

## Dissertation abstract

### Biology, ecology and distribution range of *Eurythyrea austriaca* L. in Poland

There are about 15,000 species in the *Buprestidae* family worldwide. One of them is *Eurythyrea austriaca* L. The insect is herbivorous and its developmental cycle is associated with coniferous species, most commonly the silver fir (*Abies alba* Mill.). The species is currently under partial protection in Poland.

The scarcity of studies on the range of occurrence, ecology of the species and its biology, as well as preliminary observations made, allowed us to formulate the following hypotheses: H1 – In Poland *E. austriaca* is a species occurring more frequently and over a larger area than previously thought; H2 – The contemporary forest management model does not negatively affect the occurrence of *E. austriaca* in commercial forest stands in Poland; H3 – The species shows considerable variation within the country, both in terms of the size of individuals and the shape of the emergence holes; H4 – *Eurythyrea austriaca* can develop on coniferous species other than silver fir occurring in Poland; H5 – The species prefers thermally favoured microhabitats.

Based on the hypotheses adopted, the objectives of the study were formulated for their verification. The main objectives of the study were to determine the range of occurrence of *E. austriaca* in the country, to learn about its biology, morphology, ecological requirements and variability, and the influence of the current forest management model on the status of the population, by comparing the occurrence sites located in economic stands under the management of the State Forests National Forest Holding with those located in protected areas.

The study were carried out in forest districts, reserves and national parks where the silver fir, the main host plant of *E. austriaca*, occurred. 74 forest districts, 34 reserves and seven national parks met the study criteria.

During field work in 2017-2021, a total of 5342 trees were searched for infestation by *E. austriaca*. The presence of traces of *E. austriaca* was confirmed on 2111 trees. On the basis of the results obtained, it was concluded that *E. austriaca* occurs in Poland in six separate locations on the territory of four Regional Directorates of State Forests: Wrocław, Kraków, Krosno and Lublin.

A study of the morphology and biology of *E. austriaca* proved that its eggs are oval, smooth, whitish in colour, measuring 0.7×1.5 mm. Their incubation period is between 25 and 30 days. The larvae are typical representatives of the *Buprestis* type. Their body consists of 13

segments, with the initial four having unique diagnostic features. Based on the termination of the anal sternite in the larval stage, the sex of the individual can be determined. The larval tunnels reach an average of 80 cm in length and are intricate and usually found throughout the thickness of the silver fir trunk. When the trunk is heavily infested, the tunnels intersect. The larvae feed in the wood, under natural conditions, for four to five years. Individuals that will swarm in a given year feed until mid-May, after which they pupate. This stage lasts three to four weeks and ends between 10 and 15 June with the emergence of the imagines. The toppling of a tree colonised by *E. austriaca* has a significant impact on the success of its pupation. Larvae developing in lying material had a significantly higher mortality rate than those in standing material.

The colouration of the imagines of *E. austriaca* is always metallic but highly variable. The head is orthognathic, the eyes of males are larger than those of females. Females are larger than males and also differ in colouration. Females are usually metallic green-copper-blue of varying colour intensity while the colouration of males is always closer to various shades of dark blue, especially on the ventral side of the body.

The perfect forms of *E. austriaca*, after emerging from the trunk, move up the side of the trunk on the sunny side, taking advantage of the cover of detached bark and cracks in the trunk, before flying into the crowns of the nearest silver fir trees. The flight of these insects is fast, noisy. Under artificial breeding conditions, it has been established that the perfect forms carry out complementary feeding on the youngest needles and fir honeydew.

Females signal their readiness to copulate by positioning themselves head down on the trunk. Intercourse lasts a short time, less than a minute. In total, one female lays about 150 eggs in batches of 20-40 during its lifetime. Imagines move most intensively between 12 a.m. and 2 p.m., after which a gradual decrease in their activity can be observed, as well as the increasing departure of individuals into the tree crowns. During swarming, some individuals move considerable distances, up to 12 km.

