A new and relict species for the Iberian Peninsula, with an enigmatic distribution: *Hyles tithymali gallaeci* subspec. nov. from the atlantic islands and coasts of Galicia Region (NW. Spain)

(Lepidoptera: Sphingidae)

by

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Abstract: Although several authors include Galicia Region (NW. Spain) within the distribution of *Hyles euphorbiae* (LINNAEUS, 1758), the fact is that, surprisingly, only one taxon of the *tithymali* BOISDUVAL group is present in this region replacing *Hyles euphorbiae* LINNAEUS. The morphology of the previous taxon (not well known), from Galicia Region (distributed throughout the atlantic islands and continental coasts; is a common species with abundant colonies) is hereby studied. The larvae, which show a range of variation in their lateral bands, similar to those we may see in three existing Macaronesian (Canary and Madeira islands) subspecies of *Hyles tithymali* (BOISDUVAL, 1834) and also to those of *Hyles tithymali deserticola* (STAUDINGER, 1901), differ mainly, from the previous subspecies in the combination of the flowing characters: a).- in the 86,5% of the L5 larvae, the subdorsal eye-spots (red-pink or white colour) present open black borders (area without black border) towards the head and around a 25% of them have the dorso-lateral row of eye-spots connected by a defined yellowish stripe (internally dappled with areas of various shades between red-pink-orange); b).- the adults are clearly different (in forewings the median stripe is generally pink stained; wings and body ground colour is of pale olive green) from the geographically nearest subspecies (Africa, Canary and Madeira islands) but similar to some individuals of *Hyles tithymali sammuti* (EITSCHBERGER, DANNER & SURHOLT, 1998) from Malta island.
As result of the comparison of this new population with other subspecies of the *tithymali* group, were these have been included mainly based on their larval morphology, indicates that this new population found in Galicia Region is a valid subspecies: *Hyles tithymali gallaeci* **subspec. nov.**, is described (a molecular study is found to be necessary in order to establish its philogenetic relationship).

Resumen: Aunque diversos autores incluyen dentro de la distribución de *Hyles euphorbiae* (LINNAEUS, 1758) la totalidad de Galicia (NW. España), la realidad es que en esta región, sorpredentemente, sólo existe un taxón del grupo *tithymali* BOISDUVAL el cual sustituye a *Hyles euphorbiae* LINNAEUS. Se estudia la morfología del anterior taxón, no muy bien conocida, de Galicia (distribución: islas atlánticas y costas continentales; taxón común, población abundante). Las larvas, que muestran un rango de variación en su banda lateral similar a las larvas de las tres subspecies de *Hyles tithymali* (BOISDUVAL, 1834) existentes en Macaronesia (islas Canarias y de Madeira) y de *Hyles tithymali deserticola* (STAUDINGER, 1901), se diferencian de las anteriores subespecies principalmente en la combinación de los siguientes caracteres: a).- en las larvas (L5), en el 86,5% de ellas, los ocelos subdorsales (de color rojo-rosa o blanco) tienen los bordes negros abiertos (zona sin borde negro) en la zona que apunta a la cabeza de la oruga y alrededor del 25% de las larvas tienen la fila de ocelos dorso laterales conectados por una línea definida amarillenta (manchada internamente con zonas de varios tonos entre el rojo, rosa y naranja); b).- los adultos (banda mediana de las alas anteriores normalmente manchada de rosa; color de fondo de alas y cuerpo de color oliva claro) son diferentes de los imagos de las subespecies más cercanas geográficamente (África, islas Canarias, isla de Madeira), pero parecidos a algunos ejemplares de *Hyles tithymali sammuti* (EITSCHBERGER, DANNER & SURHOLT, 1998) de la isla de Malta.
Como resultado de la comparación de esta población con otras subespecies del grupo *tithymali*, en cuyo grupo se incluye debido principalmente a su morfología larval (un estudio molecular sería muy necesario para determinar su relación filogenética), indican que la población de este nuevo taxón de Galicia es una subespecie válida: se describe *Hyles tithymali gallaeci* **subspec. nov.**

Introduction: After having observed several pictures in internet of alleged "*Hyles euphorbiae*" (sic) larvae taken by Spanish amateur photographers in coastland areas of the Galicia Region (NW. Spain, Fig. 1), to our surprise, we noticed that the morphology of the larvae resembled more to the characters of the *tithymali* group, rather than to the aforementioned species. These new and yet unknown colonies of the *tithymali* group, is the northernmost population, separated by a great distance from other colonies of *Hyles tithymali* BOISDUVAL sensu lato geographically closer, located in North Africa and Macaronesia.

