

New data on the biology and distribution of *Euchloe tagis* (Hübner, 1804) in Portugal (Lepidoptera: Pieridae)

E. Marabuto

Abstract

In the course of field work carried out in the spring of 2007, new populations of the endangered species Portuguese Dappled White, *Euchloe tagis* (Hübner, 1804) have been found in Portugal. The results yield new insights on the habitat requirements, foodplants and possible distribution of this species in Portugal.

KEY WORDS: Lepidoptera, Pieridae, *Euchloe tagis*, new records, distribution, biology, Portugal.

Novos dados sobre o dolorido a biologia e distribuição de *Euchloe tagis* (Hübner, 1804) em Portugal (Lepidoptera: Pieridae)

Resumo

Como resultado do trabalho de campo desenvolvido na Primavera de 2007, foram descobertas novas populações da Branca Portuguesa, *Euchloe tagis* (Hübner, 1807) em Portugal. À luz destes resultados, tecem-se considerações acerca dos requisitos de habitat, plantas alimentícias e a distribuição potencial da espécie em Portugal.

PALAVRAS CHAVE: Lepidoptera, Pieridae, *Euchloe tagis*, novos registos, distribuição, biologia, Portugal.

Nuevos datos sobre la biología y distribución de *Euchloe tagis* (Hübner, 1804) en Portugal (Lepidoptera: Pieridae)

Resumen

Como resultado del trabajo de campo desarrollado en la primavera de 2007, fueron descubiertas nuevas poblaciones de la Blanca Portuguesa, *Euchloe tagis* (Hübner, 1807) en Portugal. A la luz de estos resultados, se han establecido consideraciones acerca de los requisitos del hábitat, plantas nutricias y su distribución potencial de la especie en Portugal.

PALABRAS CLAVE: Lepidoptera, Pieridae, *Euchloe tagis*, nuevas citas, distribución, biología, Portugal.

Introduction

The Portuguese Dappled White, *Euchloe tagis* (Hübner, 1804) was originally described from Portugal based on specimens captured at “Piedade near Lisboa”, according to ZERKOWITZ (1946). However, there are several locations with “Piedade” in their name, both to the north and south of the Tagus river margin, namely: Quinta da Piedade (29SMD9301), Cova da Piedade (29SMC8680) and Aldeia da Piedade (29SMC9661). Though there is a higher probability the specimens come from the

last locality because of its mean altitude (150 m), this is not “near Lisboa” especially by 19th century standards. The problem remains and the author believes it could have been found originally to the north of Lisboa near one of the many limestone hills (e. g. near Santa Iria de Azóia, 29SMD9100) which would have had a better plant ground cover in the 19th century but are now mostly urbanized.

After the original description, a new colony was subsequently found in the 20th century occupying altitudes above 300 m in Serra da Arrábida and Serra de São Luis (Palmela) and there is also an odd (low altitude), isolated occurrence at Santa Catarina (29SNC1660) (VIEILLEDENT, 1905). ZERKOWITZ (1946) gives also erroneously Vale de Rosal (misspelt as “Val de Rosal”) as a locality where the species was found, presumably by Cândido Mendes de Azevedo but this is untrue as he only states he didn’t find it but knew of records from Alfeite (29SMC8779) (Mendes, 1910). Zerkowitz himself apparently found this species at Cacilhas and Almada, localities referred in his paper (ZERKOWITZ, 1946) but not in any other reference and very close to either Alfeite or the proposed Cova da Piedade as one of the possible type localities of *E. tagis tagis*.

It is worth noticing how close all these records are to each other in the peninsula of Setúbal. The early detection of colonies of this rare species near Lisboa must for a long time have played a role in the lack of new findings. If a lepidopterist wanted to see *Euchloe tagis* (Hübner, 1804) in flight, he would only need to go to the higher parts of Serra da Arrábida where the species is usually plentiful. Until this year (2007), the species was considered to be very local and endangered in Portugal (MARAVALTHAS *et al.* 2003), with records only from the calcareous Arrábida range, the western Algarve (CORLEY *et al.* 2000; GARCÍA-BARROS *et al.* 2004) and a solitary record from “Leiria” based on a specimen at the Natural History Museum of the Oporto Science Faculty captured by Maria Amélia Silva Cruz (GARCÍA-BARROS *et al.*, 2004).

