostly 1.125 mm. Head black, pigmentation on the posterior part of labium confluent; length 0.275 to 0.3 mm., width 0.45 to 0.5 mm., mostly 0.475 mm. Abdomen with eight pairs of conspicuous blood pores. Otherwise as in the second instar.

FOURTH INSTAR (Pl. XXV, fig. 1, 2).—Length 2.5 to 6.25 mm., mostly 5.5 mm.; width 1.125 to 2.5 mm., mostly 2.25 mm. Body subglobose, yellowish gray. Head glabrous, white, flecked with black, pigmentation on the posterior part of labium not confluent on the median line; length 0.3 to 0.375 mm., mostly 0.35 mm.; width 0.575 to 0.65 mm., mostly 0.6 mm. Otherwise as in the third instar.

PUPAL STAGE

Pupa (Pl. XXV, fig. 3, 4) inclosed within the larval skin; length 2.03 to 4.19 mm., mostly 3.9 mm.; width 1.77 to 1.86 mm.; color uniform chestnut-brown; ovate, with a depressed segmented area on the dorsum; dorsal surface hispid; ventral surface mildly pilose.

[1] A detailed morphological study of this larva by Dr. Adam Böving is in course of preparation.

HABITS AND SEASONAL HISTORY

THE BEETLES

The beetles emerge from hibernation at Mont Alto, Pa., about the middle of April and commence mating about the 20th of that month. When the species is feeding upon the terrapin scale, the beetles hibernate for the most part at the bases of scale-infested peach (*Amygdalus persica*) trees. After emerging from hibernation they soon depart in search of food and do not return to the peach until the adult scale, which the beetle is unable to destroy, begins to deposit honeydew—about the middle of May. For the rest of the season the species remains upon the peach, feeding upon the scale and its honeydew. The overwintering beetles are nearly all dead by the middle of July, while the new brood of beetles escapes from pupæ for the most part during the first half of that month.

There is some indication of a second brood, but there is not enough evidence at hand to establish it.

THE EGGS

A very typical group of four eggs just as they were deposited is shown in Plate XXIV, figure 3. It will be noticed that the eggs are not clustered, but are placed more or less at random in the irregularities of the bark adjacent to the host. The terrapin scale upon which the species was feeding is found only upon young wood, the growth rings of which supply a convenient shelter for the eggs of the beetle. It is not unusual, however, to find eggs in crevices at the base of fruit spurs or even upon smooth bark. It is worthy of note in this connection that the eggs are not placed under the scales. It was found that the membranous shell became dry and shriveled in from three to six days, and that the egg changed to an ash-gray near the end of the incubation period.

The first eggs of the season were laid upon the twigs of scale-infested peach trees at Mont Alto, Pa., on May 3, 1913, but were immediately consumed by the beetles, as were all later eggs, until the food supply became abundant. It was not until May 26 that eggs were permitted to hatch. Oviposition reached its maximum about June 5, and continued in a small way until September 1. Owing to the tendency of the beetles to devour their eggs, it was not possible to determine definitely the beginning of oviposition or the total number of eggs; 36 was the largest number obtained from a single female, but there were indications that several times that number had been deposited. Incubation lasts from six to eight days; the average for 18 eggs deposited between June 27 and 30, 1913, was seven days.

THE LARVÆ

The larvæ at the time they escape from the egg have the pigment lacking from the head, legs, and ninth abdominal segment. They begin searching at once for the terrapin scales; and when one is found, a larva enters the brood chamber through the anal cleft, where it remains during the first and second instars. The first noticeable appearance of the coccinellid larvæ in the orchard, which occurs about June 18, coincides with the beginning of reproduction of the terrapin scale. Once within the brood chamber of a scale the coccinellid larva (Pl. XXIV, fig. 4) preys upon the new-born young of that particular scale until the end of the second instar, by which time the rapidly growing coccinellid displaces the scale.

The second molt is made in the open, mostly at the base of a fruit spur. In the third and fourth instars many mature scales are destroyed, being displaced (Pl. XXIV, fig. 5) by the coccinellid larvæ as these thrust their heads into the brood chambers to secure the young scales. When all the old scales have been destroyed, the ladybird larvæ, which now have a superficial resemblance to mealy bugs, migrate to the leaves and there continue to feed upon such of the scale larvæ as were able to reach the leaves. It is estimated that a single coccinellid larva will destroy 90 mature scales and 3,000 larvæ.

