

Colour polymorphism in species of the genus *Notostira*  
Fieber 1858 /Hemiptera: Heteroptera:  
Miridae/ registered in Poland

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## Introduction

The *Notostira* Fieb. genus is represented in Poland by two species: *Notostira elongata* (Geoffroy, 1785) and *Notostira erratica* (Linnaeus, 1758) (GORCZYCA & TOŃCZYK, 2004), and their presence in the Palaearctic has recently been studied in depth, which pointed out to their widespread occurrence in the studied area (AUKEMA & RIEGER, 1999).

The distribution of *N. elongata* presence includes Europe, North Africa, Turkey, Northern Iran, West China and Mongolia. However, in Russia the species is present only north of St. Petersburg up to central Jacutia, in the south up to the Black Sea, the Caucasus tectonic foreland and the mountains of Central Asia and Kazakhstan. This species is likely to favour lowland zones (BOZDECHOVA, 1975).

The extent of *N. erratica* presence in Europe is very similar to that of *N. elongata*, except for England, where this species has not been reported. Many more sites of this species have been registered in Northern Europe, in the mountainous regions of Central Europe, as well as in the forest and forest-steppe zone of the European part of Russia and in the Caucasus. In Russia itself, its European part and in the north, the *N. erratica* sites predominate, in its central part those of *N. elongata*, and in the south only sites of *N. elongata* are observed. In the mountains and in the tectonic foreland of the north-western Caucasus, both species are present, in the east and trans-Caucasus *N. elongata*

clearly dominated (BOZDECHOVA, 1975). Some authors claim that the region of occurrence this species has a boreal-Alpine character (WAGNER & WEBER, 1964). Similarly KERZHNER (1964) pointed out to the more frequent presence of *N. erratica* in the forest and mountainous zones.

Because of the presence of two generations in both species during one year, other authors in their research presented different colour varieties which sometimes were treated as separate species (SAUNDERS, 1897; REUTER, 1911; 1912; GULDE, 1921; BUTLER, 1924). This hampered in a significant way an attempt to make a uniform and clear classification of the genus.

SAUNDERS already (1897) pointed out to the difference between the two colour forms of *N. erratica* described by GULDE (1921) which he considered as separate generations of the same species. KULLENBERG (1944) distinguished between the so called "I" and "II" forms, which were ultimately classified by WAGNER (1957) as *N. erratica* (L.) and *N. elongata* respectively.

Subsequent research (WOODWARD, 1952; BOZDECHOVA, 1975; WOODROFFE, 1977; GOLUB, 1978) was concerned with morphological differences between the discussed species, differences between elements of male and female copulating apparatus as well as bionomy and life cycle description of both species; however, they were not concerned with the extent of colour changeability.

The aim of this paper is to present colour polymorphism in species of the *Notostira* genus registered in Poland.

## **Material and methods**

Body colour and patterns on the head, the pronotum, the plate and hemelytrae of 314 specimens obtained from 15 different sites across Poland were analysed. Among them there were 117 females and 96 males of *N. elongata* and 57 females and 44 males of *N. erratica*. The material used during the course of the experiment was collected in 2001 and 2002; alongside specimens from the scientific collection of the *Zoology Department* of the University of Silesia in Katowice were used. The colour patterns present on particular body parts were drawn with the use of Olympus SZX9 binocular microscope.

## **Results**

### **Males**

During the course of the research on male specimens of both species, a great extent of changeability of the characteristic colour patterns was registered to occur on the head, the pronotum, plate and hemelytrae (Figs. 1-7). Such

changeability is similar in both sexes of *N. erratica* and *N. elongata* of both generations.

Despite such great changeability among the studied examples the presence of two basic colour types was recorded and presented in Figure 1.

