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EGG COLOR DIMORPHISM IN THE ENDANGERED SCHAUS SWALLOWTAIL BUTTERFLY, *PAPILIO ARISTODEMUS PONCEANUS*, OF SOUTH FLORIDA (LEPIDOPTERA: PAPILIONIDAE)

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ABSTRACT.– Females of the Schaus Swallowtail (*aristodemus ponceanus* Schaus) lay dark green eggs and light green eggs in an approximately 1:2 ratio in the wild on Elliott Key, Biscayne National Park, southern Florida. This color dimorphism may be maintained as a balanced polymorphism by selection for cryptic matching of new and old growth foliage of the primary larval hostplant, torchwood (*Amyris elemifera*, Rutaceae).

KEY WORDS: *Agathymus*, behavior, biology, eggs, Florida Keys, hostplants, Hymenoptera, immatures, Megathymidae, Mexico, Nearctic, oviposition, parasitoids, Rutaceae, Trichogrammatidae.

The Schaus Swallowtail (*Papilio aristodemus ponceanus* Schaus) once reportedly ranged from Key West to south Miami in Florida; today, it is found only in the upper Florida Keys and has been close to extinction for about two decades (Emmel, 1985; Emmel and Minno, 1986, 1988; Minno and Emmel, 1993). While undertaking mark-recapture and captive propagation studies of *P. a. ponceanus* on Elliott Key in Biscayne National Park, Florida, in late May of 1991, the authors observed that several females which had been confined in a large flight cage produced two different color eggs (Fig. 1). The purpose of this paper is to report our observations, suggest a possible selective basis for this color dimorphism, and compare the situation with that found in other butterflies.

A 6 x 6 x 12-foot nylon mesh flight cage was set up in the field along a trail in the tropical hardwood hammock, and the covered area included growing specimens of torchwood (*Amyris elemifera*, Rutaceae), the normal larval host and ovipositional substrate for *P. aristodemus ponceanus*. A total of 199 eggs were collected over a five-day period, approximately two-thirds of which were pale green with the remaining one-third being dark green. We found no gradation or intermediates between the two color extremes. Ovum age and fertility were not found to be factors affecting coloration. Freshly oviposited eggs were collected twice daily in order to reduce the risk of parasitism from *Trichogramma* wasps, so all eggs in each collection were of equal age. Of the 199 eggs collected, 95% were viable and produced first-instar larvae.

Fig. 1. Light and dark green eggs of the Schaus swallowtail, *Papilio aristodemus ponceanus* (from Florida Keys, laid on young torchwood leaf).

The only other American butterflies reported to exhibit egg color polymorphism of this type is the giant skipper, *Agathymus*

estelleae (Stallings & Turner) (Megathymidae), found in the vicinity of Saltillo, Mexico (Stallings & Stallings, 1986). Confined females laid from 50% to 80% eggs that were various shades of beige, and the remainder were olive green. All eggs were fertile. Stallings and Stallings (1986) noted that *Agathymus estelleae* females drop their eggs after alighting near the tip of their *Agave lechuquilla* hosts, where they fall at random to lodge between leaf axils or all the way to the ground at the base of the plant. The array of egg colors may help in concealing the eggs from predators and parasitoids that attack that skipper species. Green eggs were noted to be more cryptic when lodged in the plant, while beige eggs had the cryptic advantage when they fell to the ground. No other species of Megathymidae are known to produce eggs of different colors; all are green. Additionally, all other known Megathymidae glue their eggs to the foodplant leaves.

Papilio aristodemus ponceanus utilizes torchwood (*Amyris elemifera*, Rutaceae) as a primary host throughout its range (Emmel, 1985; Emmel and Minno, 1986, 1988; Minno and Emmel, 1993). Typically, eggs are laid on the upperside of new growth foliage, although we have infrequently found mature leaves used as ovipositional substrates. The two different color eggs produced by the captive females match closely the color of new and old growth foliage. We therefore suggest that such color dimorphism aids in cryptically concealing eggs from visually oriented predators and parasites, and may be a particularly beneficial strategy in years when new-growth foliage of torchwood is an extremely limited resource. Ant predation and Trichogrammid wasp parasitism are particularly severe selective forces on Schaus Swallowtail eggs in the Florida Keys (Emmel and Minno, 1986, 1988). Thus the observed dimorphism may be a balanced genetic polymorphism maintained by natural selection. This observation of egg-color polymorphism in the Schaus Swallowtail is the first record of egg color variation for a North American member of the Papilionidae.

From the evidence available to date, the egg deposition for each color morph seems to be random with respect to leaf color; that is, the matching may be due to chance alone, and the skewed dimorphism contributes to enhanced survival and is preserved by natural selection simply because the adult tries to choose light green young leaves and normally finds an abundance of them, but occasionally must settle for older dark green leaves in years with little rainfall. It is also possible that the female itself can determine the color of the egg as an adaptive response to the availability of the preferred young foliage (light green) versus older leaves (dark green), as responding to the annual rainfall. The color of the egg may be physiologically determined to be light or dark depending on the length of time the female has to hold it in the oviduct before encountering satisfactory substrate (young leaves) for oviposition; if young light-colored leaves are quite scarce, the female may hold the eggs longer and they deepen their chorion coloration before oviposition finally occurs on available but less satisfactory mature leaves. A less likely scenario would be the female matching her egg color to the leaf at each ovipositional event. Experiments are planned to test these hypotheses.

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