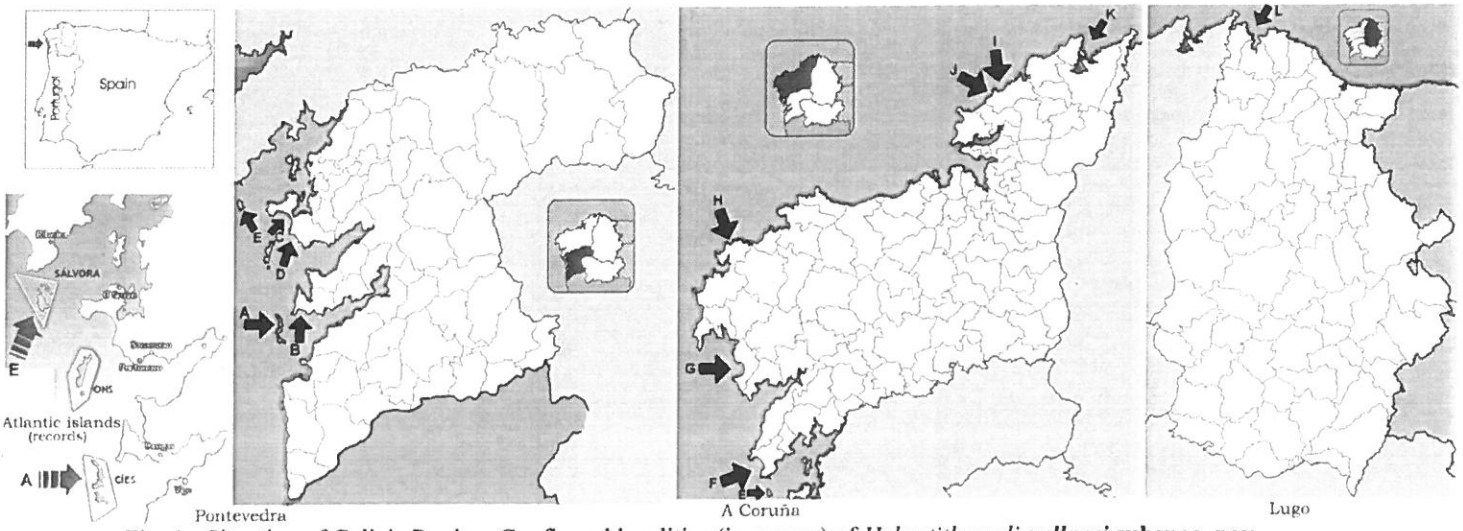


Fig. 1.- Situation of Galicia Region. Confirmed localities (in arrows) of *Hyles tithymali* ***gallaeci*** **subspec. nov.**

Subsequently, in the web page referring to *Hyles euphorbiae* (L.) of PITTAWAY (1997,)we were able to observe a picture of a larva L5 (photo still available to the date of this publication in the same web site) considered by him as a hybrid of "*Hyles euphorbiae*

euphorbiae x *Hyles tithymali gecki*" (sic), from Minho province, N. Portugal [Note: Minho is located north of Portugal, adjacent to southern Galicia]. The larvae referred to, is similar to some of the forms (lateral band) of the larvae that we have obtained from Galicia Region. The hypothesis of PITTAWAY (1997) of a supposed hybrid in which one parent is *Hyles tithymali gecki* (DE FREINA, 1991) seems quite improbable if we take into account the great distance barrier between Madeira island (locality of the previous *Hyles*) and southern Galicia or northern Portugal (around 1.300 km!). In addition, according to our observations, we must state that we never found larvae morphologically similar to picture of PITTAWAY neither in the rest of Portuguese territory (centre and south of Portugal) or even S. Spain (Andalusia Region), both of which are much closer to Madeira Island, but only typical morphotypes of *Hyles euphorbiae*. Very probably, the north Portugal is the southern distribution limit of the galician studied taxon referred to in this paper.

Some authors follow surprising the hypothesis of PITTAWAY, displaying through web pages pictures of these Galician larvae, identified as "hybrids". Consequently hereafter we are willing to prove that the morphological characters of the caterpillars of this new taxon do not indicate by any means that these features have derived from their supposed ancestors ("*Hyles euphorbiae euphorbiae* x *Hyles tithymali gecki*") alleged by PITTAWAY (1997).

In *Hyles tithymali* (BDV.) sensu lato, the larval coloration and patterns are highly important in the study of the phylogenetic relationships that determine these between the different subspecies: MEERMAN (1993), GIL-T. & GIL-UCEDA (2007). The wide range of larvae samples studied from Galicia, prove that this taxon belongs to (according to larval morphology) a probable relict population of the *tithymali* group. These larvae show a similar variability in their lateral bands (background colour and patterns) as to other subspecies of *Hyles tithymali* (BDV.), specifically: *Hyles t. tithymali* (BOISDUVAL, 1834) of Tenerife, Gran Canaria, Fuerteventura and Lanzarote islands; *Hyles t. phaelipae* (GIL-T. & GIL-UCEDA, 2007) of El Hierro and La Palma islands [GIL-T. & GIL-UCEDA (2007); GIL-T. (2009, 2010b)]; including the intermediate (mixture) population between the two previous subspecies of La Gomera island (GIL-T., 2009, 2010a); *Hyles t. gecki* DE FREINA of Madeira island; and *Hyles t. deserticola* STAUDINGER of North Africa (south of the Atlas Mountains). The larvae of this new population (Galicia) differ from the other mentioned subspecies on the combination of various features on the dorso-lateral line of eye-spots and on the morphology of the adults. In base to the previous facts and also to the extreme isolation respect to other subspecies, we consider appropriate to propose and describe the population of this Sphingidae from Galicia Region as a new subspecies: *Hyles tithymali* ***gallaeci*** **subspec. nov.**

Material and Methods: Around 50 caterpillars (from L1 to L3) were collected (between the end of may and beginning of June) from different localities of Galicia Region and reared in captivity until pupation. From these pupae and from a pair of adults, a new generation (F1: around 40 larvae) was obtained in captivity. Samples of larval varieties or forms obtained were photographed laterally. The photos of the most characteristic larvae representing their entire range of variability were selected to compose the figures mentioned hereafter.