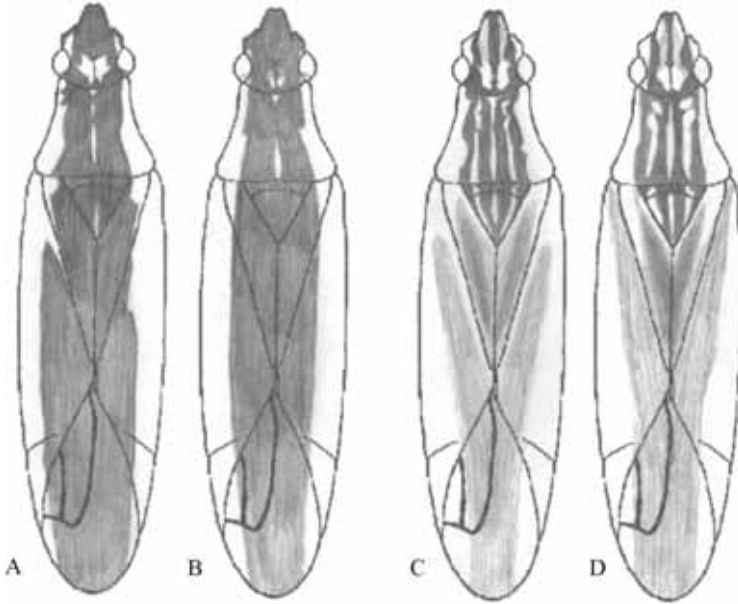


Figure 1. Two basic colour types of males: A, C- *Notostira elongata*; B, D- *Notostira erratica*

The first type characterizes males of dark colour along the body ridge of which there are more or less wide yellow or green stripes (Fig. 1 A, B). They run along from the head through the pronotum up to the end of hemelytrae crossing over to the membrane (sometimes they start on the head right behind the eyes). Among the specimens occurring in the summer, especially in the beginning of the summer these stripes acquire quite intensive colour and in the case of males which occur in late summer and in the autumn they are brighter. In the middle of the body runs a dark stripe, slightly widened in the middle part of hemelytrae and slightly narrowed at the end (Fig. 1 A, B). Colour changeability of the hemelytrae only is simply based on the changeability of colour intensity (frequently unequal on individual body parts) and on the formation of irregularities on design edges (Fig. 1 A, B).

The greatest extent of changeability of patterns was registered on the head, the pronotum and the scutellum where only in the middle line of the body there occurs a small, more or less clear, yellowish or greenish pattern (Fig. 1 A, B). On the head it forms a stain of various size which is situated on the vertex of the head and which usually is symmetrical in relation to the long body axis (Figs. 2 A-B; 3 A-F). This stain is often dark and small which makes the head seem to

be completely black. The bright design in a form of a line of diversified length, width and colour is present between the eye and the Antennifers (Figs. 2 A-B; 3 A-F). This line can be reduced to a little stain placed directly in front of the eye (Figs. 1 B; 3 B, E). Behind the eye there also occurs a small bright stain which in particular specimens disappears in different extent (Figs. 2 A-B; 3 A-F).



Figure 2. Colour polymorphism on the example of the head of *N. elongata* males

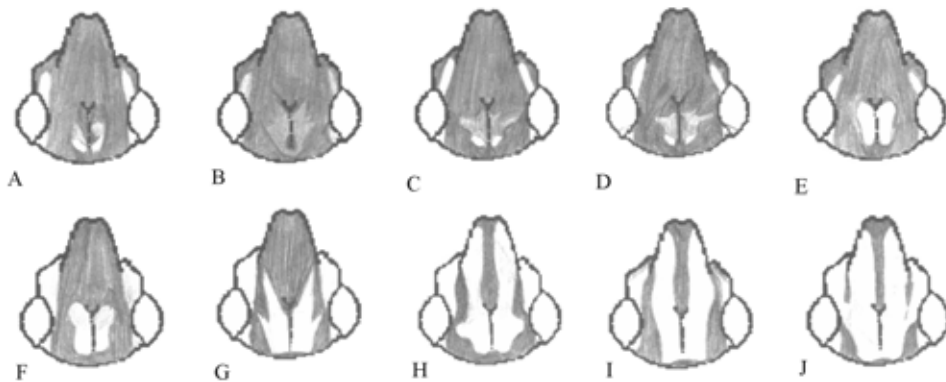


Figure 3. Colour polymorphism on the example of the head of *N. erratica* males

On the pronotum and scutellum the patterns form a longer or shorter line situated in the middle (Figs. 4 A; 5 A; 6 B; 7 B), which in the case of the scutellum often disappears completely (Figs. 6 A; 7 A).

The line on the pronotum may be partially broken and then there usually are two lines or a line and a stain in a shape of a triangle situated in the frontal hemelytrae margin (Fig. 1 A). This line may also be reduced to a large extent (Figs. 1 B; 4 A). All the described designs may have a varied intensity of colour

(also in the same specimen) (Fig. 5 A) ranging from typically bright to dark tones.

The second colour type is represented by males of straw-like or greenish colour (Fig. 1 C, D). A darker pattern present on their head, pronotum and scutellum has the pattern of irregular stripes; three stripes on the head and four on hemelytrae and scutellum. The darker stripe which occurs on hemelytrae in males of the first type is here much lighter and clearly narrows in a wedge-shaped way towards their end.

