

THE OCCURRENCE OF A NEOTROPICAL HAWKMOTH IN SOUTHERN PORTUGAL: *AGRIUS CINGULATUS* (FABRICIUS, 1775) (LEPIDOPTERA: SPHINGIDAE)

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Abstract: During September 2002 a male individual of the hawkmoth species *Agrius cingulatus* (Fabricius, 1775) was caught in southern Portugal which is perhaps the first specimen arriving unassisted and the third occurrence within the European continent in the last 276 years. The occurrence is discussed with some ideas on its origin.

Key words: Lepidoptera, Sphingidae, *Agrius cingulatus*, Migration, New record, Europe, Portugal

A ocorrência de uma esfinge Neotropical em Portugal: *Agrius cingulatus* (Fabricius, 1775) (Lepidoptera: Sphingidae)

Resumo: Em Setembro de 2002 um indivíduo macho da esfinge *Agrius cingulatus* (Fabricius, 1775) foi capturado no sul de Portugal podendo tratar-se possivelmente do primeiro indivíduo migrante natural e a terceira ocorrência no continente Europeu nos últimos 276 anos. O achado é discutido com algumas ideias sobre a sua origem.

Palavras-chave: Lepidoptera, Sphingidae, *Agrius cingulatus*, Migração, Novo registo, Europa, Portugal

Introduction

The seasonal arrival of several species of Lepidoptera from southern parts of Europe and northern Africa to the north of Europe is well documented, some even managing to produce one or more summer generations, although they are not usually able to survive the harsh winters. Most of these seasonal migrants arrive in numbers during early spring or the end of summer when southern winds and populations seem to be at peak. In this group, various species belonging to a wide range of families are included. From the small and apparently fragile *Plutella xylostella* (Curtis, 1832) (Plutellidae) through a wide range of medium sized species, as in the Noctuidae and butterflies, to the largest of the Hawkmoths (Sphingidae).

Most of these species are residents in certain southern European countries like Portugal, Spain, Italy and Greece and elsewhere around the Mediterranean Sea. In addition to these natural migrants, once in a while a different type of species is reported from the Western Palaearctic.

In most cases, however, these rare vagrants are considered to be introductions or escapees from butterfly farms, arrivals on ships and deliberate releases. Sometimes they even become established, with several documented cases like the Australian *Epiphyas postvittana* (Walker, 1863) in the UK around 1936 (Leverson, 2001), the South African *Cacyreus marshalli* (Butler, 1898) in the Balearic Islands in 1989 (Sarto i Monteys, 1992) and the Neotropical *Paysandisia archon* (Burmeister, 1800) in eastern Spain in 2000 (Aguilar et al. 2001), although according to Williamson & Brown (1986) only around 10% of accidental introductions become established in a foreign place.

However, certain species are physically and behaviourally able to undertake a migration on their own and eventually reach the Western Palaearctic from other biogeographic areas.

With the help of seasonally favourable winds and differences in air pressure, several Lepidoptera species like the

Monarch Butterfly (*Danaus plexippus* (Linnaeus, 1758)), American Painted Lady (*Vanessa virginiensis* (Drury, 1773)), *Sphinx drupiferarum* (Smith, 1797) and Stephen's Gem (*Megalographa biloba* (Stephens, 1830)) have been found on the western coasts of Europe, mainly in the UK and Portugal (Waring & Townsend, 2003) as well as several species of birds not usually seen on the east side of the Atlantic. These are mostly Nearctic species and in North America are known to occur either in large numbers as pests of certain crops (*Megalographa biloba*) (Lafontaine & Poole, 1991; Waring & Townsend, 2003) or to perform extensive migrations (*Danaus plexippus* and *Vanessa virginiensis*) (Schmidt-Koenig, 1993)

Among the Rhopalocera, *Danaus plexippus* is known to reach the European coasts presumably from North America with several specimens recorded in the UK, France, Ireland, northern Portugal and northern Spain almost every autumn (Silva Cruz & Gonçalves, 1973; Coombes & Tucker, 1996; Asher et al., 2001; Fernández Vidal, 2002; García Barros et al., 2004), having established permanent colonies in the Azores, Madeira, Canary Islands, southern Spain and southern Portugal (Neves et al., 2001; Palma & Bivar de Sousa, 2003; personal observations in Madeira and Portugal, 2000-2005).