Hyles tithymali gallaeci subspec. nov.

Holotype ♀ (Fig. 6: H): A Lanzada isthmus, Pontevedra province, Galicia Region, NW. Spain (Fig. 1: arrow C); larva: 11/VI/11, imago emerged: 8/VII/11; in coll. F. GIL-T.

Paratypes: 17 imagos, of which: 7 ♂♂ 4 ♀♀, emerged 8-10/VII/11, in coll. F. GIL-T; 2 ♂♂ 1 ♀, emerged 8-10/VII/11, in coll. S. REQUEJO; 2 ♂♂ 1 ♀, emerged 11-VII-11, in coll. Dr. U. EITSCHBERGER (EMEM - Entomologisches Museum, D-Marktleuthem -).

Morphology of the preimaginal stages: L1 and L2 (Fig. 2): similar to the larvae of other subspecies of the *tithymali* group, specifically: the three subspecies of Canary and Madeira islands as well as *Hyles t. deserticola* (STGR.): black at first, turning to olive black after feeding; at the final stage of L2 a slight pattern is visible (some white spots of the lateral band), form and colour of the eye-spots and lateral band undefined.

In L3 (Fig. 2): immediately after de second moult the future larvae pattern design begins to be noticeable. In this stage the eye-spots are normally white. The majority of the larvae display one of the principal characters which will be referred to during L4 and L5 stages: the subdorsal eye-spots (red-pink or white colour) present open black borders (areas without black border) towards larvae's head. This feature resembles in some way the intermediate eye-spot forms of *H. tithymali* (BDV.) from La Gomera island (GIL-T. 2010a), considered as the result of a mixture between *H. t. tithymali* BOISDUVAL and *H. t. phaelipae* GIL-T. & GIL-UCEDA, of which solely represents a 17,50% from the total of the island (GIL-T., 2009, 2010a). The remaining *H. t.* ***gallaeci*** **subspec. nov.**, caterpillars, show the typical eye-spots of the nominal subspecies: complete black border, round eye-spots of red-pink or white colour.

In L4: all the larvae present their final colour pattern: 86,5% of these, display the subdorsal eye-spots (coloured in red, pink or white during this stage) the black borders are open towards larvae's head (Fig. 3); the remaining 13,5% present normal eye spots (Fig. 4): circular with complete black border. All the previous caterpillars exhibit the same range of variation in their lateral bands as the three subspecies of Canary and Madeira islands.

In L5 (65-77mm): besides the characters previously referred to for L4 (Fig. 3 & 4) in the majority of the larvae (76%) the subdorsal eye-spots are coloured in red or pink. During this stage an exclusive feature appears in *H. t.* ***gallaeci*** **subspec. nov.**: around 25% of the caterpillars presented a defined yellowish stripe (internally dappled with areas of various shades between red-pinkish-orange), visible and delimited, connecting the eye-spots (Fig. 5). This stripe connecting the eye-spots resembles in some way those displayed by a great number of *H. t. phaelipae* GIL-T. & GIL-UCEDA larvae (El Hierro and La Palma islands), but in this latter subspecies (GIL-T. & GIL-UCEDA, 2007) the stripe is much more conspicuous, of a greenish-yellow colour and the eyes pots (in 100% of the larvae) are very elongated and of orange-ochre colour, with the black border of each eye-spot reduced to a dorsal and ventral black stripe both horizontally separated. It is significant that in those caterpillars (*H. t. gallaeci* **subspec. nov.**) with an almost black lateral band, or those strongly flushed with black, the stripe that links the eye-spots is defined (Fig. 5) and maintains its yellowish colouring (including the internal zone of this red-pinkish-orange colour stripe). The two distinctive features mentioned in L4 and L5 are different to the typical larvae of the geographically nearest subspecies.

Pupae: Smaller than those of *H. euphorbiae* Linnaeus, generally 38-45 mm.

