

## PRELIMINARY DATA REGARDING THE POSSIBILITY OF INDUSTRIAL MELANISM IN THE TWO - SPOT LADYBIRD, *ADALIA BIPUNCTATA* L., IN THE BAI A MARE AREA

*Grigorie Ștefănescu*

*Northern University Baia Mare, Romania*

**Abstract** - Research done on species that are bio-indicators of those modifications of the environment that are the outcome of industrial and urban pollution is extremely up-to-date. One of such species is the Two-spot Ladybird, *Adalia bipunctata* L., which has been paid special attention through investigations establishing the existence of a true urban-industrial melanism among its populations.

Owing to the non-ferrous industry, a high level of atmospheric pollution has been recorded in the Baia Mare area for the last decades.

The study of a representative sample of the population of *Adalia bipunctata* L. in one of the residential quarter of Baia Mare shows a frequency of 30.40 per cent for the melanic forms, suggesting the possibility of a manifest urban-industrial melanism.

**Key words:** *Adalia bipunctata* L., industrial melanism, bio - indicators of urban - industrial pollution

After vast research on populations of Two - spot Ladybirds (*Adalia bipunctata* L.), done on the basis of the gatherings from Riga and Leningrad as well as around these big urban centres in 1925 - 1959, **Lusis** (1961) reached the conclusion that the highest frequency of melanic individuals belonging to this species is met with in industrialized urban regions and decreases with the distance from such zones. At the same time, **Lusis** notices a relatively high frequency of melanic two - spot ladybirds in places with high humidity due to maritime climate.

**Zacharov and Sergievsky** (1978), by resuming the research done by **Lusis** 25 - 35 years before, presented the results of their research on Two-spot Ladybird populations from Leningrad and its outskirts. Their conclusions are both interesting and significant with regard to the causes and factors that can lead to urban - industrial melanism in the *Adalia bipunctata* L. species.

The first conclusion that came to mind was that within the populations in Leningrad the melanic forms prevail with a frequency of 84.7 % or 59.1 %, which is higher than the frequency of these forms in the populations in two suburbs of Leningrad where it is of 51.5 % and 42.9 %, respectively. During a period of 35 years, in the two suburbs the frequency of melanic forms in *Adalia bipunctata* L. increased from 22.8 % and 9 %, respectively, because of the swift pace of urbanization and industrialization which led to a higher pollution of those two suburbs.

These data yielded a second conclusion, namely the fact that the increase in the frequency of melanic individuals in the suburbs of Leningrad is a consequence of the

general pollution of the environment around this big urban-industrial centre.

Very thorough research on the industrial melanism with regard to *Adalia bipunctata* L. has been done in Great Britain. Thus, owing to a study undertaken in England and Wales, **Creed** (1966) emphasized the tight correlation between the levels of smog pollution and the frequency of melanic forms.

In a lengthier study, where he considered a great number of independent variables, recorded in 36 stations for the gathering of the Two-spot Ladybirds in Great Britain, **Creed** (1971 a) did a series of determinations of the distances to the sources of pollution, the altitude, precipitations, medium temperatures, levels of smog and sulphur dioxide pollution, etc. These data helped calculating the frequency of *Adalia bipunctata* L. melanic forms depending on fifteen variables, **Creed** establishing that the most significant factor, taken individually, is the local level of smog pollution. This was also the confirmation of the data of **Lusis** (1961) who had found a significant correlation between the frequency of the *Adalia bipunctata* L. melanic forms and the level of atmospheric humidity. In fact, we could infer that in determining the high frequency of melanic Two-spot Ladybirds there intervenes the high level of atmospheric nebulosity, which is generated by fog and haze, in combination with the smoke and thin powders produced by the industry, means of transportation, and domestic fuel consumption. Among the *Adalia bipunctata* L. melanic forms studied by **Creed** in Great Britain, the most wide-spread are the *quadrimaculata* and *sexpustulata* forms.

The decreases of the frequency of *Adalia bipunctata* L. melanic individuals in the Birmingham area as a consequence of the implementation of control's measures in the atmosphere pollution by fog was signalled out by **Creed** (1971 b) as a new proof of the relevance of the smoke pollution, when smoke is associated with fog and haze, in the determination of the high melanism met with in this species.

