

Short scientific note

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An update on the ethoecology of the exceedingly restricted and most outstanding Italian endemic moth, *Brahmaea (Acanthobrahmaea) europaea* Hartig (Lepidoptera: Brahmaeidae)

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Abstract

Brahmaea (Acanthobrahmaea) europaea Hartig, 1963, is an Italian endemic species exhibiting a very restricted geographic distribution (Basilicata and Campania regions, Grotticelle di Monticchio Nature Reserve and neighbouring areas); only a few Oleaceae (*Fraxinus angustifolia* subsp. *oxycarpa*, *Ligustrum vulgare* and *Phyllirea latifolia*) have been recognized as larval host plants for this species. Before 1997 only adult moths were collected with artificial light. After 1997, egg clusters and larvae were located, inside and outside the Reserve, so allowing to investigate the specific habitat preference, conservation status and survival of *B. europaea* in order to draw up strategies for the conservation of this species. The comparison of the previously found egg clusters (2014–2017) has revealed interesting common traits, and during the spring of 2021, the discovery of another egg cluster allowed to amplify and further define some aspects of the ethology and ecology of this moth.

Key words: *Brahmaea (Acanthobrahmaea) europaea*, Brahmaeidae, Lepidoptera, egg cluster, behaviour, habitat, Italy.

Brahmaea (Acanthobrahmaea) europaea Hartig, 1963, the so-called European Owl Moth or European Bramea, is an Italian endemic exhibiting an exceedingly restricted geographic distribution (Hartig 1963, 1966, 1997; van Schepdael 1967; Rougeot 1971, 1975; Parenzan 1978; Bertaccini et al. 1995; Mosconi et al. 2014). In 1971, a nature reserve was established to protect this species, the “Riserva Naturale Orientata di Grotticelle” (Basilicata Region), of approximately 219 hectares (Audisio et al. 2012; Spicciarelli 2013). Subsequently, the Reserve was annexed to the Special Area of Conservation (SAC) of “Grotticelle di Monticchio” (SAC IT9210140), of approximately 342 hectares (Spicciarelli et al. 2011).

The ecological requirements of the species are still poorly known. On the basis of the historical catches made with artificial light (Parenzan 1978; Bertaccini et al. 1995), in a few localities of the provinces of Potenza, Matera and Avellino, the area occupied by the moth has been ascertained. The moth frequents mixed broadleaved forests dominated by deciduous oaks (in particular *Quercus cerris* L., in addition *Q. pubescens* Willd.), accompanied by leaved evergreens such as *Q. ilex* L., with flowering ash (*Fraxinus ornus* L.) and narrow-leaved ash (*F. angustifolia* subsp. *oxycarpa* (Willd.)) trees, hornbeams (*Carpinus ori-*

entalis Mill. and *C. betulus* L.), wild privet (*Ligustrum vulgare* L.), hawthorn (*Crataegus monogyna* Jacq.), maples (*Acer monspessulanum* L., *A. campestre* L. and *A. opalus* Mill.), and broad-leaved phyllirea (*Phyllirea latifolia* L.), at an altitude between 200 and 800 m (Spicciarelli 2013).

B. europaea feeds on Oleaceae (Bilek 1965, 1967; Stella 1992) as well as many other Palaearctic species of *Brahmaea* (Nässig 1980; De Freina 1982, 1985; Konno et al. 2001).

In 1970, Dufay reported a first bioethological account on this moth. For a long time, host plants and feeding habits by the larvae remained unknown. In 1997, for the first time, a group of *B. (A.) europaea* caterpillars was found in nature (Spicciarelli 1997).

During research conducted in 2013–2014, an egg cluster of *B. europaea* was observed and collected in nature for the first time, and other groups of larvae were found inside the Reserve. First palatability tests assessed that *Fraxinus angustifolia* subsp. *oxycarpa* (Willd.), *Ligustrum vulgare* L. and *Phyllirea latifolia* L. could be used by this moth species as larval hosts, while leaves of the flowering ash (*Fraxinus ornus*) were not accepted (Spicciarelli 2018a). From spring 2015, new bioethological observations on *B. europaea* were conducted, and surveys aimed at mapping the distribution of its host plants in the overall



Fig. 1 – On the left, a *Brahmaea europaea* egg cluster. On the right, the narrow-leaved ash tree with the apical defoliation by caterpillars. Aquilonia Scalo (Avellino province, Campania Region).

SAC were also undertaken. The map of the local Habitat 91B0, “Thermophilous *Fraxinus angustifolia* woods” (EU Habitats Directive), in Reserve, has been outlined. It occupies the 21.2% of the total surface of SAC “Grotticelle di Monticchio” corresponding to about 72.5 hectares, an area partially covered by the European Bramea food plants (Spicciarelli 2018b).

During 2016 and 2017, other egg clusters and groups of larvae were found, which enabled to detail several aspects of the egg-laying and larval behaviour until pupation. *Fraxinus angustifolia* results to be the main host plant of *B. europaea*, while both wild privet and broad-leaved phyllirea plants have a secondary role or a replacement one. In fourth and fifth instars the pattern of mobility defined by Fitzgerald & Peterson (1988) as “nomadic foraging” was confirmed (Spicciarelli 2018b).

In spring 2018, prolonged diapauses by *B. europaea* pupae kept in the laboratory was documented (Spicciarelli 2018c).