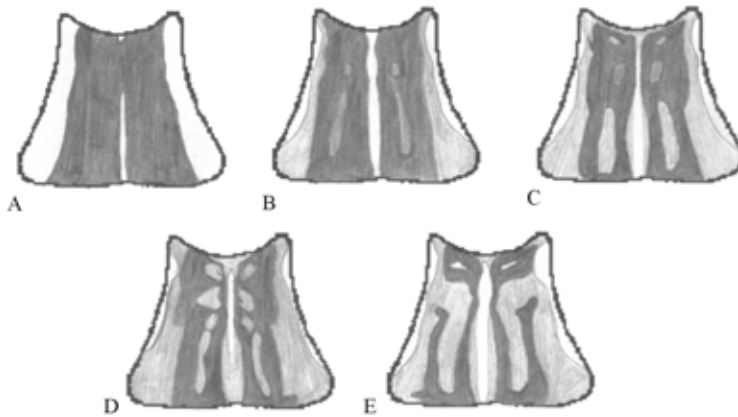


Figure 4. Colour polymorphism on the example of pronotum of *N. erratica* males

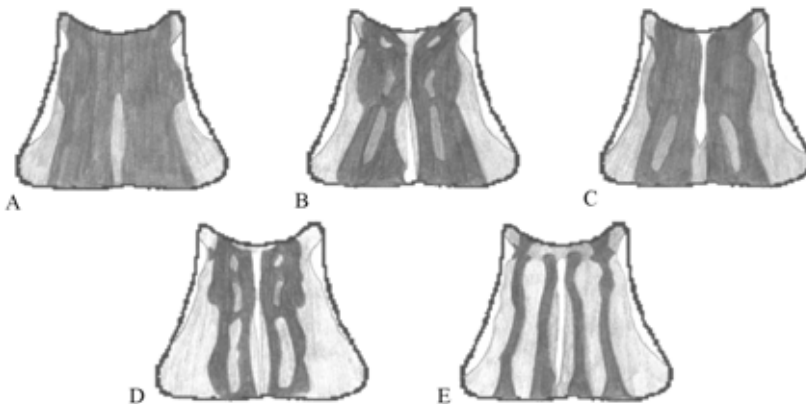


Figure 5. Colour polymorphism on the example of pronotum of *N. elongata* males

The patterns on the head may form different combinations thanks to which the course of stripes on it may be disordered (Figs. 2 C-J, 3 G-J). The pattern variations on the head are numerous, however, usually they narrow down gradually which results in their disappearance starting from the level of the vertex of the head (Figs. 2 I, J; 3 J). Reverse situations are also possible in which

there is an increase of pigmentation leading to a darkening of the front part of the head (Figs. 2 H; 3 G).

In case of patterns which occur on the pronotum, the stripes on each side often merge which results in there being only two thick stripes (Figs. 4 B; 5 B, C). When the stripes do not merge, the marginal stripes, or rarely the middle ones, tend to be irregular or strongly reduced (Fig. 4 E). However, it may also happen that the intensity of inner stripe colour is much weaker. This feature is marked much more intensely in the case of females (Figs. 14 D-F; 15 A, B, E).

A black or brown pattern on the scutellum is a continuation of stripes present on the pronotum and similarly as in the case of pronotum, the intensity of its colour is changeable. The stripes on the scutellum often join each other in one or two points (Fig. 7 C, D). Often in the case of the reduction of marginal stripes their number can be limited to two (Figs. 6 D-E; 7 F).