A model describing their shape was built on the basis of the measured exit holes of *E. austriaca* and insects from the families *Cerambycidae* and *Siricidae*. The overall correctness of the model was 92.68%, with the exit holes of *E. austriaca* being recognised correctly in 100%. Similarly, the model built to determine the affiliation of *E. austriaca* exit holes to selected subpopulations from the three sites was 80.79% correct in separating exit holes into groups described as: Bieszczady, Roztocze and Przemyskie Foothills.

*Eurythyrea austriaca* usually foraged in the wood of dead and dying fir trees, although egg-laying was observed on living trees in good condition with only locally damaged bark. Wood with sign of an infestation by *E. austriaca* was usually characterised by low moisture content. An attempt to artificially infest the wood of selected coniferous tree species occurring in Poland, such as Scots pine (*Pinus sylvestris* L.), Norway spruce (*Picea abies* L.), European larch (*Larix decidua* Mill.) and silver fir, was successful. The size of the larvae, despite the simultaneous colonisation of the trunks, varied significantly depending on the species of wood that was colonised. Three years after the start of rearing under artificial conditions, differences in size of the imagines were also found within the individuals colonising the same trunk.

In commercial stands, 42.8% of all trees surveyed have larval galleries of *E. austriaca*, in the form of exit holes. A very similar proportion of trees of this type was found in reserves. However, in the national parks, colonised trees accounted for only 26.9%. The vast majority of exit holes of *E. austriaca*, as much as 76%, were found in commercial stands. Exit holes of this species found in national parks and nature reserves accounted for only 14% and 10% respectively. On the basis of the surveys carried out, *E. austriaca* was found in: 30 forest districts, four national parks (Roztoczański National Park, Magurski National Park, Pieniński National Park and Bieszczadzki National Park) and 15 nature reserves.

In the surveyed stands, the highest number of trees colonised by *E. austriaca* was found on the southern slopes. The breeding material with traces of this species was mostly lit from the southern direction. In the case of trees bearing traces of feeding by *E. austriaca*, canopy cover immediately surrounding the analysed material was statistically lower in economic stands than in protected areas, which included national parks and reserves.

The degree of wood decomposition was very similar in all forest groups studied. A similar relationship applied to breast height and tree height. Statistically significantly higher values were reached by the thickness of lying trees in national parks, where the average value of this trait was 89.34 cm, while in reserves it reached 69.95 cm and in commercial stands 68.81 cm. The area of the side of the trunk deprived of bark was the largest in the reserves and was statistically significantly different from the other studied stand groups. The most common cause of death of trees colonised by *E. austriaca* was mainly wind, accounting for 41% of their deaths while the second most important factor was insect attack. The least frequent cause of death of trees colonised by *E. austriaca* was the negative influence of the silver fir mistletoe (*Viscum album* ssp. *abietis* (Wiesb.) Abrom).

Genetic studies on selected individuals yielded COI gene fragment sequences of 709 nucleotides. The genus *Eurythyrea* forms a clearly distinguishable group on the tree obtained as a result of phylogenetic analysis, but is located at a considerable distance from other representatives of the tribe *Buprestini*, to which it was classified by systematists on the basis of morphological features and is undoubtedly similar to them. The clade itself, comprising the specimens of the species under study, is slightly differentiated and it is possible to distinguish certain subgroups within it that only partially correspond to the sites of their capture.

Based on the results obtained, all the formulated hypotheses were confirmed; the species is definitely more abundant in Poland than so far expected. The higher percentage colonisation of trees in economic stands than in protected areas suggests that the current forest management model does not have a negative impact on the occurrence of the studied species. The variability of the species within the country is considerable, which is confirmed by the results of analyses based on biometric measurements of selected traits of imagines and exit holes, and partly by the results of genetic studies. Although the preferred species on which *E. austriaca* develops is silver fir, it is also capable of colonising Norway spruce, Scots pine and European larch. The insect has specific requirements for breeding material, preferring strongly insolated dead or dying fir trees on south-facing slopes.

**Keywords:** *Buprestidae*, *Abies alba*, microhabitat, biometrics, phylogenetics