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INFLUENCE OF DAY-LENGTH ON SEASONAL DIMORPHISM OF *POLYGONIA EGEA* (CRAMER, 1775)

(Insecta Lepidoptera Nymphalidae)

Riassunto

[*Influenza del fotoperiodo sul dimorfismo stagionale di* Polygonia egea *(Cramer, 1775)*]
In base a due allevamenti paralleli ex ovo viene dimostrata una connessione diretta tra le due forme stagionali di *Polygonia egea* ed il fotoperiodo durante lo sviluppo larvale.

Abstract

On the basis of two parallel breedings ex ovo a direct connection is shown between the two seasonal forms of *Polygonia egea* and the photoperiod during larval development.

Key-words: Lepidoptera, Nymphalidae, *Polygonia egea*, seasonal dimorphism, photoperiodism, polyphenism.

Introduction

Polygonia egea (Cramer, 1775) is a Euroasiatic species, extending from Mediterranean Europe, through Asia Minor, Syria and Iran to North India.
Widely distributed in Italy, the species is present in the major islands and all over the peninsula, where it flies up to about 1300 metres in the Apennines. In North Italy it becomes scarce and is absent in the Alpine region.
The adult prefers warm places and is often found resting in the sun on old wales were *Parietaria diffusa* M. & K. (Urticaceae), the food plant of larvae, lives.
According to Verity (1950) this species flies in Italy in two annual broods, the first in May-June and the second in August-September. The butterflies of the second brood hibernate as adult and fly again in spring.
The adults of the two broods are very different.
The first brood is the nominal form *egea* Cr., slightly larger with marginal angles of the wings less pronounced, ups orange with small brown markings, uns yellow-brown with dark striae.
The second brood is the form *i-album* Esp., slightly smaller with marginal angles

more pronounced, ups darker orange with darker markings, uns brown with dark striae. Between the two forms there are no intermediates.

Personal remarks on the life cycle

In my Country the adults of this species fly again in March after hibernation. They are always of the dark form *i-album* and I have never seen in early spring specimens of the nominal form *egea*.
According to my observations this form appears normally in May and June, according to the season conditions, with large and light specimens which are of the first brood.
The butterflies soon mate and lay eggs producing a second generation with adults in July, still of the nominal form *egea*.
That is what I verified by breeding ex ovo, from a female of the form *egea* of the beginning of June, specimens of the same form *egea* in about 35 days.
I have collected and bred in Bologna specimens of the same form up to the middle of August.
On the contrary, from the second half of September to the end of October the specimens bred and found in nature are of the dark form *i-album*, that must correspond to a third generation.
Probably there is an overlap in the broods, as it happens in the species when those are more than two.
In my breedings of this species for many years, I noticed also the occasional emergence of anomalous specimens whose aspect was not in relation with the brood.
For example I have in my collection four specimens ex larva of September and October of the light form *egea* and a single specimen ex larva of June of the dark form *i-album*.
Those occurrences seem to be uncommon in nature (NARDELLI, 1981), so I think that when obtained by rearing, they may be due to environmental modification caused by captivity.

Concise synthesis of the knowledge

It is known that in many species of butterflies a short photoperiod in larval stage induces the entry into diapause, leading to the development of the spring forms (diapause-mediated polyphenism).
Most of temperate species show this behaviour: In the first brood, after the hibernation of the pupa, the spring form are produced, and in the successive broods the summer ones (MÜLLER, 1955; SHAPIRO, 1968).
There are few species in our Country which hibernate as adult, mostly Vanessiinae, and among these the species of the genus *Polygonia* have two or more annual broods with different seasonal forms.

Photoperiodically controlled polyphenism, not involving diapause, was investigated in the oriental species *Polygonia c-aureum* L. (HEADACHE & AIDA, 1963), but I was surprised to have not found experimental evidences concerning other *Polygonia*.
Through the described breedings I tested the influence of the photoperiod during larval development in *Polygonia egea*.