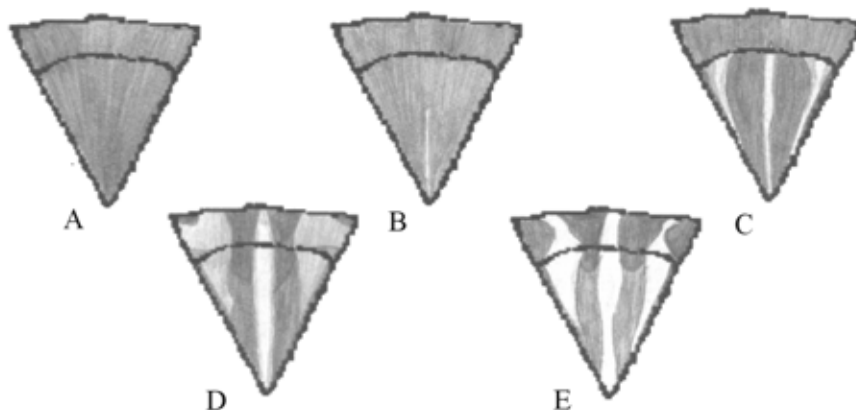


Figure 6. Colour polymorphism on the example of scutellum of *N. erratica* males

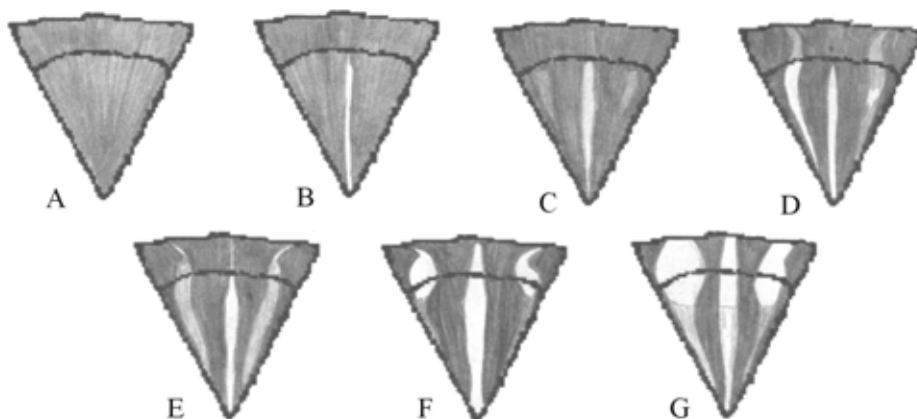


Figure 7. Colour polymorphism on the example of scutellum of *N. elongata* males

On each of the mentioned body parts the described patterns may acquire different tones of a given colour which additionally increases the number of possible combinations.

In the described colour type, just as in the case of males of the first type, runs a dark, wide stripe on the surface of hemelytrae. However, its colour intensity can be varied. Sometimes it is so pale that its presence is marked only on the clavus. Both colour types of males are recorded in the summer and autumn generations in both species; alongside many intermediate forms are observed.

## Females

A comparison of females of both species revealed the presence of an equally large extent of colour changeability, especially strongly marked in specimens of different generations (Figs. 8; 9). Such changeability is connected not only with the presence of colour patterns on the head, hemelytrae and scutellum (Figs. 10-15) as it was in the case of males but also with a clearly different colour of the whole body in females of the summer and autumn generations (Figs. 8; 9). It has to be marked that females of both species never acquire such a dark colour as the one recorded in males of the first type although one may also find forms with darker body colour among them (Figs. 8 C; 9 B). The presence of forms with protective body colour in the female autumnal generation of both species was typical (Figs. 8 D; 9 C).

The changeability concerning the colour patterns in females is very similar to that in males of the second type of colour. They have characteristic patterns forming irregular stripes: three on the head and four on the pronotum and scutellum (Figs. 8-15) and on the hemelytrae one can observe a more or less clear, wide and dark stripe which is frequently absent in autumnal generation.

Females of the *N. erratica* and females of the *N. elongata* reveal a similar extent of changeability in designs on the head, hemelytrae and scutellum, however, in case of the autumnal generation they are much less clear and bright.

The stripes present on the head and plate in both described species may form different combinations, through disappearance or merger of its particular elements just as in the case of males in the second type of colour can be observed (Figs. 10-13).

Irregular stripes on the pronotum almost never merge, however, they can often be reduced. Usually this refers to exterior stripes, rarely the interior ones, and it is based on an extensive brightening of their colour which is often connected with the disappearance of some (usually middle) parts (Figs. 14; 15).

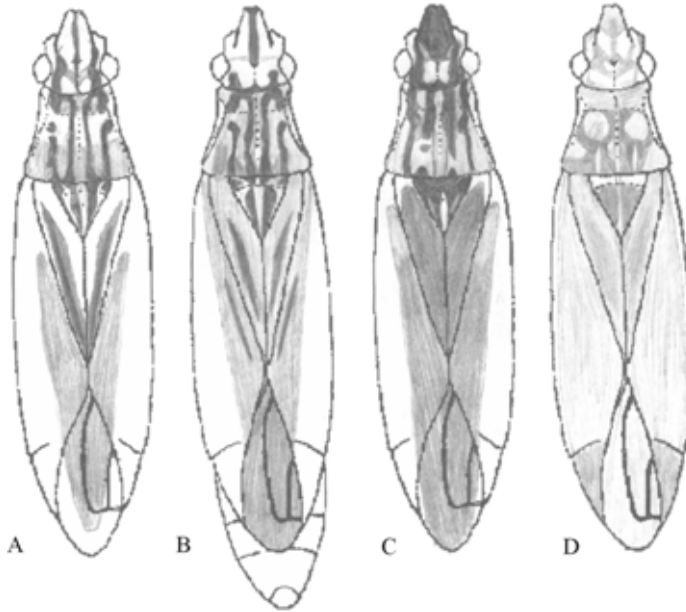


Figure 8. Colour of *N. elongata* females: A, B, C- summer generation; D- autumnal generation