As yet, there have been no surveys directed towards localities with suitable geological, topographical and botanical conditions to hold a population of *E. tagis*. According to CASINI (1993, 1996) and OLIVARES & BACK (2004), the species is calcicole and needs calcareous soils with rocky outcrops in hilly situations, preferably low altitude ridges covered with low Mediterranean scrubland, flowery meadows and open rocky outcrops with little human disturbance. Since there are few limestone / dolomitic hills and mountain ranges in Portugal, and there are few species of butterflies on the wing in these habitats at this time of the year, the detection of such an early flier (March-April) is unlikely without specifically targeted surveys.

The main motivation for the surveys made in the year 2007 derived from study of the works of GARCÍA-VILLANUEVA *et al.* (1997) and GARCÍA-BARROS *et al.* (2004) which show a very clearly defined distribution in Spain, especially in Extremadura. *E. tagis* was found by García-Villanueva and colleagues in many places with the right habitat, some very close to the international border, suggesting the probability of new colonies awaiting discovery in Portugal.

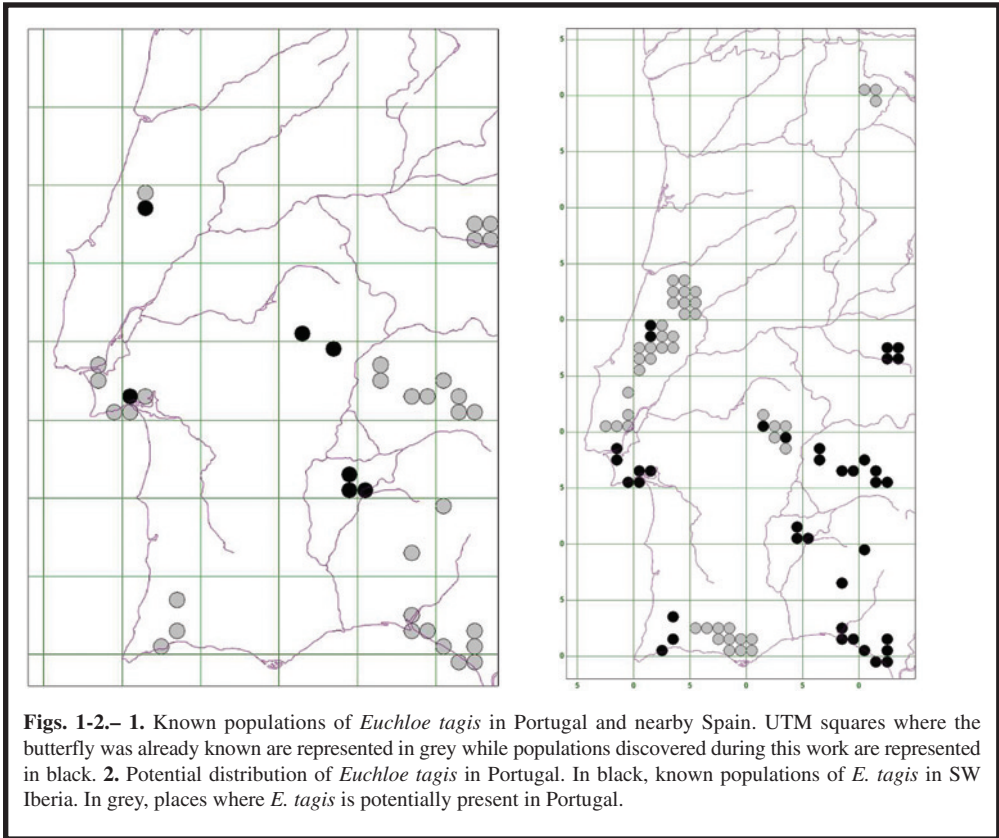
This paper reveals the discovery of two new colonies of *Euchloe tagis* in Alentejo, the confirmation of a colony in Estremadura and gives new insights into the biology, systematics and habitat requirements of this species, strengthening the idea that it may be found in other places in Portugal.

Material and Methods

The field work was conducted during the day, in March and April 2007 together with Manuel Dinis Cortes and António Bívar de Sousa in places where the presence of *E. tagis* was predicted. Depending on the time available, the places were usually visited once or twice for a few hours. Field trips were organized to Serra de Ficalho (Baixo Alentejo), the anticline of Estremoz, between Vila Viçosa and Sousel (Alto Alentejo) and Serra dos Candeeiros, a mountain range in central Portugal included in the Serra D’Aire & Candeeiros Natural Park (Estremadura).