Morphology of the imagos: Wingspan: 64-70 mm [note: *Hyles euphorbiae* (L.): 70-85 mm; *Hyles t. sammuti* EITSCHBERGER, DANNER & SURHOLT: 63-75 mm; *Hyles t. tithymali* (BDV.): 63-85 mm]
In forewing upperside (Fig. 7) the adults display de following features:
Background colour: is quite different from other existing subspecies of the *tithymali* group in N. Africa, Canary and Madeira islands. The colour of the median stripe and submarginal area is very variable: ranging from whitish-cream or pale cream stained with pink, up to various shades of rose more or less intense.
Colour of thorax and abdomen: pale olive green. The subbasal area and postmedial (postdiscal) vary between pale to very dark olive green.
Median stripe: constant and very narrow medial (discal) area, extremely narrow or even absent in some specimens (Fig. 7), dividing the median stripe in two separate parts.
Venation: the subspecies *H. t. tithymali* (BDV.); *H. t. phaelipae* GIL-T. & GIL-UCEDA, *H. t. gecki* DE FREINA, *H. t. himyarensis* (MEERMAN, 1988) and *Hyles t. deserticola* (STGR.) have normally superimposed silvery venation in forewings. This feature is absent in *H. t.* ***gallaeci*** **subspec. nov.**
Wings underside (Fig. 6): ground colour pink-red, a very infrequent feature in other subspecies, but typical in *H. t.* ***gallaeci*** **subspec. nov.**

Genitalia (♂)**:** We have compared it with those of *H. euphorbiae* (L.) and *H. t. tithymali* (BDV.) (Tenerife island), the resulting was found to be as follows:- Uncus: (Fig. 8: top) similar to *H. t. tithymali* (BDV.), but thinner than the latter with prominent basal indentation. Gnathos: highly developed, with small teeth towards the end. Juxta: triangular as in *H. t. tithymali* (BDV.) but with straight arms rather than curved as in *H. euphorbiae* (L.) and in *H. t. tithymali* (BDV.).
The group of small teeth at the end of the aedeagus (Fig. 8: bottom) is continuous and similar to *H. t. tithymali* (BDV.), but with its final portion flatter, and the row of teeth are smaller and parallel to the exterior part.

Diagnosis: As previously seen, the imagos of *H. t.* ***gallaeci*** **subspec. nov.** are remarkably different to the geographically nearest subspecies (Africa, Canary and Madeira islands), but as we can see in DANNER et al. (1998: 55) and PITTAWAY (1997) they are similar to some individuals of *H. t. sammuti* (EITSCHBERGER, DANNER & SURHOLT, 1998) from Malta island. *H. t.* ***gallaeci*** **subspec. nov.** differs from the previous subspecies in the significant morphological differences of the larvae, a major percentage of pink-red coloured adults (underside and upperside) and a narrower median stripe in the medial (discal) area.
The larvae of *H. t.* ***gallaeci*** **subspec. nov.,** differ from those of other subspecies of the *tithymali* group because none of the previous subspecies fulfils (in L5) the following combinations: a).- in the 86,5% of the larvae, display subdorsal eye-spots (red-pink or white colour) present open black borders (areas without black border) towards the head of the caterpillar (Fig. 2 & 3), similar to some La Gomera island larvae (17,5%) (GIL-T., 2010a) except for the fact that the eye-spots of these latter are of orange-ochre colour; b).- around 25% (Fig. 5) of the larvae show a defined yellowish stripe (internally dappled with areas of various shades between red-pinkish-orange), connecting the eye-spots.
For these reasons, as well as on account of its extreme isolated distribution; the northernmost populations within the *tithymali* group, that we consider appropriate to award the taxonomic category of subspecies to this population of Galicia Region.

Derivation nominis: The Gallaeci or Callaeci were Celtic people who inhabited Gallaecia, the region roughly corresponding to what is now Galicia Region, west of Asturias Region (NW. Spain); and N. Portugal, from the Iron Age and through the Roman period. They spoke a Celtic language related to Celtiberian language. They were anexed to the Roman Empire during the Cantabrian Wars, which lead to a period of assimilation into a Gallaecian-Roman culture.

Phenology. Ecology. Climate: Alike other taxa of the *tithymali* group, they have continuous broods throughout the year, in Galicia from late May until late September or mid-October. The first generation, contrary to *H. euphorbiae* (L.), is abundant and before mid-June larvae can be found simultaneously in various stages of development. Larvae may be found during the whole mentioned period with a minimum of three broods per year. The larvae feed exclusively on *Euphorbia paralias* which is fairly abundant along beaches and dunes of the Galician coastline.
The coast of Galicia is located in a temperate zone (mild humid oceanic climate), among the climates in the Iberian peninsula it has the minor thermal contrast between them all. It presents short temperature variations: mild winters and fresh summers. The coastline temperature oscillates between 8°-10° C in winter and 20°-25°C in summer, as a consequence of being under the effects of much warmer and humid masses. Coast frosts are somewhat infrequent (less than 10 days a year). The farther we move away from the coast (habitat of *H. t.* ***gallaeci*** **subspec. nov.**) the climate presents major differences respect to the average temperatures: higher during summer and lower during the winter months, a probable reason of why this taxon is absent from the interior of Galicia.
The particular climate of the Atlantic island and coast line of Galicia (Fig. 1) could well be one of the factors that have influenced in the persistence of *H. t.* ***gallaeci*** **subspec. nov.** in this territory of the Iberian Peninsula as it is actually accepted that *H. euphorbiae* (L.) is better adapted to lower temperatures than the members of the *tithymali* group