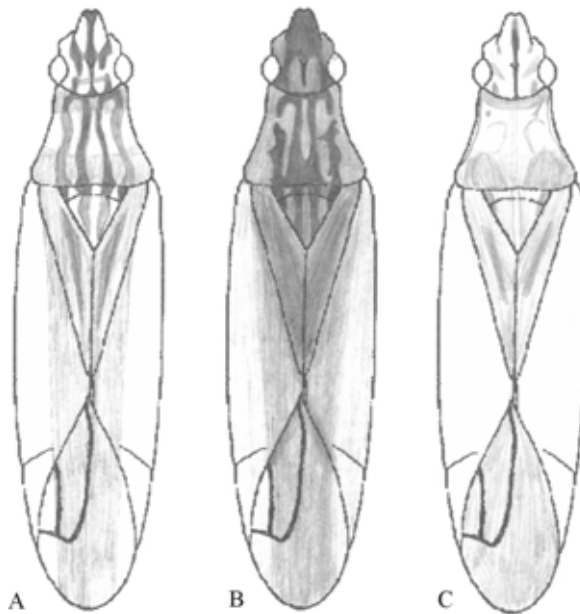


Figure 9. Colour of *N. erratica* females: A, B- summer generation; C- autumnal generation



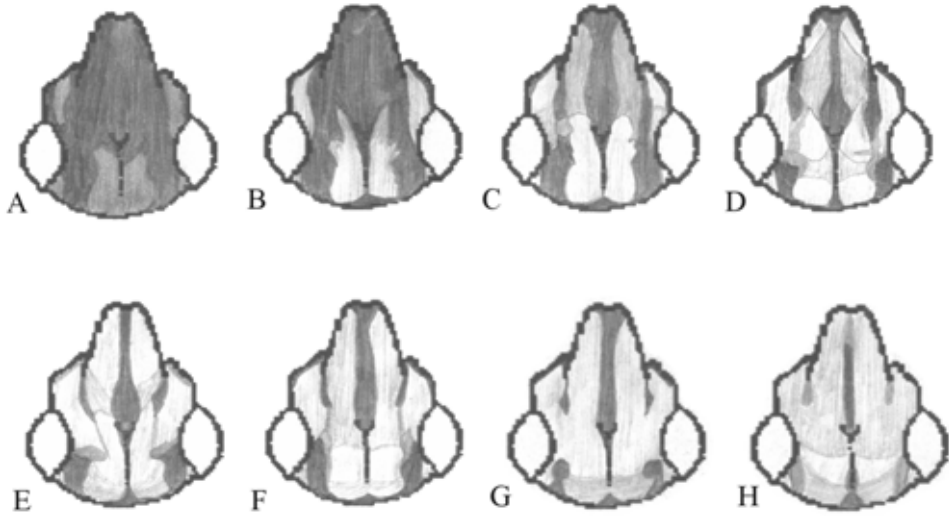


Figure 10. Colour polymorphism on the example of the head of *N. erratica* females:  
A, B, C, D, F, G- summer generation; E, H- autumn generation