The forecasting of the presence of this species in places in Portugal other than Serra da Arrábida and its vicinity, depended on the combination of the presence of plants of the genus *Iberis* (the usual foodplants of *Euchloe tagis*) and the predominance of high pH, calcareous soils in hilly situations,

particularly small mountain ranges with Mediterranean influence, which had not suffered from forest fires recently. After consulting military and geological maps and flora and vegetation works on likely places, the final decision was made to explore Serra de Ficalho, the area between Vila Viçosa and Sousel and Serra dos Candeeiros. The author went with Manuel Dinis Cortes to Serra de Ficalho and Serra da Adiça on 28-III-2007 and 22-IV-2007; Manuel Dinis Cortes went alone to Vila Viçosa and Sousel on 12-IV-2007 and 23-IV-2007 and the author went with Antonio Bívar de Sousa on 19-IV-2007 to Serra dos Candeeiros. A short account of each site with UTM grid references is given below followed by a summary of the records of *Euchloe tagis*.



Figs. 1-2.— 1. Known populations of *Euchloe tagis* in Portugal and nearby Spain. UTM squares where the butterfly was already known are represented in grey while populations discovered during this work are represented in black. 2. Potential distribution of *Euchloe tagis* in Portugal. In black, known populations of *E. tagis* in SW Iberia. In grey, places where *E. tagis* is potentially present in Portugal.

Habitats and localities with UTM 10 km square and altitude: (County in brackets)

SERRA DE FICALHO

Western base of Serra de Ficalho (Serpa) PC40 320 m.

Álamo - Sobral da Adiça (Moura) PC41 350 m.

Serra de Ficalho (Moura) PC50 510 m.

The mountain range Serra de Ficalho is a succession of three small mountain ridges with a NNE-SSE orientation in the Baixo Alentejo region of Portugal, near the border with Spain with their confluence near the city of Moura. This mountain range is formed by several reliefs with the highest being Ficalho (523 m), Adiça (477 m) and Álamo (425 m) which contrast with the peneplains of

Alentejo. Geologically and geomorphologically rather heterogeneous, the area concerned is a mosaic of mainly calcareous rocks with some siliceous intrusions. The carboniferous rocks here are grouped in two categories, Cambrian dolostones, the “Dolomitic Formation” occupying most high ground; marbles and dolomitic limestone from the Middle Ordovician at lower elevations.

The area is dominated by agricultural fields, mostly olive trees which are more or less abandoned towards the summit of the main elevations where the flora is very interesting (especially the calcicolous species) and rich with nearly 500 different taxa (PINTO-GOMES, 1995). Among the diverse plant associations present (PINTO-GOMES, 1995) the three different places where *Euchloe tagis* was found are dominated by low shrubs of *Quercus coccifera*, *Lonicera implexa* and *Cistus albidus* comprising the seral stages of degradation of the climactic Mediterranean dry forest, *Quercetea ilicis* on a basic substrate. At this point, the predominant plant associations of the habitat of *E. tagis* are the “carrasçais” of *Myrto-Quercetum cocciferae* and the more degraded calcicole “estevais” *Phlomido-Cistetum albidum* but it is not present in the south facing areas with *Genisto hirsutae-Cistetum ladaniferae*. These two formations are present in a mosaic and the foodplant, *Iberis ciliata contracta* grows near outcrops of dolostone and in clearings. During March and April 2007, the butterfly was abundant, nearly dominant, flying lazily only above and near scrubland, basking frequently on the ground and rocks. Stragglers were found up to no more than 20m away, inside an olive tree plantation. The foodplant is assiduously visited by females and oviposition was observed occasionally by the author.