Distribution: Although DE FREINA & WITT (1987), DANNER et al. (1998) and other authors include the totality of the Galician territory within the distribution range of *Hyles euphorbiae* (L.), the fact is that the only representative of the *Hyles euphorbiae*-complex is *H. t.* ***gallaeci*** **subspec. nov.,** whose distribution is solely limited to the coastal areas (mainly dunes) and nearby islands belonging to this region were their populations are abundant and well distributed. The above demonstrates that the existence of this taxon is not as exceptional as PITTAWAY (1997) gives to understand when considering as a "hybrid" one larva from north Portugal (see Introduction).
The distribution range known (Fig. 1, see arrows), with stable colonies and a high number of individuals is the following:
a).- In Pontevedra province: Vigo: Cies islands (A); Cangas de Morrazo: Donón, dunes and beach of Barra (B); O Grove: beaches and dunes of A Lanzada & Paxareira (C); Sanxenxo: Maior beach (D).
b).- In A Coruña province: Santa Eugenia de Ribeira: Salvora Island (E) and Corrubedo dunes and beach (F); Muros: Carnota,

Carnota beach (G); Camariñas: dunes of Trece (H); Valdoviño: Frouxeira beach (I) and Meirás beach (J); Ortigueira: Morouzos beach (K).

c).- In Lugo province: Viveiro (L)

Without any doubt its distribution range is bound to be much greater, further prospecting will prove its presence all along the coast line of these provinces. The southern limit of its distribution could well be Minho province (N. Portugal; S. Galicia Region) likewise it is also very probable its presence in western Asturias Region (E. of Galicia) being unknown to us, for the time being, if there is a contact area with *Hyles euphorbiae* (L.) in either of these last localities.

Discussion

Concerning the existence of hybrid areas in the *tithymali* group: It shouldn't be a surprise, the apparent separation of *H. t.* ***gallaeci*** **subspec. nov.** populations from those of *H. euphorbiae* LINNAEUS within the Iberian Peninsula, although we don't discard the existence of a contact zone (presently unknown) towards the outermost parts of its distribution area (perhaps north Portugal?). Similar cases occur to other subspecies of the *tithymali* group:

a).- In *H. t. himyarensis* MEERMAN, of the mountains of Yemen: *H. euphorbiae conspicua* (ROTHSCHILD & JORDAN, 1903) of SW. Saudi Arabia, along the border with Yemen, it has come into contact with the previous relict population (south of Abha). According to PITTAWAY (1997), as a consequence of this overlapping, adults quite clearly intermediate appear and probably represent hybrids. Nevertheless the previous author considers that *H. t. himyarensis* MEERMAN is "certainly a good subspecies, with little interbreeding between it and *H. e. conspicua* ROTHSCHILD & JORDAN".

b).- *H. t. cretica* (EITSCHBERGER, DANNER & SURHOLT, 1998) from Creta islands, according to PITTAWAY (1997) and HUNDSDOERFER *et al.* (2005), has interbred to some extent with vagrant individuals of *H. euphorbiae* (L.).

c).- *H. t. sammuti* EITSCHBERGER, DANNER & SURHOLT also has interbred to some extent with vagrant individuals of *H. euphorbiae* (L.), according to the mtDNA study of HUNDSDOERFER *et al.* (2005).

d). - *H. t. deserticola* STGR. merges with *H. t. mauretanica* (STAUDINGER, 1871) in the southern Atlas Mountains. Very probably, this latter also merges with imagos of *H. euphorbiae* (L.) from the Iberian Peninsula in north Morocco: the larvae of *H. t. mauretanica* STGR. illustrated in DANNER et al. (1998: 167) are identical to several forms of larvae (pers. obs. GIL-T.) present in the Iberian Peninsula, mainly in Andalusia Region (S. Spain).

Note: The five taxa (*himyarensis, conspicua, sammuti, deserticola, mauretanica*) are regarded by DANNER et al. (1998) as different species.

Biogeography and hypothesis on the origin of *H. t. gallaeci* subspec. nov.: PITTAWAY (1997) suggested that after the last Ice Age, North African conditions extended across the Mediterranean Basin, allowing *H. tithymali* to colonise southern Europe. When Europe cooled 3900 years BP, *H. tithymali* retreated southwards and was replaced in most of southern Europe by the more cold-tolerant *H. euphorbiae*. Actually, relict populations of the *tithymali* group survived on several semi-isolated Mediterranean islands, where it may now form a stable hybrid zone with *H. euphorbiae*.

The range of a species can show an expansion and contraction in response to changes in environmental conditions. Most probably, the range of distribution of *H. tithymali* included the totality of the Iberian Peninsula; inhospitable ecological conditions, successive ice-ages, caused its disappearance (except in NW Spain?), thence replaced and reabsorbed by *Hyles euphorbiae* through repeated colonisations, allowed them to expand its range throughout all the Iberian Peninsula.

