Spathius curvicaudis (Hymenoptera: Braconidae) new for The Netherlands; a parasitoid of the oak buprestid beetle, *Agrilus biguttatus* (Coleoptera: Buprestidae)

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Abstract: Recently, populations of the buprestid beetle *Agrilus biguttatus* have increased in The Netherlands. By chance, a larva was found to be parasitised by the braconid wasp *Spathius curvicaudis*, a new species for The Netherlands.

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Introduction

During the beginning of the nineteen eighties, oak decline has been observed all over Europe. This phenomenon seems to be correlated with a complex of factors such as defoliation by insects, water stress, late winter frosts and infestations by fungal diseases (Hartmann & Blank, 1992). During the nineties, especially in Germany, infestations by the oak buprestid beetle, *Agrilus biguttatus* (Fabricius) (= *A. pannonicus* Piller & Mitterpacher) also contributed to the decline of the oak. The larvae of this species (fig. 1) excavate galleries under the bark of weakened trees (fig. 2). As a result of this girdling the trees will die. Recently, reports from other countries also referred to important infestations by the larvae. In England, *A. biguttatus* was listed in the British Red Data Books as a vulnerable endangered species (Gibbs & Greig, 1997). However, recently it has shown a remarkable revival. In the London area, larvae and exit holes were found in many dying and dead oaks in woodlands and parks (Hackett, 1995). Also in France, Poland and Hungary the beetle has recently become an important factor in oak decline (Moraal & Hilszczanski, 2000).

Bionomics of *Agrilus biguttatus*

The buprestid beetle *A. biguttatus* is a Palaearctic, Euro-Siberian species, present all over Europe except Finland (Bily, 1982). Host plants are *Quercus*-species except the American *Quercus rubra* Linnaeus (Moraal & Hilszczanski, 2000). In May-July, the beetle deposits groups of 5-6 eggs, on bark on the south-side of the tree. The cream-coloured and legless larvae are relatively long and flat, with a pronotum that is a bit wider than the rest of the body. They have a distinctive tail-segment that terminates in a pair of minute black-brown horns (Klausnitzer, 1994). The larvae excavate zigzagging galleries under the bark, up to 150 cm long. The insect may have an one-year cycle, but a two-year cycle is more common. The mean length of the larva during its first year is about 10 mm and 25-43 mm during its second overwintering. More information on bionomics and infestations can be found in Moraal (1997) and Moraal & Hilszczanski (2000).

Agrilus biguttatus in The Netherlands

In The Netherlands, the adult beetle is known

Fig. 1. The larva of *Agrilus biguttatus* (photo: A. van Frankenhuyzen).

Fig. 2. Dead tree with old larval galleries (photo: L. G. Moraal).

from several provinces: Drenthe, Overijssel, Gelderland, Zuid-Holland, Noord-Brabant and Limburg (Brakman, 1966). However, during the annual monitoring of insect pests on trees since 1946 (Moraal, 1991), infestations of the larvae have never been observed. The very first observations of infestations date from 1997. During that year, many larvae and exit holes were found in oak trees in several locations (Moraal, 1997).

Locally, an important oak decline is still occurring and therefore a research project was started in 1999, to collect data on the magnitude of the decline and its causal factors. In 122 oak stands, dead trees were examined for infestations of the buprestid (Oosterbaan et al., 2001). If no exit holes of the adult beetles were found, the bark was removed to investigate the possible occurrence of larvae in their galleries in the cambial zone.

This research was also done on July 27th in 1999 in an oak forest at "Landgoed Twickel" near Delden. The 61-year-old trees had a mean diameter at breast height (dbh) of 45 cm. In this forest stand, several recently dead trees were present. On removing some bark, a circa 24 mm long, lifeless larva of *A. biguttatus* was found. During the vegetation period, the larvae are active in the cambial zone behind the bark. It was therefore very surprising that a larva was found in an overwintering cavity inside the bark. For many ectoparasitoids it is known that the females paralyse the host larva during their oviposition and that they prefer a large individual larva of a late instar. Therefore the specimen was collected for further inspection. Microscopical investigation showed that six larvae of an ectoparasitoid, about 2 mm long, were present on the outside of the buprestid body. The larvae were reared at room temperature and the adult parasitoids (5 females and 1 male) emerged almost one month later on August 30th.

Spathius curvicaudis

The parasitoids were identified as *Spathius curvicaudis* Ratzeburg (Hymenoptera: Braconidae), a new species for The Netherlands. This braconid wasp differs from other *Spathius*-species by its markedly up-curved ovipositor. This insect is recorded to parasitize not only *Agrilus biguttatus* but also *A. elongatus* Herbst, *A. subauratus* Gebler, *Buprestis rustica* Linnaeus (Buprestidae), *Xestobium plumbeum* (Illiger), *Hedobia pubescens* Olivier (Anobiidae), *Obrium cantharinum* (Linnaeus)(Cerambycidae), *Magdalis carbonaria* Linnaeus, *M. armigera* Geoffrey. (Curculionidae) and *Scolytus multistriatus* Marshall (Scolytidae) (Hedqvist, 1998; Herting & Simmonds, 1973).

In addition to The Netherlands, the distribution of *S. curvicaudis* includes England, France, Sweden, Germany, Hungary, Italy, Poland, Turkey, Serbia, Czech Republic and Russia (Hedqvist, 1998; Herting & Simmonds, 1973; Moraal & Hilszczanski, 2000; Shaw, 1988).

Most *Spathius*-species are solitary ectoparasitoids, *but S. curvicaudis* is a gregarious one. The adult female use the ovipositor to penetrate the substrate to oviposit on or near the host. In most cases the host is probably stung and paralysed first. But it has been observed that host activity continued for a while after parasitisation by a species of *Spathius* (Robert, 1961; Shaw & Huddleston, 1991). This might explain why we found the parasitised *Agrilus* larva during summer in its overwintering cavity. In summertime, the larvae are found to be active in the cambial zone behind the bark. During autumn they leave their galleries to excavate a small cavity deep inside the bark just below the surface. In this cavity they overwinter as a larva. In spring they pupate and the adult beetle gnaws its way through the bark. We suggest that a parasitised larva leaves the gallery earlier. This enables the adult *Spathius* to escape easier through the bark. Larval development of *Spathius* spp. is fairly rapid; some species are plurivoltine and in all cases the winter is passed as a final instar larva in its cocoon, which is spun in situ and from which the adult emerges through an irregular chewed hole (Shaw & Huddleston, 1991).

Other natural enemies

The natural enemy complex of *A. biguttatus* is not rich. The most notable are birds, such as woodpeckers, feeding on the overwintering larvae inside the bark. Among insects, only a few species are recorded as being associated with this buprestid: *Ephialtes imperator* Kriechbein (Ichneumonidae), *Atanycolus sculpturatus* Thompson, *Doryctes rex* Marshall, *Spathius rubidus* (Rossi), *S. ligniarius* Ratzeburg, *S. radzayanus* Ratzeburg and *S. curvicaudis* Ratzeburg (Braconidae) (Hedqvist, 1998; Herting & Simmonds, 1973; Moraal & Hilszczanski, 2000).

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