ANTICLINE OF ESTREMOZ

Vila Viçosa (Vila Viçosa) PC39 420 m

Santa Vitória do Ameixial (Estremoz) PD10 300 m

The area concerned has a NW-SE orientation and roughly goes from near the village of Sousel to Vila Viçosa, in the eastern part of Alto Alentejo and is a narrow belt of small elevations with calcareous origin attaining a mean altitude of 400 m. Geologically quite similar to Serra de Ficalho because of the shared origin of its carboniferous rocks, this anticline however, is much more metamorphosed having a higher percentage of marbles (Ordovician) surrounded by a dolomitic matrix (Cambrian). Unlike Serra de Ficalho and because the marbles are of good quality, the area is replete with marble quarries, leaving few places for the natural vegetation to thrive. Nevertheless, in some places a dense scrubland of *Quercus coccifera* develops, associated with a very interesting basophile flora, with the presence of many orchid species, *Pistacia terebinthus*, *P. lentiscus*, *Cistus albidus* and *C. monspeliensis*, corresponding to the alliance *Asparago albi-Rhamnion oleoidis*. The common seral association is *Phlomido-Cistetum albidum*, especially at the habitat margins. In more degraded situations, adjacent to the abundant olive tree crops and where the soil has been leached, *Cistus ladanifer* is often found plentifully. Here, some populations of *Euchloe tagis* were found by Manuel Dinis Cortes but very locally in the right kind of habitat remnants, where *Iberis ciliata contracta* is a common herbaceous plant of the disturbed understoreys and clearings. The two sites surveyed revealed the presence of the Portuguese Dappled White and it is most probable that it is present at least in the intermediate places where the destruction of suitable habitats has not yet taken place.

SERRAS D’AIRE & CANDEEIROS NATURAL PARK

Serra da Pevide (Porto de Mós) ND18 300 m

In this protected area, Antonio Bívar de Sousa and I only had the opportunity to visit the westernmost part, which is the Serra dos Candeeiros, near the town of Porto-de-Mós, at a place called Serra da Pevide. Almost all of the Natural Park lies within the most important calcareous area in the country, the “Mação Calcário Estremenho” in central, western Portugal. Geologically these mountain ranges are composed of a very hard limestone of Jurassic origin associated with dolostone

nuclei (Serra dos Candeeiros and Serra D'Aire), the range attaining its maximum altitude at 678 m a.s.l. In spite of relatively high rainfall (P=1000 mm/y), the high permeability of the soil and rocks produces an extremely dry local environment with an absence of permanent water courses in most areas. The vegetation is very variable with a predominance of xerophilous species. In the more impermeable areas, which have not suffered the effect of the frequent wildfires, a lush mesophile forest develops, the *Arisaro-Quercetum broteroi* where *Quercus faginea* ssp. *broteroi* is the dominant species. However, the greatest part of the area is either occupied by the sere *Lonicero implexae-Quercetum rotundifoliae*, consisting of much degraded meadows of *Teucrio capitati-Thymetum sylvestris helianthemetosum violaceae* or other meadow communities in a mosaic with non-burnt areas of *Quercus coccifera* scrubland, here the endemic *Quercetum coccifero-airensis*. The only *Iberis* species and possible foodplant found in this area is the vulnerable, Portuguese endemic, *Iberis procumbens* ssp. *microcarpa* which develops on rocky calcareous hills of central western and central southern Portugal. This is presumably the foodplant of the Serra da Arrábida population too. The few specimens of *E. tagis* observed were seen in a typical "carrascal" of *Quercus coccifera* with a good ground cover of herbaceous plants and low shrubs, especially *Cistus albidus*, *Thymus zygis* ssp. *sylvestris* and *Lonicera implexa*, among others.

Abbreviations and symbols:

Fw.: Forewing
 Hw.: Hindwing
 Sp.: Specimens seen.
 W: Western
 EM: Eduardo Marabuto
 DC: Manuel Dinis Cortes
 BS: António Bívar de Sousa
 JPC: João Pedro Cardoso

Provinces:

AAL: Alto Alentejo
 BAL: Baixo Alentejo
 E: Estremadura

Records chronologically organised:

BAL: Serra de Ficalho (Moura) (29SPC50, 510 m), 26-III-2007 (12 sp. EM & DC).
 AAL: Vila Viçosa (Vila Viçosa) (29SPC39, 420 m), 12-IV-2007 (6 sp. DC).
 E: Serra da Pevide (Porto de Mós) (29SND18, 300 m), 19-IV-2007 (1 sp. EM & BS).
 BAL: W base of Serra de Ficalho (Serpa) (29SPC40, 320 m), 22-IV-2007 (20 sp. EM & DC).
 BAL: Álamo – Sobral da Adiça (Moura) (29SPC41, 350 m), 22-IV-2007 (3 sp. EM & DC).
 AAL: Santa Vitória do Ameixial (Estremoz) (29SPD10, 300 m), 23-IV-2007 (3 sp. DC).