The length of the larval instars, together with the number of specimens used in their determination, is shown in Table I.

TABLE I.—*Length of the larval instars of Hyperaspis binotata*

Instar.	Number of specimens.	Length of instar.		
		Average.	Minimum.	Maximum.
		Days.	*Days.*	*Days.*
First	17	2.98	2	4
Second	11	2.18	1	3
Third	7	2.71	2	4
Fourth	5	12.00	12	12

The dates at which the respective instars occur in the field are given in Table II. The first and second dates show the time of greatest abundance; the first and last dates show the total time of occurrence for each instar.

TABLE II.—*Sequence of the seasonal appearance of the larval instars of Hyperaspis binotata in the field*

Instar.	Date present in field.
First	June 17 to 20 to Sept. 15.
Second	June 20 to 22 to Sept. 20.
Third	June 22 to 25 to Sept. 25.
Fourth	June 25 to July 7 to Sept. 30.

The author has depended upon head measurements in distinguishing the instars; a key for this purpose (Table III) has proved satisfactory. As will be seen from the table, it is only necessary to consider the width of the head.

TABLE III.—*Key for determining the larval instars of Hyperaspis binotata according to width of head*

Instar.	Width of head.
	Mm.
First.....	0.225
Second.....	.325
Third.....	.475
Fourth.....	.600

THE PUPA

The pupal period lasts for from 10 to 13 days, averaging 12 days. Pupæ appear in the field early in July and are most abundant from the 7th to the 20th of the month. They are found, surrounded by the last larval skin, attached to leaves or concealed in clusters under bark. An occasional one may be found as late as October.

NATURAL ENEMIES

There seem to be very few enemies of this ladybird. No parasites were obtained, and no birds were observed to feed upon it. Aphis lions were found preying upon the eggs, and a common plant bug, *Brochymena* sp., was taken upon two occasions with this coccinellid impaled upon its beak.

SUMMARY

Hyperaspis binotata Say is found in the eastern United States and westward to the semiarid region. It feeds upon aphides and soft-bodied scales and is very effective in controlling the cottony maple scale and the terrapin scale. The eggs are salmon-colored and are deposited singly on twigs adjacent to the hosts. The life cycle requires 39 days and is as follows: Incubation, 7 days; first instar, 3 days; second instar, 2 days; third instar, 3 days; fourth instar, 12 days; pupa, 12 days.

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PLATE XXIV

Hyperaspis binotata:

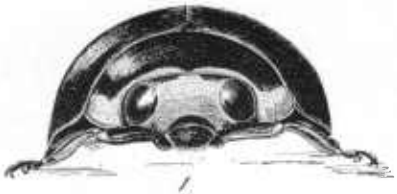
Fig. 1.—Male, showing the characteristic markings. Much enlarged.

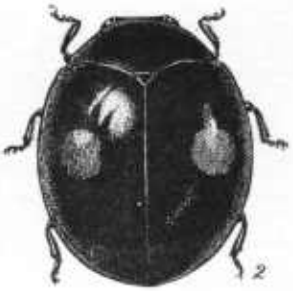
Fig. 2.—Female, showing the dorsal view. Much enlarged.

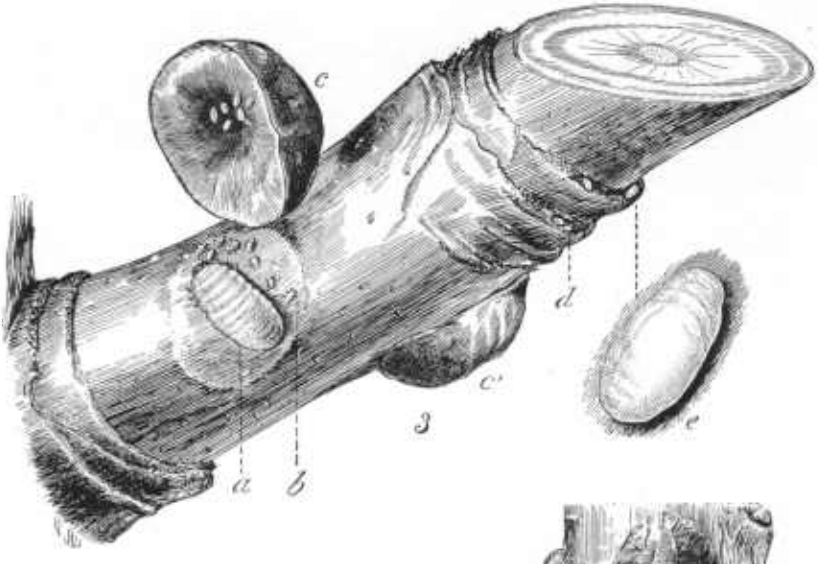
Fig. 3.—Eggs and a second-instar larva. *a*, Second-instar larva as disclosed by displacing the host; *b*, larvæ of the terrapin scale, *Eulecanium nigrofasciatum; c*, a displaced scale; *d*, eggs "in situ"; *e*, egg somewhat enlarged.