Among the Heterocera, *Megalographa biloba* (Stephens, 1830) seems to be the most common American migrant on the British western coasts with seven individuals taken so far, mostly coinciding with the arrival of American birds (Waring & Townsend, 2003; Steven Nash, pers. com.). An up to date account on the rare strays, immigrants and possible moth imports to the UK is given by Waring & Townsend (2003).

Other species have recently been recorded in the UK and Spain. Indeed, Nash (2003) reported *Earias vittella* (Fabricius, 1794) from these two countries whereas Yela & De Vrieze (2002) reported *Mythimna languida* (Walker, 1858)

from southern Spain; the latter has subsequently been found in new sites since its discovery (De Vrieze, 2004; pers. observations 2004). This might well be associated with the known phenomenon of global warming.

The Sphingidae are among the Lepidoptera families whose members have the greatest physical capabilities to undertake great migrations. Nevertheless there are few records of intercontinental arrivals, almost all probably introductions: single specimens of *Sphinx drupiferarum* (Waring & Townsend, 2003) and *Daphnis hypothous* (Cramer, 1780) as well as two specimens of *Agrius cingulatus* have been seen in Europe in the last 300 years (Pittaway, 2003)

The last species occurs naturally over South and North America, Hawaii and the Galapagos but was found in the UK in 1728 and 1826 (Waring & Townsend, 2003) and Pittaway (1993, 2005) states it was also found "on ships off the French coast". It seems likely these records are referable to importations of sweet potatoes (*Ipomoea batatas*), a natural foodplant in its natural range and the moths or their early instars came with this product. But because of the species' migratory tendencies (Pittaway, 1993) the possibility of an unassisted arrival to Europe in the autumn months was never put aside (Waring & Townsend, 2003; Pittaway, 2005). In fact, the association with sweet potatoes probably led to the colonization, by this species, of the Macaronesian islands of Cape Verde, on the eastern side of the Atlantic (Bauer & Traub, 1980) although there seem to be no recent data from the archipelago.

The phenomenon of Lepidoptera migration is well known to naturalists and entomologists all over the world and there has been a great interest in their recording, especially in the UK (Steven Nash, com. pers.). Because the study of these insects is not so well developed in Portugal, the amount of new findings is minimal although growing together with the interest in Nature Conservation of the last years. Adding to this, the relevance of studying Lepidoptera migrations over Portugal has great importance as this country is traversed by most West Mediterranean migration routes, and because of the milder temperatures all over the country year round, newcomers (especially subtropical species) have better conditions to establish new colonies.

Specimen Data

A single specimen of *Agrius cingulatus* was trapped in the region of Serpa, Baixo Alentejo / Portugal with the following data: 1♂ Monte da Laje (UTM 10 km: 29SPC30; 200m altitude), 21-IX-2002; Marabuto leg & coll. Specimen attracted by a Mercury Vapour lamp (160W) on a hot night (min Temperature= 16°C) with prevalent westerly winds.

The Lepidoptera fauna of this site has been surveyed by the author for the last 9 years and besides this specimen, four *Agrius convolvuli* were seen that night. Although this species is not a rare sighting at the place, this regular migrant usually appears only as single individuals during the given period of the year.

Description. *Agrius cingulatus* (Fabricius, 1775) is very similar morphologically (and ethologically) to the only native Palaearctic species of the genus *Agrius*, the Convolvulus Hawk moth, *Agrius convolvuli* (Linnaeus, 1758) and may have been mistaken with it in the past in Europe. Nevertheless, closer examination reveals the following differences, among others:

- Abdominal coloured patches are bright pink instead of reddish pink in *A. convolvuli* (Pittaway, 1993);
- Base of hindwings pink, uniformly grey in *A. convolvuli* (Pittaway, 1993).
- Postmedial line of forewing less "wavy" than in *A. convolvuli* and white.
- Dark area near the cell area of the forewing better defined by a whitish outer cross line.
- Between the outer cross-line and the outermost cross-line there is a golden cream band not present in *A. convolvuli*.

Both species feed as caterpillars especially on plants of the Convolvulaceae family and typically inhabit tropical and subtropical environments, having migratory tendencies and stray to more temperate areas (*A. convolvuli* to Europe and Iceland; *A. cingulatus* to Northern USA and Canada) during the summer months (Pittaway, 2005).

The following description is based on the Portuguese specimen, which is a male. Wingspan 89mm. Head and thorax greyish-brown and methathorax bearing two incipient eyespots outlined in yellow. Abdomen darker with a series of bright pink 'ribs' on the dorsal surface and whitish underside. Legs are dark grey. The forewings are almost uniformly greyish brown with shades of white and cream and hindwings are grey with black stripes and some pink suffusion near the base. Underside uniformly grey with a white blotch near the basal area of the hindwing, intercepted by a black cross-line.