Nowadays, it is accepted that *H. tithymali* sensu lato and *Hyles dahlii* (GEYER, 1828) have derived from a common ancestor, as is indicated in MEERMAN (1993), and that *H. dahlii* GEYER evolved in isolation and derived in a different species (adaptive radiation) on Corsica and Sardinia. It is unknown when the initial colonization of these islands took place and why the *H. euphorbiae* has been unable to colonize these islands. A similar case occurs between the african butterfly *Papilio saharae* OBERTHÜR and *Papilio hospiton* GUENEE (PITTAWAY et al., 1994) in Corsica and Sardinia islands, derived from a common ancestor. *Papilio machaon* L. has established itself on Corsica and Sardinia, but its co-existence with endemic *P. hospiton* GUENEE shows little interbreeding.

The relict population of *H. t.* ***gallaeci*** **subspec. nov.**, may be considered as a similarity to *Hyles dahlii* GEYER, previously referred to (note: the island of Corsica & Galicia have a similar latitude). It's quite possible that, as a result of unknown factors, a population of the ancestral *tithymali* could have survived somewhere in Galicia, probably in the atlantic islands (the species is actually found in Cies and Salvora islands: Fig. 1, bottom left; and likely in some other islands), where the climatic effects had a minor impact and to where the European colonisation of *H. euphorbiae* (L.) did not reach.

Subsequently, from these islands colonisation of the nearby Galician continental coasts took place and expanded along the coastline of Pontevedra, A Coruña and Lugo provinces. Presently *H. euphorbiae* (L.), is alien to this region, being *H. t.* ***gallaeci*** **subspec. nov.** the only representative of the *Hyles euphorbiae*-complex.

Final note: Although this new taxa has been included within the *tithymali* group on account of its external (mainly larval) morphology, we consider that the extreme isolation and geographical distance of the populations of *H. t.* ***gallaeci*** **subspec. nov.** respect to other subspecies of the *tithymali* group is an enigma which may only be clarified by means of molecular study (DNA sequencing), in order to determine phylogenetic relationship with other taxa of the *Hyles euphorbiae*-complex. The possibility of adaptive radiation of the studied taxa (a different species?) similar to that of *Hyles dahlii* GEYER is not discarded.

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Fig. 2-8: *Hyles tithymali gallaeci* subspec. nov.

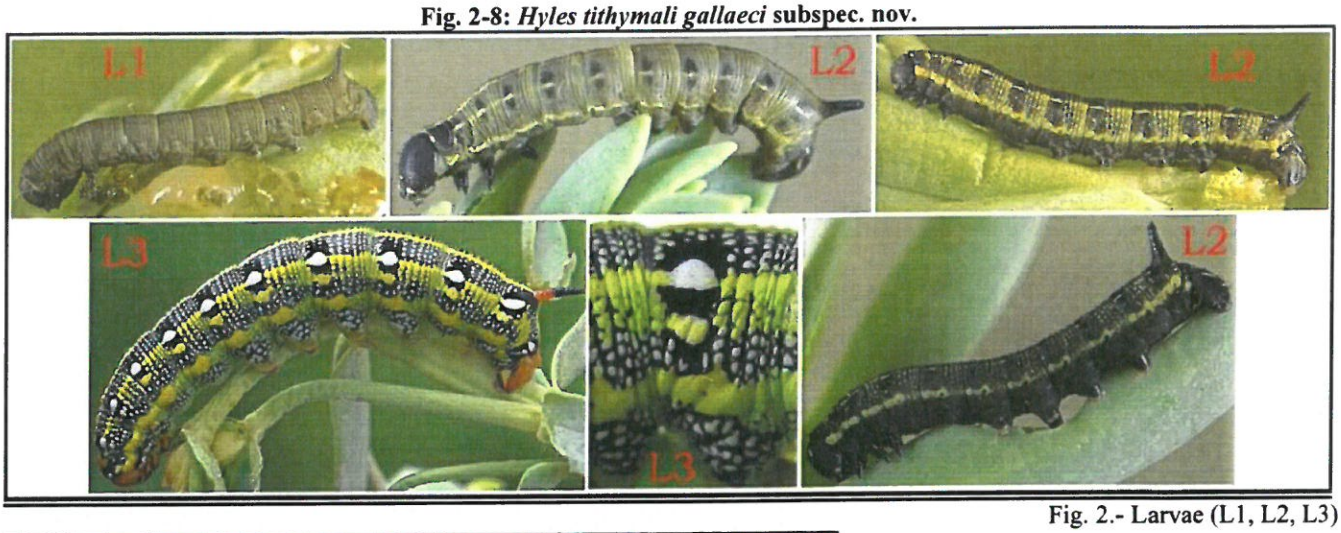


Fig. 2.- Larvae (L1, L2, L3)