To go deeply into the causes of the urban-industrial melanism when it is about the *Adalia bipunctata* L., other observations need to be mentioned. Thus, **Lusis** (1961), referring to the research done by **Timofeeff-Ressovsky** (1940), who had noticed that the frequency of *Adalia bipunctata* L. melanic individuals is higher in the summer time, put forward the hypothesis according to which this fact owes to a more intense sexual activity of the melanic insects, deriving from their quicker response to the modifications of the temperature of the environment. Darker insects would get warm quicker and therefore be more active than typical forms, of lighter shades. In case this hypothesis holds good, it might be possible that in the summer, in industrial areas, where the smog reduces the sunlight to a critical level, melanic Two-spot Ladybirds have a selective advantage over the typical forms, absorbing more warmth than those and consequently being more active in order to survive and multiply.

Knowing the high level of atmospheric pollution in the Baia Mare area as well as the regime of liquid and solid precipitations, with a high frequency of the occurrence of fog and haze, we could state that smog, be it either compact or less so, could easily come into being in the atmosphere of the industrial basin of Baia Mare. This way there could be good conditions for the melanic forms of the Two-spot Ladybird to appear and even record significant frequencies. Bearing this possibility in mind, we have undertaken a series of observations that could be regarded as preliminary research. Thus, in a previous study (**Ștefănescu**, 1998) individuals of the *Adalia bipunctata* L. species have been gathered in the two campuses of the Northern University in Baia Mare, Romania. These campuses are at 1.5 kilometers from and diametrically opposed to one another in the residential quarter Sasar, yet sharing the same ecological conditions.

Thus, the individuals gathered could represent the population of *Adalia bipunctata* L. extant in this quarter, situated at the north - western limit of the town and at 6 to 8 kilometers from the main sources of industrial pollution which lie at the south - eastern and north - western town limits, respectively.

The sample studied was made up of 192 individuals, gathered from of the vegetation in the summer of 1997 year as well as from wintering spaces (1997 - 1998).

In this sample have been 123 individuals (64.06 %) of the form *typica* (red body, with two circular black spot) and 5 individuals (2.60 %) of the *extreme pale* form (orange-yellow body, no spots). Of the melanic forms, 16 individuals (8.33 %) belong to the form *quadrimaculata* (black body, with four red-orange spot) and 36 individuals (18.75 %) to the form *sexpustulata* (black body, with six red-orange spot). An interesting point is the presence of 12 individuals (6.25 %) belonging to the *extreme melanic* form (body about altogether black, with two marginal and reduced red-orange spot).

Reading the data, we find out that the frequency of melanic individuals within the population of Two-spot Ladybirds, *Adalia bipunctata* L., in the Baia Mare residential district Sasar is of 33.33 %.

This relatively high frequency of *Adalia bipunctata* L. melanic individuals is comparable to that mentioned by **Zacharov** and **Sergievsy** (1978) for populations of this species existent in the suburbs of Leningrad in 1975 - 1976 years. These two authors showed that, for instance, in the Gatchina suburb of Leningrad, the *Adalia bipunctata* L. population studied by them in 1975 counted 42.5 % melanic forms whereas in the same population studied by **Lusis** (1961) in 1932 -1935 years, the frequency of the melanic individuals only reached 9.0 %. The above - mentioned authors considered that the increase of the frequency of melanic individuals is a proof of industrial melanism since that suburb had gone through a process of intense urbanization and a considerable industrial development.

Naturally, we are to assume that the level of atmospheric pollutions in Baia Mare has always been much higher than that of a Leningrad suburb where, almost certainly, there is no non-ferrous industry comparable to the one in Baia Mare. Nevertheless, the frequency of *Adalia bipunctata* L. melanic individuals in the population of the Baia Mare residential district Sasar is less than that of the population of Gatchina - Leningrad.

A plausible explanation to this difference has to start from the kinds of noxious substances that pollute the atmosphere as well as from other factors involved in the two cases. It is possible that in the population of Gatchina the smog with a more compact smoke and higher humidity caused by the vicinity of the Finic Gulf has contributed to the high frequency of *Adalia bipunctata* L. melanic individuals. In fact, the increased nebulosity associated with the smoke of urban origin (transport, domestic fuel consumption) could be invoked in the case of very high frequency (84.7%) of the *Adalia bipunctata* L. melanic individuals in the central, highly urbanized area of Leningrad (**Zacharov** and **Sergievsy**, 1978).