Discussion

It has been shown that the migratorial phenomenon, common in butterflies and moths is highly associated with temperature inside Europe (Sparks et al. 2005). However, the apparently rare events of intercontinental movements in Lepidoptera are usually interpreted as correlated with the also rare phenomena like hurricanes and abnormal tropical storms (Oku et al. 1979; Murata et al. 1998; Moskowicz, 2001) although most findings of this kind are thought to be of anthropogenic origin where specimens either "take a lift" on ships or are introduced by people to a new place (Waring & Townsend, 2003).

Anemochoric - wind-borne - dispersal has been highly correlated with insect movements between places (Gatehouse, 1997) although mostly, authors find some difficulties accepting it on such a vast scale. (i.e. Scott, 1986). However, its importance in transatlantic flights of the Monarch butterfly is undeniable and has been named as the main way these butterflies arrive in Northern Europe in autumn by Coombes & Tucker (1996). These authors point to a characteristic low (600m alt.) westerly air flow forming in eastern United States which extends through the Atlantic and reaches Western Europe as the main agent of dispersal, discarding the possible origins of the Monarch Butterfly in the UK as being the result of deliberate introductions, migrants from the Macaronesian islands or even the Iberian Peninsula.

Hawkmoths are especially attractive and well known by people because of their size and conspicuous behaviour of hovering in front of flowers while feeding as well as by the habit, best known in temperate latitudes, of performing extensive migrations. Given their physical structure and

ability of highly controlled manoeuvrable flight it is intuitive to think that hawkmoths have the strength needed for great journeys, even more than most butterflies, although being heavier makes them less suitable for being transported by wind. These moths have the advantage over Monarchs that, given appropriate weather, they can fly either by day or by night, although it remains equally difficult to come from North America without assistance from some wind phenomenon.

Several American moth species had already been recorded from the Palaearctic area (Waring & Townsend, 2003; Nash com. pers. 2003) but this one was given special emphasis, being considered as a possible overlooked vagrant from the Americas because of its resemblance with *A. convolvuli* (Pittaway, 1993, 2005; Waring & Townsend, 2003).

There are three possible origins for the Portuguese specimen of *A. cingulatus*: 1) human assisted either as a larva or adult among products arriving from North or South America; 2) vagrant from the archipelago of Cape Verde; 3) wind-borne migrant from North America having followed the route Monarchs and birds use to get to Europe.

1) For the possibility of a human assisted journey or part journey from a place of departure located anywhere in the New World, the most probable countries of origin would be Brasil, because of the great commercial connections with Portugal or the United States, because of closer geographical proximity. In any of the cases, the likely places of arrival in Portugal would be the ports of Lisboa – 165km in direct line to northwest, Sines – 88km to the west, or even Faro – 110 km south of the place. Nevertheless, neither of these countries exports sweet potatoes in quantities to Portugal nor does there seem to be a correlation of this event with any particular ship. Sweet potatoes are a local traditional crop since the Moorish times (one thousand years ago) in south-western Portugal, mainly in the district of Setúbal, in Aljezur and other places by the coast, roughly between the river Mira and Odeceixe (Anonymous, 2002) and the production is distributed all over the country.

2) It is quite difficult to accept that the specimen comes from Cape Verde archipelago mostly because of difficulties in flying unassisted over such great distances. As a matter of fact, there are no direct air currents from the area to Western Europe and the great distance by sea or the mostly arid lands of the Sahara are quite difficult obstacles to cross. Lepidoptera arriving in small islands usually adopt a different strategy to what they were used to take in large landmasses like continents, which are characterized by greater competition for resources and i.e. *Danaus plexippus* seems to be a pretty stenochorous species in the Macaronesian islands of Azores, Madeira and the Canary Islands (Neves et al., 2001; Palma & Bivar de Sousa, 2003) the same probably applying to *A. cingulatus* on the Cape Verde archipelago.

3) On the contrary, there's a strong possibility that this specimen came by the North Atlantic route that several American organisms follow every year (albeit not voluntarily) to reach the European coasts. As said before, the well known annual migration of the Monarch Butterfly promotes the arrival of many to Britain and Spain in most years (Coombes & Tucker, 1996; Asher et al., 2001; Fernández Vidal, 2002). The same happens with birds (Mullarney et al., 2003) and occasionally, other Macrolepidoptera species (Waring & Townsend, 2003).