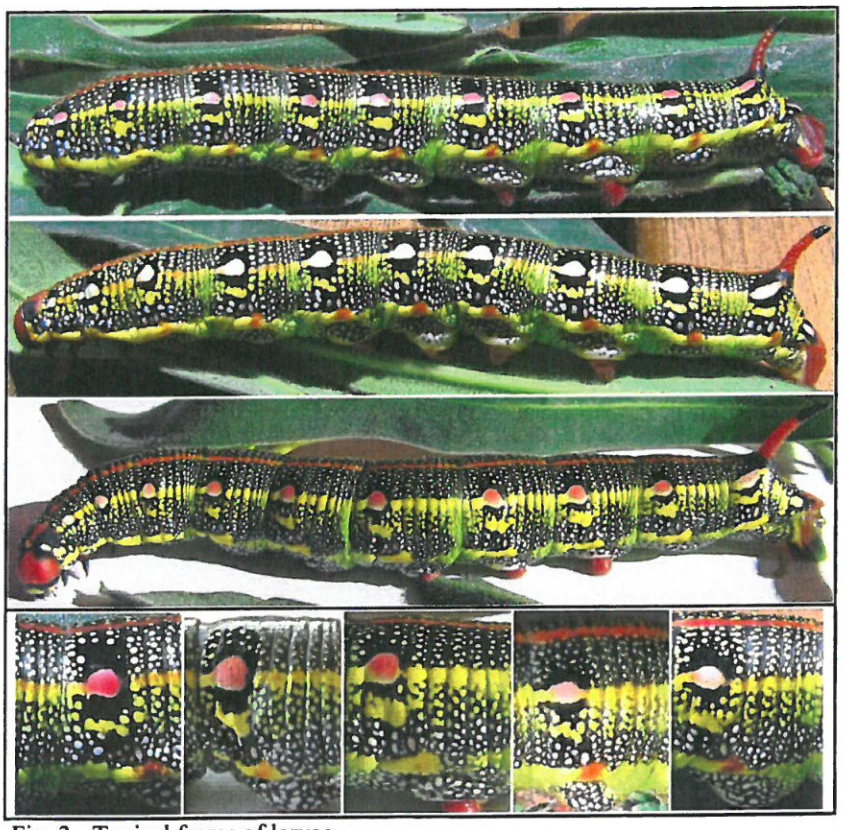


Fig. 3.- Typical forms of larvae



Fig. 8.- Lateral view ♂ genitalia and aedeagus

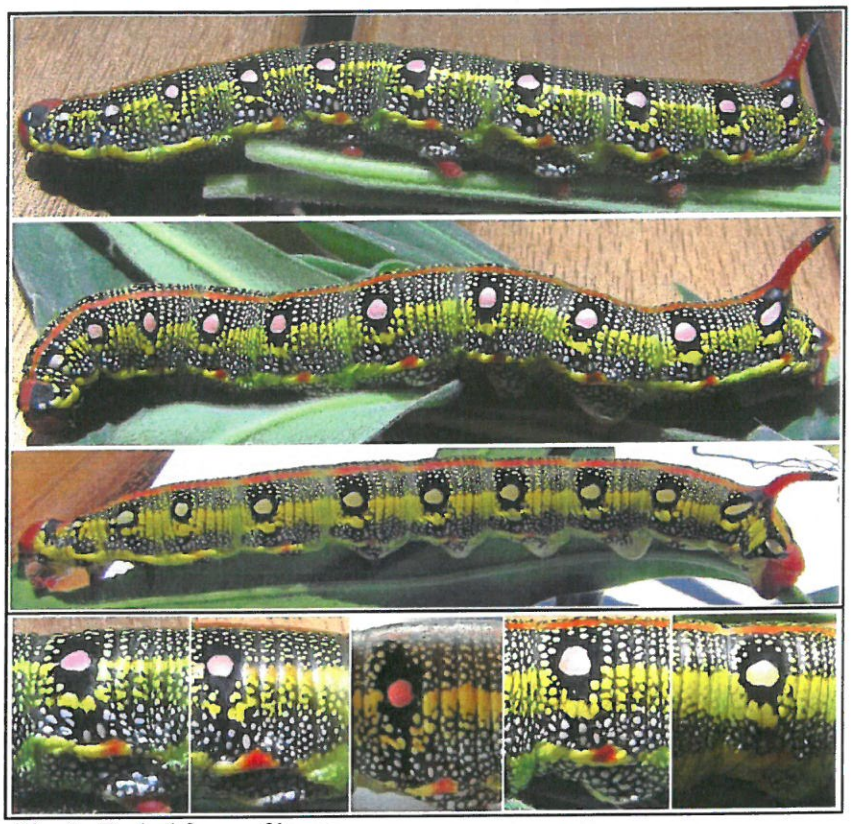


Fig. 4.- Typical forms of larvae.



