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**NOTES ON THE GENETICS OF *PHYMATODES TESTACEUS*
(COLEOPTERA: CERAMBYCIDAE)**D. C. L. Gosling¹

ABSTRACT

Phenotype ratio for elytral coloration among reared offspring of *Phymatodes testaceus* suggests that this trait is controlled by a single gene with a dominant allele producing brown elytra and a recessive allele for blue elytra. The brown-elytra phenotype previously has been reported as recessive in this species.

The genetics of a natural population of insects can be difficult to determine. Lampert (1973) attempted to explain the heredity of color variation in *Phymatodes testaceus* (L.), basing his observations on 91 adults collected over a span of three years as they emerged from oak logs stored inside a woodshed. Lampert stated, without further justification, that this sample was "a good random cross section of the population." When sorted into the two principal color variations, blue or brown elytra, there were 67 beetles with blue elytra and 24 with brown. This nearly 3:1 phenotype ratio was interpreted by Lampert as supporting his hypothesis that this trait is controlled by a single gene with a dominant allele producing blue elytra and a recessive allele for brown elytra.

Although not stated in his paper, Lampert's conclusion depended upon another important assumption. If the hypothesis were correct, and if it were indeed a random sample of the population, the 3 blue:1 brown phenotype ratio could be expected only if each of the two alleles had a frequency of 0.5 in the gene pool. If we propose a competing hypothesis that blue elytra is a recessive phenotype rather than a dominant one, the same 3 blue:1 brown phenotype ratio would be predicted for a population in which the recessive allele for blue elytra had a frequency of 0.866.

Lampert did not present any information that would support his assumption of equal allele frequencies, nor any substantiation for his assertion about the validity of the sample, and his conclusion must be regarded as questionable. Nonetheless, Lampert's paper was successful in prompting further observations of this phenomenon, which I believe was his principal intent.

The first series of *Phymatodes testaceus* adults I reared came from 1-m bolts of *Carya glabra* that had been cut in April 1979 and placed in oak-hickory woodlands near Tamarack Lake in St. Joseph County, Michigan (Gosling 1981). The bolts were recovered in August 1979 and placed in rearing cages. One adult emerged in 1980, 85 in 1981, and four in 1982. Twelve (13.3%) of these had brown elytra.

In April 1983 I cut 1-m bolts of *Quercus velutina* and placed them in an oak-hickory woodland near Klinger Lake, about 5 km from the sites used in 1979. These bolts were transferred to a rearing cage the following spring and 38 adults were collected as they subsequently emerged in early June 1984. Five (13.2%) of the 38 beetles exhibited the brown phenotype.

Phymatodes testaceus is unusual among Michigan cerambycids in that the adults are active in the early evening. While making a daily inspection of the rearing cage at dusk

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on 4 June 1984, I found a single adult had emerged. As it was a female with brown elytra, and a check of the cage found no other adults present, this seemed an opportunity for an experimental mating. I transferred the female to another cage in which I placed several freshly cut bolts of *Quercus velutina*. Over the next two days, four adult males with brown elytra emerged and were transferred to the cage with the female. I observed one copulation but do not know if other mating activity occurred. All of the beetles died by 11 June.

Although I cannot identify which of the males may have fathered the subsequent offspring, I am at least reasonably sure the parents had brown elytra. Their progeny emerged in mid-May 1985; 32 (76%) with brown elytra and 10 showing the blue phenotype. While this sort of rearing lacks the controls desirable for genetic research, the data obtained do provide a better basis than was available to Lampert for speculation about heredity in *P. testaceus*.

If Lampert's hypothesis were correct, beetles with brown elytra must be homozygous for the recessive allele, and two such parents could produce only offspring with brown elytra. This is clearly not consistent with my observations. Rather, the results of my experiment support the competing hypothesis that brown is the dominant trait and blue the recessive ($\chi^2 = 0.0317, P > 0.8$). According to the Hardy-Weinberg model, the frequency of the dominant allele for brown elytra in this gene pool would be 0.067. In such a population 96.5% of the beetles with brown elytra would be heterozygous. But is there support for the point common to both hypotheses, that this trait is determined by a single gene?

When a series of specimens is examined a range of coloration is apparent. At one extreme are light-colored beetles with dark pigmentation confined to the metepisternal sclerites; at the other are beetles that are entirely dark except for the tarsi, tibia, femoral bases, and terminal abdominal segment. There is no continuum of variation, however, and at least five seemingly independent traits involving dark pigmentation are apparent:

- (1) some ventral pigmentation is always present, ranging from just the metepisternal sclerites to all exposed sclerites of the mesothorax, metathorax, and abdomen;
- (2) pigmentation of the head, generally but not invariably including the antennae and (or) anterior margin of the pronotum;
- (3) pigmentation of the distal portion of the femora;
- (4) pigmentation of the elytra; and
- (5) pigmentation of the disk of the pronotum extending to the entire prothorax.

These traits can be found in at least six different combinations (Table 1), indicating they are, to a large degree, independent. The dark pigmentation of the ventral sclerites, head, and prothorax each show a range of variation that suggests polygenic inheritance. Pigmentation of the femora and elytra, however, presents only two contrasting phenotypes and may well be determined by a single gene in each case.

Lampert also speculated on the possibility of local populations that might be homozygous or exhibit different phenotype ratios. *Phymatodes testaceus* is noted for its color variation throughout its range in eastern North America and the western Palearctic. It seems clear that selection is maintaining heterozygosity in this species, although we may

Table 1. Combinations of five independent traits involving pigmentation observed in adult *Phymatodes testaceus*. Solid symbol indicates presence of dark pigmentation.

Pigmentation	Combinations					
Ventral sclerites	●	●	●	●	●	●
Head	○	●	●	●	●	●
Femora	○	○	●	○	●	●
Elytra	○	○	○	●	●	●
Prothorax	○	○	○	○	○	●

never succeed in determining why. There is no indication of any trend toward gene fixation, and genetic drift is unlikely to accomplish this in so common and mobile a beetle, even in localized populations. However, there may be a pattern of differences in variation among local populations that would provide clues to the adaptive significance of heterozygosity in this species.

Because my principal concerns are with cerambycid ecology and behavior, I was particularly interested to note that the phenotype ratio among adults reared from *Carya glabra* bolts was virtually identical ($\chi^2 = 0.0007$, $P > 0.975$) to that among a second group reared from *Quercus velutina* bolts five years later and 5 km away. This suggests that these borers do not have innate or learned host-plant preferences, at least between *C. glabra* and *Q. velutina*, sufficient to disrupt gene flow within their gene pool. I shall probably have to look elsewhere for an explanation of why the beetles completed their life cycle in one year in oak while nearly all those boring in hickory required two years.

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