Morphology and systematics

Five subspecies of *E. tagis* have been described from the Iberian Peninsula:

- 1.– *Euchloe tagis tagis* (Hübner, 1804): Arrábida Range south of Lisboa (Portugal), South Spain west of Sevilla.
- 2.– *E. tagis granadensis* (Ribbe, 1910): South Spain East of Malaga (Betic range).
- 3.– *E. tagis castellana* (Verity, 1911): Spain to the north of Sierra Morena.
- 4.– *E. tagis alhajarae* Olivares & Back, 2004: Sierra de Aracena (Western Sierra Morena).

5.– *E. tagis davidi* Torres Mendez & Verdugo Páez, 1985: Cadiz and Huelva along the coast. Synonymised with *E. tagis tagis* by OLIVARES & BACK (2004).

Some populations have not yet been assigned to a specific subspecies or been formally separated form known taxa (see OLIVARES & BACK, 2004).

From a taxonomic point of view, the Portuguese Dappled White is a complex species to analyse for its multiple geographical and individual forms, many different taxa have been named, even recently (CASINI, 1993; OLIVARES & BACK, 2004). There is probably genetic isolation of many colonies within the wide distributional area of this species: from Algeria north to Portugal and east to Italy. Some of the subspecies appear to be real separate entities although no genetic studies have been made so far.

In Portugal, *E. tagis* is a very poorly known species and until this work, only the population of Serra da Arrábida was still known to thrive. All south-western Iberian populations were grouped in the nominal subspecies which is considered to also occur in southern Spain. According to OLIVARES & BACK (2004), this taxon is characterized by:

Reduced white markings on the hindwing underside. Olive green to yellowish green hindwing underside. Abundant black scales on the base, costa and apex of the forewing upperside. Pure white ground colour on the forewing upperside. The largest subspecies, with a mean forewing length greater than 20 mm. Considering these characters and others available in the literature and the lack of a straightforward placement of the new populations just looking at the distribution of any of the known subspecies, a small sample of specimens ($n = 18$) from all populations known in Portugal (Serra da Arrábida ($n = 8$), Serra de Ficalho ($n = 3$), Anticline of Estremoz ($n = 6$) and Serra dos Candeeiros ($n = 1$)) was analysed for phenotypic differences. These specimens are in the personal collections of EM ($n = 8$), DC ($n = 4$) and JPC ($n = 6$).

A preliminary analysis using biometrics and wing pattern was undertaken on the available sample using digital images of the specimens where all the parameters (ISO, aperture, shutter speed, etc.) were manually defined and standardized (ISO: 200; F20; 1/160). With the aid of an image analysis software (Image J version 1.38x, National Institute of Mental Health, Bethesda, MD, USA), measurements were made using three landmarks on the left forewing of each specimen: forewing costal and basal length, forewing width between the termen and the apex and the amplitude of two angles: angle 1 connecting the apex-base-termen and angle 2 connecting apex-termen-base. Furthermore, the mean amount of red, green and blue (RGB/3) was measured on a standardised area on the underside of the left hindwing (Fig. 3).

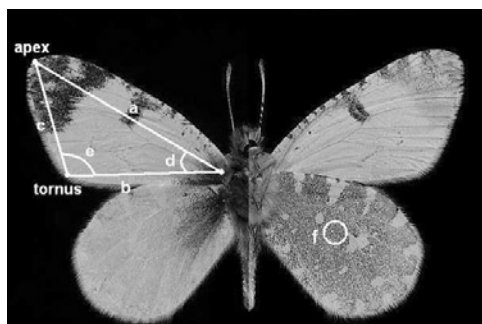


Fig. 3.– Measured phenotypic features on the forewing upperside and hindwing underside in *Euchloe tagis*: a) fw costal length; b) fw basal length; c) forewing width; d) apex-base-termed angle; e) base-termed-apex angle; f) Area of mean (RGB/3) measure.