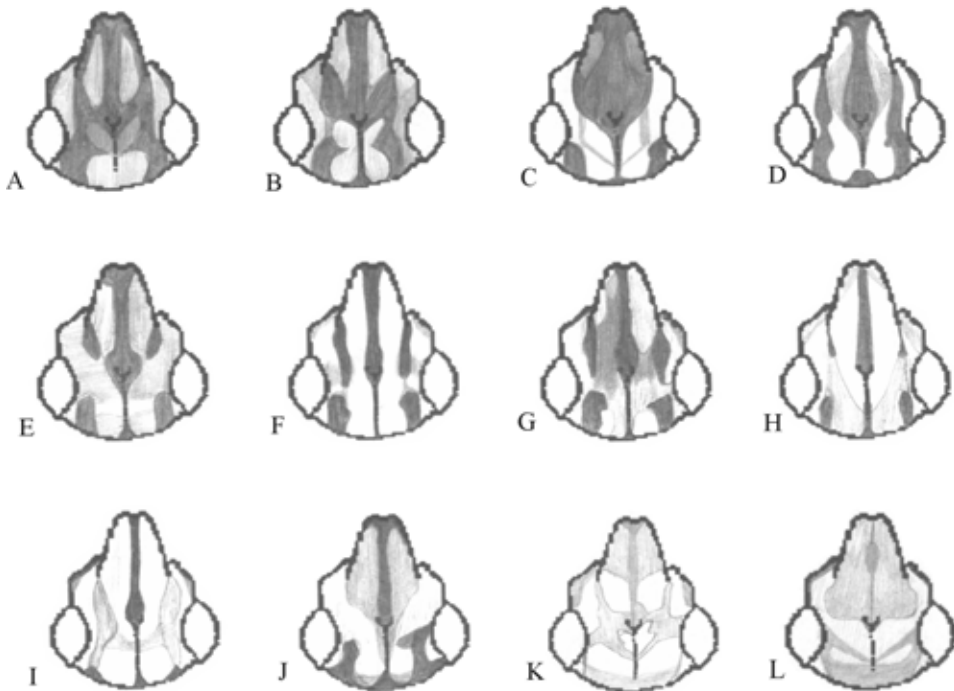


Figure 11. Colour polymorphism on the example of the head of *N. elongata* females:  
A, B, C, D, E, F, G, H, J- summer generation; I, K, L- autumn generation

In females of the summer generation green is the colour which not only dominates but also is the basic colour which decides about the total body tint. Just as in the case of males of the second type of colour there are black or brown patterns on the head, the pronotum and the scutellum. On the surface of hemelytrae in the middle part there is a dark stripe narrowing down towards the end. Exterior parts of hemelytrae are bright. In both species there tend to appear some specimens in which a dark pattern in clavus is limited to their exterior parts only (Fig. 8 A). Just as in males these colours are most intense in specimens that are recorded in the beginning of the summer. On the basis of the studied material it was observed that in specimens appearing at the end of summer the basic green colour gradually changes to become straw-coloured. Likewise, in the beginning or in the middle of the summer single specimens of a more straw-yellow tint were recorded.

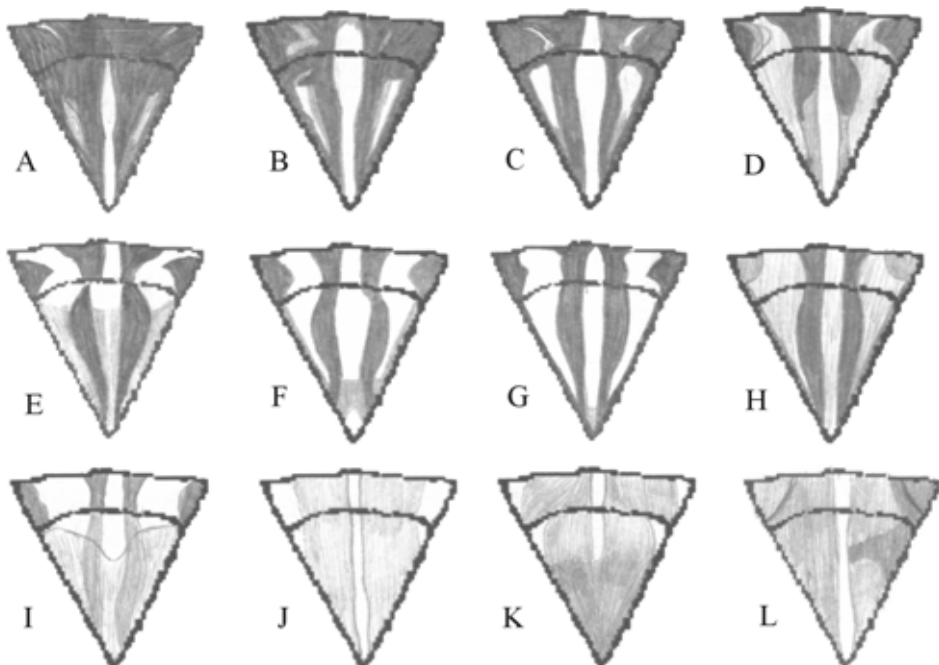


Figure 12. Colour polymorphism on the example of the scutellum of *N. elongata* females:  
A, B, C, D, E, F, G, H, I- summer generation; J, K, L- autumn generation