The comparison of the egg clusters found in 2014-2017, revealed some interesting common ecoethological traits (Spicciarelli 2018a, b) but the limited amount of data requires other observations to confirm these preliminary conclusions. During spring 2021, the discovery of another Bramea egg cluster amplified and further defined some aspects of the

ethology and ecology of this rare moth. These latter egg clusters (Fig. 1, left) were identified outside the Reserve, on the left bank the Ofanto River, in the municipality of Aquilonia (Avellino, Campania Region), on a young narrow-leaved ash of about 12 years old, a tree that hasn’t produced samaras yet. Furthermore, the development of the caterpillars was followed from the first larvae stage up to pupation. The characteristics of this new egg cluster and of the larvae that hatched were compared with the egg clusters localized in previous years. They are all shown in Table 1.

The collected data made it possible to get some new information. The host plant where *B. europaea* lays its eggs was a young narrow-leaved ash (Fig. 1, right), which does not yet produce samaras; the moth arranges them in groups of 10 to over 190 eggs on a branch with a diameter between 5 and 11 mm and at a distance from apical bud between 55 and 90 cm; egg clusters are faced East or East-Southeast.

The *Brahmaea europaea* caterpillars, just hatched, reach the apical shoot. Once consumed, they pass to one below. The first, second and third larval instars are particularly gregarious; fourth and fifth tend to become less social. This behaviour has probably to do with the change of the mimetic strategy. The caterpillars gets more colours as they age, first getting an orange stripe along their side and then white stripes on their backs. Afterwards, they

develop other interesting colour patterns, with white and black stripes on their backs and orange covering posteriorly and in the tract of the thoracic segments.

During these last two stages, the larvae tends to move to other plants to feed (not only ash, but also privet and phyllirea), if the primary host plant leaves are in exhaustion. As fifth instars, larvae feed until they reach maturity. They leave the host food plant, lose their dorsal appendages and move away, even 20-30 meters, finally finding a shelter to pupate in the ground, even 3 or 4 centimetres deep. This last stage usually occurs within the second half of May.

At present the species has been explicitly recorded in some red lists (e.g. Spicciarelli 2002) but it is not protected by law. European *Braema* is protected in the Reserve only, where, however, the narrow-leaved ash is present in a very small surface and there are few areas with young ash trees.

Considering its biological characteristics and the restricted extension of the area, every possible effort should be made to increase the extension and connectivity among the environmental patches actually or potentially hosting the species.

Since 1997, both inside and outside the Reserve, the specific environmental conditions of the spots where the caterpillars have been located were recorded. At the end of March, all the plants were inspected in a radius of ten meters surrounding each host plant with an egg cluster. In March end, for few weeks (Laplanche 1973; Spicciarelli & Fimiani 2004), female lays eggs choosing vegetation patches sharing some common traits concerning tree and bush coverage, particularly within ten meters radius.

The narrow-leaved ash does never constitutes monospecific forests; in forest patches colonized by the moth,

the constants association of young ash trees to privet and phyllirea plants appears to be congruent with the ecological requirements of the *Braema*; while flowering ash, deciduous oaks, elder, maple, thorny shrubs (*Pyrus pyraister* (L.) Burgsd and *Prunus spinosa* L.), hawthorn, have nothing to do with biological requirements of the moth. But presence and frequency of these tree species could have a role in allowing the permanence of the host plants of *Braema* in the studied areas.

This plant community is a small remain of the broader original one, and during the last decades it has been severely perturbed by numerous local factors: inappropriate silvicultural operations, soil loss and alteration of its hydrogeological characteristics, habitat fragmentation, plant species invasiveness, particularly in this area of the Mt. Vulture, where eastern hornbeam (*Carpinus orientalis* Mill. subsp. *orientalis*) and some alien trees such as black locust (*Robinia pseudoacacia* L.) and tree of heaven (*Ailanthus altissima* (Mill.) Swingle) are now widespread.

The ecological requirements of *Brahmaea europaea* shall require a greater attention when planning the silvicultural management techniques, which unfortunately does not occur. An integrate management and protection of forested areas, which are currently shared among different administrative bodies, should also be enforced. This is particularly true for that stretch of the Ofanto Valley which coincides so far the area where the most abundant *Braema* populations have been found. The river course marks, in fact, the boundary between two different provinces (Avellino and Potenza) and Regions (Campania and Basilicata), not sharing the same forestry policies.

Table 1 – Characteristics of the *Brahmaea* egg clusters localized up to now. Also in 1997 (Spicciarelli 1997) and 2013 (Spicciarelli 2018a) groups of caterpillars were located. However, it was not possible to detect the eggs.

ID (egg cluster year)	egg numbers	unhatched egg	facing	diameter of the branch (mm)	distance from the apical bud (cm)	height of the host plant (m)	host plant (diameter at breast height) (cm)	full desertion from food plant
1 ₂₀₁₄	68	6	East	11.0	90	2.5	4.6	24 may
1 ₂₀₁₆	70	2	East	9.5	85	3.5	2.7	23 may
2 ₂₀₁₆	49	1	East	9.5	75	3.0	2.4	22 may
3 ₂₀₁₆	10	1	East	7.0	70	4.0	3.4	22 may
4 ₂₀₁₆	70	2	East-Southeast	9.0	55	2.5	2.6	22 may
5 ₂₀₁₆	45	-	East	10.0	70	4.5	3.7	23 may
6 ₂₀₁₆	55	3	East	5.0	65	3.5	4.2	24 may
7 ₂₀₁₆	18	2	East	7.0	60	5.0	6.7	23 may
8 ₂₀₁₆	116	-	East	9.0	65	4.5	6.1	23 may
9 ₂₀₁₆	141	3	East-Southeast	7.0	60	5.5	8.6	17 may
10 ₂₀₁₆	128	3	East	6.0	55	same plant of the number 9		17 may
1 ₂₀₁₇	193	4	East-Southeast	6.5	75	3.5	3.0	14 may
1 ₂₀₂₁	138	6	East	11.0	80	6.0	9.0	25 may

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