Methods

Since this species hibernates as adult, to determine whether the photoperiod would affect the length of the larval development, or this would affect directly the phenotype of the specimens, I reared this species ex ovo in two different conditions of day-length, getting the results here summarized.
A single female was collected on 11 April 1996 in Bologna and placed in a large cage (cm 22x55x95) with potted plants of *Parietaria officinalis* L. (a secondary host plant of this species) on a window exposed to Est, reached directly by the sun of the morning.
In the following two days 26 eggs were laid singly on the leaves.
On 15 April 1996 the eggs were randomly divided in two groups, each one of 13.
The eggs of the first group were placed in a cage (cm 34x34x42) with potted plants of *Parietaria officinalis* L., kept in a closed room and artificially lightened with a 32 Watt cool white fluorescent light.
All over the developing time, until the eclosion of the adults, the specimens were kept in a short-day photoperiod of 8L:16D and a temperature of 18-20 °C.
The eggs of the second group were left in the same cage of deposition, in natural daylenght conditions, as control.
This corresponds in our Country to a long-day photoperiod of about 16L:8D if twilight is included.
During this period the external mean temperature was of about 18 °C.

Results

The development of the first group (short-day photoperiod) occurred in the following stages:
Hatch of eggs 21 and 22 April 1996.
The young larvae soon accepted *Parietaria officinalis*.
First moult 25 April 1996.
Second moult 28 April 1996.
Third moult 31 April 1996.
Fourth moult 6 and 7 May 1996.
Pupation 11-16 May 1996.
For a disease 8 larvae had difficulties in prepupa and died failing pupation.

Plate 1 - Imagos of *Polygonia egea* bred ex ovo; dorsal views.

Figs. 1-5 - Specimens reared in natural daylenght conditions: 1. Male emerged 23.V.1996; 2. Male emerged 26.V.1996; 3. Male emerged 26.V.1996; 4. Female emerged 26.V.1996; 5. Female emerged 27.V.1996.

Figs. 6-9 - Specimens reared under short day photoperiod: 6. Male emerged 24.V.1996; 7. Male emerged 26.V.1996; 8. Female emerged 24.V.1996; 9. Female emerged 24.V.1996.

Plate 2 - Imagos of *Polygonia egea* bred ex ovo; same specimemns as in plate 1, but ventral views.

Figs. 1-5 - Specimens reared in natural daylenght conditions: 1. Male emerged 23.V.1996; 2. Male emerged 26.V.1996; 3. Male emerged 26.V.1996; 4. Female emerged 26.V.1996; 5. Female emerged 27.V.1996.

Figs. 6-9 - Specimens reared under short day photoperiod: 6. Male emerged 24.V.1996; 7. Male emerged 26.V.1996; 8. Female emerged 24.V.1996; 9. Female emerged 24.V.1996.

Eclosion: 1 male and 2 females on 24 May 1996, 1 male on 26 May 1996, 1 pupa became darker the 27 May 1996 but failed eclosion.
All the specimens obtained from the eggs and reared under short day photoperiod were of the dark form *i-album*.
Also the aborted pupa, dissected, showed to belong to this form too.
The development of the second group, reared in natural daylenght conditions as control, occurred in similar times with pupation from 12 to 16 May 1996.
For a disease two larvae had difficulties in prepupa and died failing pupation.
Eclosion 1 male on 23 May 1996, 1 female on 24 May 1996, 3 males and 1 female on 26 May 1996, 2 females on 27 May 1996.
All the specimens were of the light form *egea*.

Discussion

In spite of the different conditions of day-length there were no significant differences in the development times among the two groups of specimens, both completed their cycle from egg to adults in about 42-44 days.
This is probably due to a very little difference between the average temperature of the cage in the window and that of 18-20 °C of the cage in the closed room.
All the specimens reared in a short-day photoperiod of 8L:16D yielded to adults of the dark form *i-album*.
All the specimens reared in natural daylenght conditions as control (long day photoperiod of 16L:8D) yielded to adults of the light form *egea*.
No intermediate forms were obtained.
My results are open to further refinement but for the moment they would confirm the hypothesis that seasonal polyphenism of *Polygonia egea* is caused by the seasonal variations of photoperiod during larval development.
The critical photoperiod that determines the photoperiodic response and the switch between the two forms has not been investigated, but the time of their occurrence in nature suggests that this may be of about 12L:12D.
It would be interesting to investigate also the sensitive period (third and fourth larval instars) in *Polygonia c-aureum*) and the possible influence of temperature.

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