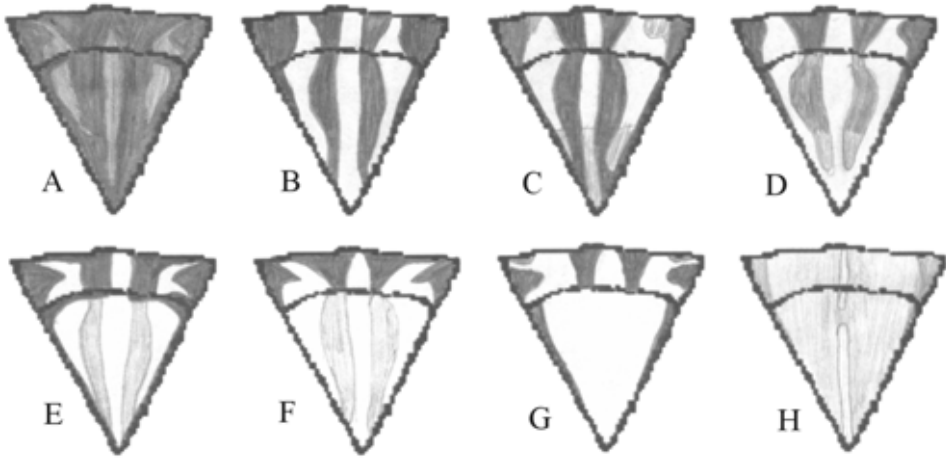


Figure 13. Colour polymorphism on example of the scutellum of *N. erratica* females:  
A, B, C, D, E, F, G- summer generation; H- autumn generation

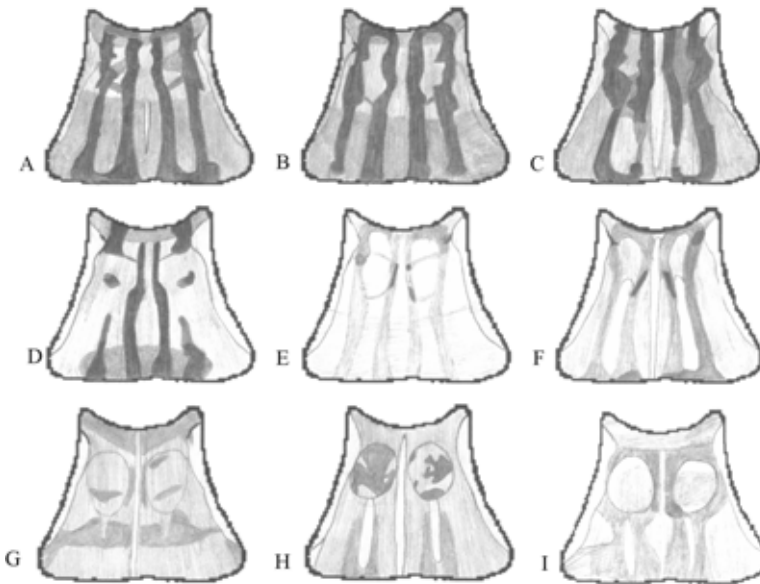


Figure 14. Colour polymorphism on the example of the pronotum colour of *N. elongata* females:  
A, B, C, D- summer generation; E, F, G, H, I- autumn generation

The autumnal generation of ochre colour differs greatly from the summer generation and shows a decidedly lower changeability of colour and pattern that are present on particular body parts (Figs. 8 D; 9 C). The colour of the

specimens of the discussed generation is often highly intense while on the surface of hemelytrae especially on the clavus there appear pale pink areas. In case of some females the entire body becomes pale pink. Patterns that are characteristic for the summer generations are very weak in the autumn generation and only slightly are they distinguished from the background. In case of females of the autumn generation which have a pale pink colour, the head, pronotum and scutellum patterns are bright. Moreover, the same bright colour have marginal pronotum and the line running across its middle. At the end of autumn females of brown body colour can be recorded, on the head, pronotum, scutellum and hemelytrae of which there can be found large grey areas. Just as in the case of the summer generation in the studied material no significant differences in colour between *N. erratica* and *N. elongata* females of the autumn generation were found.