In Baia Mare, the main noxious element is not the smog, with its fraction deriving from the burning of solid, liquid, or gaseous fuels, but the sulphur dioxide and the very thin industrial powders which trouble less the penetration of the solar rays to the ground, their low level being, according to some authors (**Lusis**, 1961), a decisive factor in favour of the multiplication of the *Adalia bipunctata* L. melanic forms. Under these circumstances, the frequency of melanic individuals within the Two-spot Ladybirds in Baia Mare would be relatively low, especially if also taking into account

the fact that the population investigated by us comes from a quarter diametrically opposed to the industrial area of the town, and the presence for a few years of the dispersion funnel, 351 meters high, could diminish significantly the formation of the compact, persistent smog in the atmosphere of the town.

In order to check this assumption we have done supplementary research, the results of which are presented in this paper.

### MATERIALS AND METHODS

Individuals of the *Adalia bipunctata* species have been gathered from the campus of the Faculty of Sciences (Northern University in Baia Mare, Romania). This campus is situated on the eastern limit of the Sasar residential quarter in the Baia Mare town, at 6 kilometers from the main industrial pollution sources. The studied sample included 283 individuals gathered from the vegetation in the campus in the summer of 1999 year.

### RESULTS AND THEIR INTERPRETATION

The data obtained from our estimation shows that 192 individuals (67.84 %) from the studied sample belong to the typical forms and 5 individuals (1.76 %) belong to the extreme pale form (orange-yellow body, no spots, or with five very small black spots).

Of the melanic forms 32 individuals (11.30 %) represent the *quadrimaculata* form, 18 individuals (6.36 %) the *sexpustulata* form, 2 individuals (0.70 %) *extreme melanic* form and 34 individuals (12.01 %) different *moderate melanic* forms.

The data obtained prove that the frequency of the melanic forms in the sub-population of Two - spot Ladybird, *Adalia bipunctata* L. existing in the campus of the Faculty of Sciences within the Northern University in Baia Mare is about 30.40 %. These data correspond to those obtained in a previous research (Ștefănescu, 1998) that established that the frequency of the melanic forms of the population of *Adalia bipunctata* L. species in the two campuses of the Northern University in Baia Mare, existing in the Sasar residential quarter of the town is of 33.33 %.

### CONCLUSIONS

The study of a representative sample of a sub-population of *Adalia bipunctata* L. species in the Sasar residential quarter in the town of Baia Mare shows a frequency of 30.40% for the melanic forms. The data obtained represent a stage of preliminary research, the main conclusion that could be drawn from it being the fact that the analysis of a possible industrial melanism in the Baia Mare area could be taken further given its practical importance in the field of bio-indication and monitoring of the level of urban-industrial pollution in this region.

### REFERENCES

- Creed, E.R., (1966) - *Geografic variation in the Two-spot Ladybird in England and Wales*, "Heredity", 21, 57-72.
- Creed, E.R., (1971a) - *Melanism in the Two-spot Ladybird, Adalia bipunctata, in Great Britain*, In: "Ecological Genetics and Evolutions", Blackwell, Oxford, 134-151.
- Creed, E.R. (1971b) - *Industrial melanism in the Two-spot Ladybird and smoke abatement*, "Evolution", 25, 290-293.

- Lusis, J.J.**, (1961) - *On the biological meaning of colour polymorphism of ladybeetle, Adalia bipunctata L.*, "Latvijas Entomologs", 4. 3-29.
- Ștefănescu, Gr.** (1998) - *Unele observații asupra frecvenței formelor melanice de Adalia bipunctata L. în zona Baia Mare*, "Bul. Șt. Univ. de Nord Baia Mare", Seria B, vol. XIII, Chimie-Biologie, 138-143.
- Zacharov, I.A., Sergievsky, S.O.**, (1978) - *Studies on the variation of Adalia bipunctata populations in Leningrad city and suburbs*, "Genetika", XIV, 2, 281-284.

*Date preliminare privind posibilitatea melanismului industrial la  
buburuza cu două pete, Adalia bipunctata L. în aria Baia Mare  
(Rezumat)*

*Studiul unui eșantion reprezentativ al unei sub-populații de Adalia bipunctata L. din cartierul Săsar al orașului Baia Mare estimează o frecvență de 30,40 % pentru formele melanice. Datele obținute reprezintă o etapă a unei cercetări preliminare, principala concluzie care poate fi desprinsă din ea fiind aceea că analiza unui posibil melanism industrial în aria orașului Baia Mare ar putea fi efectuată în viitor, dată fiind importanța practică în domeniul bioindicării și monitoringului nivelului de poluare urban industrială în această regiune.*