Fig. 5.- Larvae showing the coloured stripe connecting the eye-spots

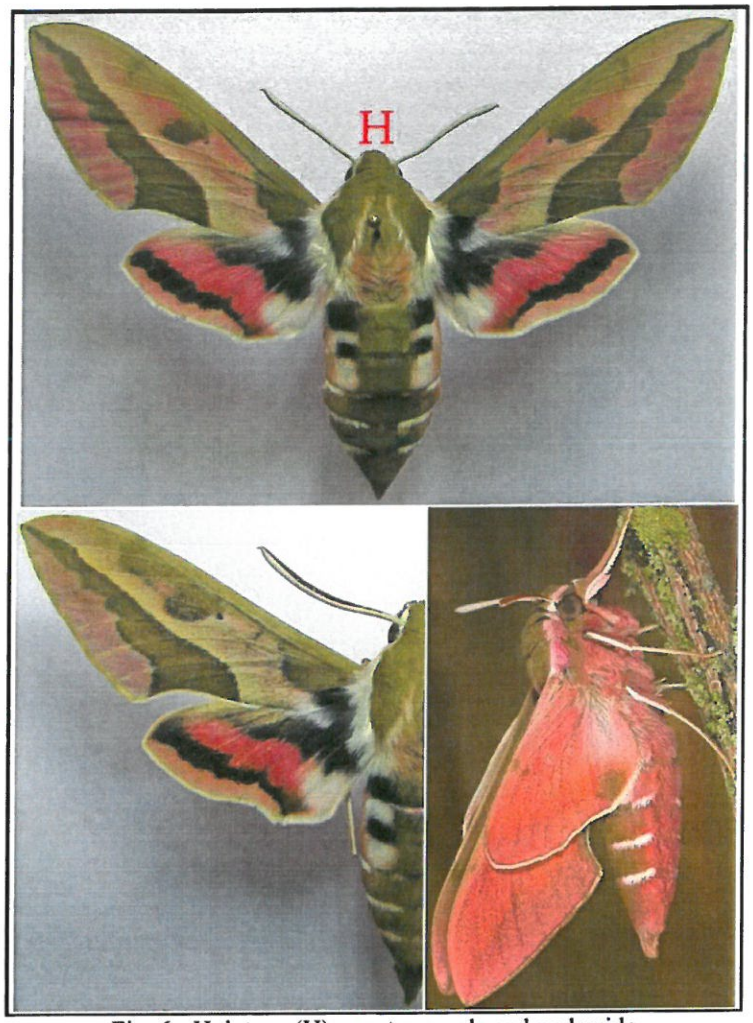


Fig. 6.- Holotype (H), paratype male and underside

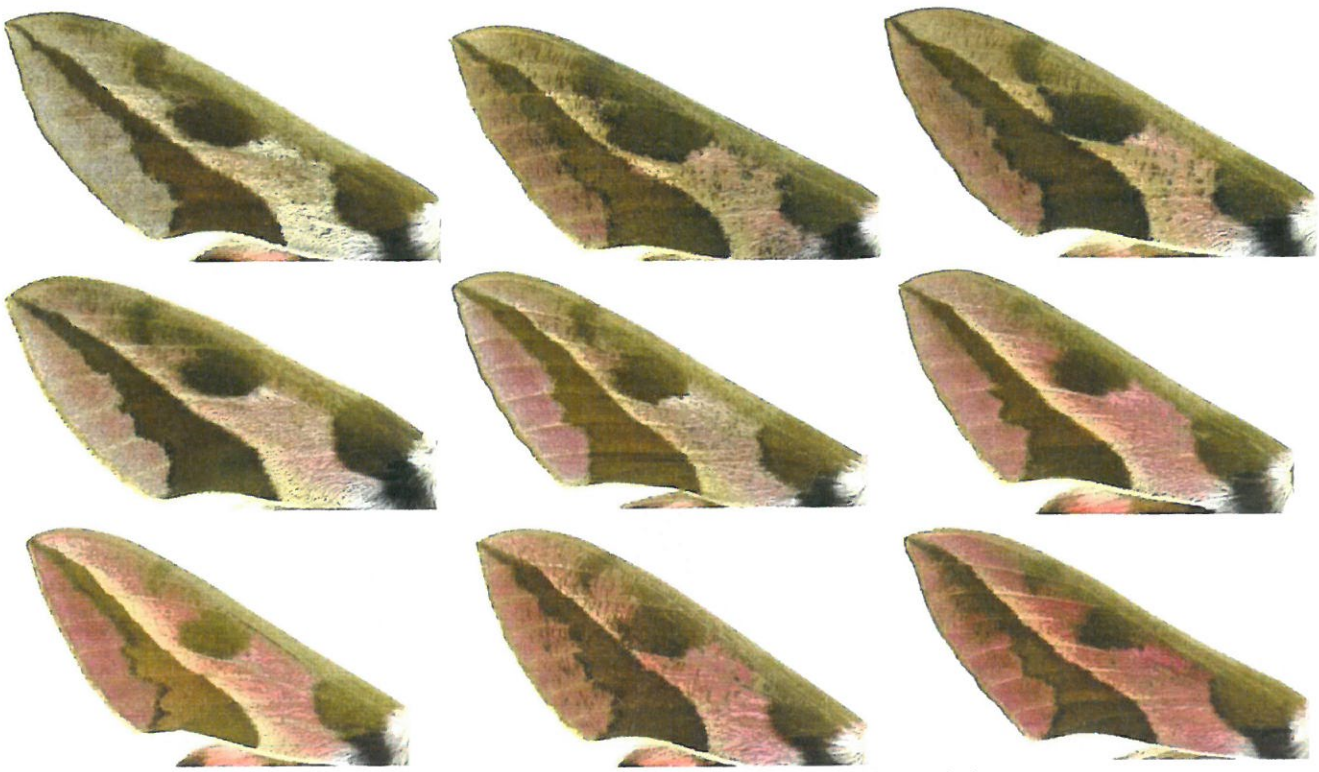


Fig. 7.- Detail of the background colour and median stripe variation