Nash & Hill, (2002) show a high influx of migrant Lepidoptera to Britain in the period 14–24 September 2002 with interesting and rare immigrants being recorded like eight *Agrius convolvuli*, two *Helicoverpa armigera* and singles of *Chrysodeixis chalcites* (Esper, 1789), *Dia-semiopsis ramburialis* (Duponchel, 1834), *Hypena obesalis* (Treitschke, 1828), and *Daphnis nerii* (Linnaeus, 1758). Nevertheless, the most interesting record comes from Glamorgan (UK) where a specimen of the American moth, Stephen's Gem, *Megalographa biloba* (Stephens, 1830) was trapped on the same night as the Portuguese *Agrius cingulatus* (Nash & Hill, 2002; Steven Nash, comm. pers.), 21st September 2002. Although this alone with the Portuguese record may reflect little, the abundance of migrant species in the referred days, another American species in Europe and predominant westerly winds may indicate a possibly unassisted passage across the North Atlantic Ocean reaching Europe's western coasts and some inland localities.

Crucial information could be obtained by checking the winds on the nights prior to the finding to prove and quantify the intensity of the westerly flow through the Atlantic, but this could not be traced by the author.

Final Remarks

The fauna of a given biogeographic region is not static and long distance dispersal movements followed by subsequent colonizations, though rare can take place, the Lepidoptera being no exception (Williamson & Brown, 1986) and air currents having a crucial role (Gatehouse, 1997).

The Neotropical hawkmoth, *Agrius cingulatus*, known to be a widespread species in Southern, Central and North America is sometimes regarded as a pest in this continent where the caterpillars feed especially on sweet potato, *Ipomoea batatas* (Clavijo & Chacín, 1992). This led probably to the colonization of the Macaronesian archipelago of Cape Verde (Bauer & Traub, 1980).

The male of this species found in Baixo-Alentejo is the third confirmed in Europe, following the records in Waring & Townsend, 2003) and the first seen on the continental mainland. However, as Pittaway (1993) hypothesises, this species may be a rare vagrant to the region and easily overlooked with the autochthonous *Convolvulus* Hawkmoth, *Agrius convolvuli*. Therefore, more attention should be paid to specimens arriving in Europe, especially during high migrant activity periods and favourable winds (west and south-west) at the end of the summer.

In spite of strong evidence supporting the hypothesis of the specimen of *Agrius cingulatus* being a genuine migrant from the American continent, the cultivation of the potential hostplant in Portugal opens the possibility that if more specimens arrive in the country and due to the mild temperatures, the species may colonize southern Portugal. This would put in contact two otherwise allopatric species of the genus *Agrius*, *A. cingulatus* and *A. convolvuli*, the latter feeding also in the larval stage on *Ipomoea batatas*.

With this record, the number of hawkmoth species known from Portugal increases to 17, given that the record of *Hyles nicaea* (de Prunner, 1798) (Vieilledent, 1905) is probably a misidentification of *Hyles euphorbiae* (Linnaeus, 1798) (Martin Corley, pers. comm).

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APPENDIX

Systematic list (following Pittaway, 1993) of the Hawkmoth (Sphingidae) Species known from Portugal and confirmed by the author.

FAMILY SPHINGIDAE Latreille, [1802]

Subfamily Sphinginae Latreille, [1802]

- Agrius cingulatus* (Fabricius, 1775)
Agrius convolvuli (Linnaeus, 1758)
Acherontia atropos (Linnaeus, 1758)
Sphinx ligustri Linnaeus, 1758

Subfamily Smerinthinae Hübner, [1819]

- Marumba quercus* (Denis & Schiffermüller, 1775)
Mimas tiliae (Linnaeus, 1758)
Smerinthus ocellatus (Linnaeus, 1758)
Laothoe populi (Linnaeus, 1758)

Subfamily Macroglossinae Harris, 1839

- Hemaris fuciformis* (Linnaeus, 1758)
Hemaris tityus (Linnaeus, 1758)
Proserpinus proserpina (Pallas, 1772)
Macroglossum stellatarum (Linnaeus, 1758)
Hyles euphorbiae (Linnaeus, 1758)
Hyles livornica (Esper, 1779)
Deilephila elpenor (Linnaeus, 1758)
Deilephila porcellus (Linnaeus, 1758)
Hippotion celerio (Linnaeus, 1758)