Fig. 4.—First-instar larva.

Fig. 5.—Method of attacking the mature scales during the third and fourth instars.



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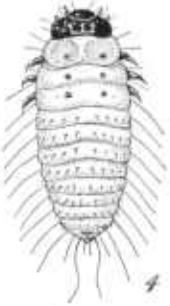
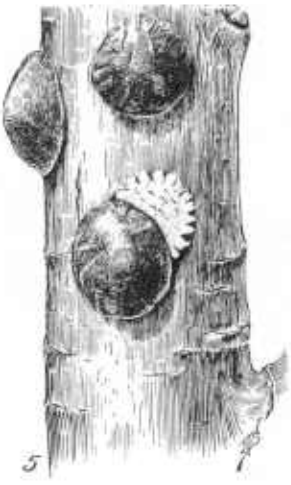
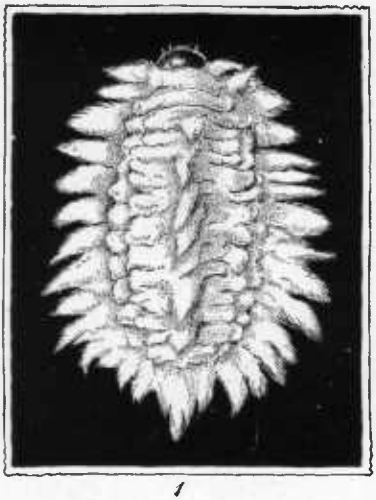




Hyperaspis binotata

PLATE XXV



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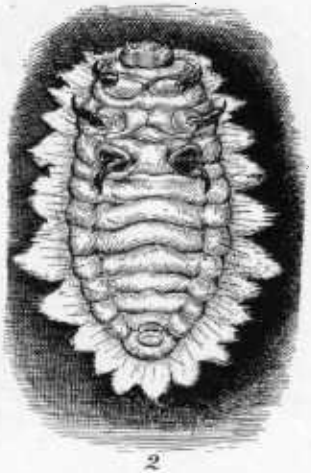

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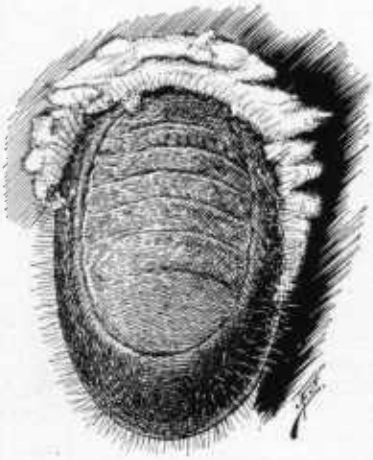

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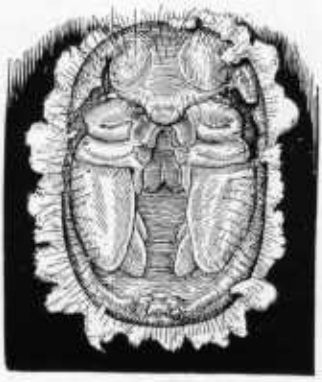

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PLATE XXV

Hyperaspis binotata:

Fig. 1.—Mature larva as it appears when attacking the leaf-attached larvæ of the terrapin scale, *Eulecanium nigrofasciatum.*

Fig. 2.—Ventral view of mature larva.

Fig. 3.—Dorsal view of pupa, showing the last larval molt skin and the depressed segmented area.

Fig. 4.—Ventral view of pupa.