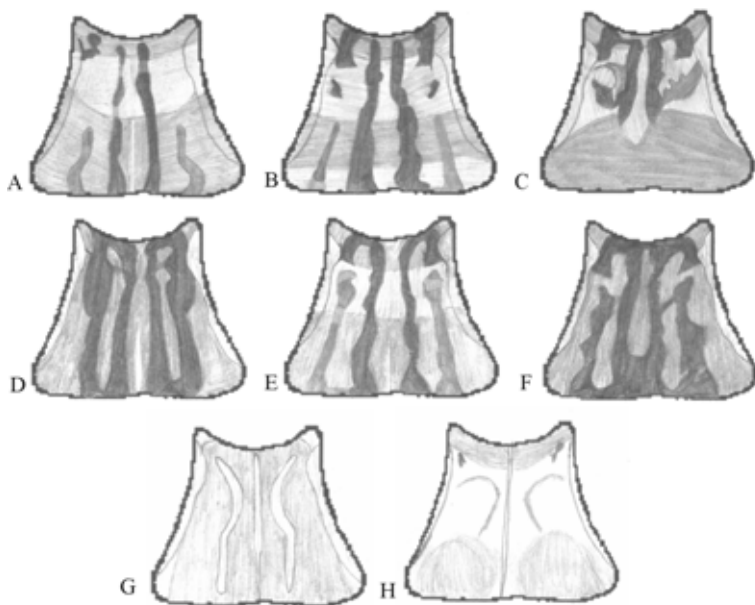


Figure 15. Colour polymorphism on the example of the pronotum colour of *N. erratica* females: A, B, C, D- summer generation; E, F, G, H, I- autumn generation

## Discussion

The obtained results let one observe an extensive level of colour changeability in both species of the *Notostira* genus that occur in Poland. Such changeability is connected not only with the presence of two generations throughout the year (in the case of females these differ greatly in terms of colour) but also with extensive variation of colour patterns in one generation of both species.

In the case of males of both species it is much more difficult to ascribe particular specimens to a given generation on the basis of colour than it is in case of females, which results from slight differences between summer and autumn generations. In the analysed material no males of ochreous body colour were recorded. However, it was observed that the changeability in male colour of both species boils down to two basic types while the changeability of patterns present on particular body parts lets one to describe a large number of variations.

Extensive changeability among females is observed not only between the generations of a given species but just as in the case of males, it concerns also specimens of one generation. This issue was considered by BUTLER (1924) and was based on the example of *N. erratica* species. In the above mentioned paper there are descriptions of four types of colour in males and five types of colour in females. BUTLER'S research seems to confirm the lack of males with a typically ochreous body colour, though he also mentions grey males with red body parts which he considers to be the fourth type of colour.

In the case of the researched females colour polymorphism has a similar extent as in males, however, rarely does one observe dark-coloured females of the summer generation which would correspond with males of the first type of body colour. The presence of specimens of the ochreous body colour which belong to the autumn generation is typical. Patterns on females' bodies in the case of specimens of the autumn generation are much less intense, however, they show an equally extensive changeability as in the case of females of the summer generation.

It seems that polymorphic changeability may be different in various populations within the reach of *N. erratica* and *N. elongata* species depending on the environment in which they occur (BOZDECHOVA, 1975), which is connected with diversified expression of genes responsible for body pigmentation and which results from the impact of the environment (HALKKA *et al.*, 1973; 1975; McLENAN *et al.*, 1994; YURTSEVER, 1999). These facts make specimens of a given generation and species which are described by various authors, can differ in terms of colour and changeability of patterns present on particular body parts. However, according to the above paper and research results by other authors (BUTLER, 1924) the body colour in males and females of both generations of the studied species may be reduced to several basic colour types.

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**Polimorfizm barwny u krajowych gatunków z rodzaju *Notostira* Fieber 1858  
/Hemiptera: Heteroptera: Miridae/**

**Streszczenie**

Artykuł przedstawia wyniki badań dotyczących zakresu zmienności barwnej, na podstawie ubarwienia i wzorów występujących u krajowych gatunków z rodzaju *Notostira* Fieb (*N. elongata* (Geoffr.) i *N. erratica* (L.)). Badania przeprowadzono na ponad 300 osobnikach, pochodzących z różnych części Polski.

Obserwowana różnorodność zarówno podstawowej barwy ciała jak również występujących na poszczególnych elementach ciała wzorów wskazuje znaczny zakres zmienności barwnej. Na jego podstawie można przyporządkować samice do określonego pokolenia, co niemożliwe jest w przypadku samców. Uzyskane wyniki pozwoliły stwierdzić dużą ilość wariacji dotyczących przede wszystkim wzorów obecnych na głowie, przedpleczu oraz tarczce, a ich przykłady przedstawione zostały w pracy.