This role of biometric characters has been chosen because if on one hand it's widely accepted that forewing dimensions and proportions are less variable intra specifically among Lepidoptera because they are directly in control of flight capability (STRAUSS, 1990), differences that may arise from the analysis of allopatric populations of a species may indicate some degree of local adaptation and genetic distance. Here, the overall forewing shape is very important and the inclusion of two angle measures traduces the need to evaluate the forewing "acuteness" as it is expected specimens and populations with more acute forewings may have to withstand stronger winds and have the capability of longer distance dispersal because of increased aerodynamics.

When at rest, the Portuguese Dappled White conceals the forewing vertically like most butterflies do and the greenish hindwing covers

completely the white portions of the forewing. The single colour measure on the hindwing underside is therefore connected with the evaluation of hindwing colouration and camouflage of the butterfly at rest. This character may evolve with the surrounding habitat and the vegetation present so is a good starting point for speculations on the changes a population may suffer in allopatry.

According to all these characters, the first conclusion is that females are consistently larger than males, which have more pointed, shorter forewings.

The population from Serra da Arrábida and surrounding area is apparently the geographically closest to the nominal *E. tagis tagis* described by Hübner and therefore is here (as has always been) considered to be the same as the type population. A representative couple is figured (Fig. 4a & 4b). Specimens coming from this small mountain range, where the species flies above 300 m a. s. l. in clearings and outcrops of calcareous Jurassic rock are characterized by the small average size (male fw length mean = 19,0 mm), reduction of the white markings on the hindwing underside which though variable, is usually dark-yellowish green (i. e. with a high concentration of black scales). Forewing upperside is pure white with solid black apex in both sexes, even in newly emerged specimens and greyer on the hindwings. Males often have very acute forewings (male mean angle $2 = 106,91^\circ$) as in Fig. 4a while females have broader forewings and are usually larger.

The newly found population from Serra de Ficalho and Serra da Adiça, occupies most calcareous outcrops in a relatively small area of three 10 x 10 km UTM squares. Specimens are somewhat larger than the typical form (fw length mean = 20,0 mm) and are generally of a lighter greenish-yellow hindwing underside, the concentration of black scales being lower. Furthermore, the apex of the forewing is not pure black but dark-grey, especially on the female and males have less pointed forewings than the previously described population. In some specimens, ground colour is not pure white but slightly yellowish-white. Otherwise, these specimens are very similar to nominal *E. t. tagis* and should be ascribed to this taxon, despite some similarities and remarkable geographical proximity (50 km in a straight line) to the recently described *E. tagis alhajarae* (Olivares & Back, 2004). A representative couple is figured on Fig. 4b & 4f.

The Anticline of Estremoz is a calcareous outcrop that stretches for 37 km but is only around 4km wide. *E. tagis* was found in both ends of this area and specimens from these two localities (Santa Vitória do Ameixial and Vila Viçosa) are indistinguishable as expected and they probably maintain an active genetic flow. Here, as in Serra de Ficalho, the contact with other Portuguese populations is virtually impossible and this population is a natural extension of the Spanish occupying the basic ridges of southern Badajoz province. Specimens' upperside ground colour is pure white with black to grey apex of the forewings which also are much less pointed, the insects appearing more compact. The underside of the hindwing is dark green to yellowish green and the extent, size and definition of the white spots is highly variable. There are specimens with reduced white spotting resembling *E. t. tagis* but others are highly speckled with much defined large white spotting, resembling *E. tagis castellana* (Verity, 1911) from central Spain (Fig. 4c & 4g). The status of this population is for now indefinite but the author believes this still belongs to *E. t. tagis* though transitional to *E. t. castellana*. Further genetic studies may reveal a certain degree of introgression.

The only population located to the north of river Tagus was found in a small area near the town of Porto-de-Mós in the mountain range of Serra dos Candeeiros but it is expected to be a widespread species along all the mountain range in similar conditions. As only a single male specimen was located during the short survey, the characters that follow cannot be considered representative of the whole population and a good deal of variation is expected. However, this is a very different butterfly from all the other known populations of *E. tagis*: Upperside ground colour light cream-coloured and black markings well defined. Forewings bear a dark-grey apex, strong black suffusion at the base and a large, rectangular black discoidal spot. The forewing of the examined specimen is the least pointed of all measured males (angle $2 = 100,35^\circ$). Underside of forewings with a well defined bright green apex with a variegated indefinite dark pattern (unlike ssp. *tagis* but like some specimens from the Anticline of Estremoz, except the bright green

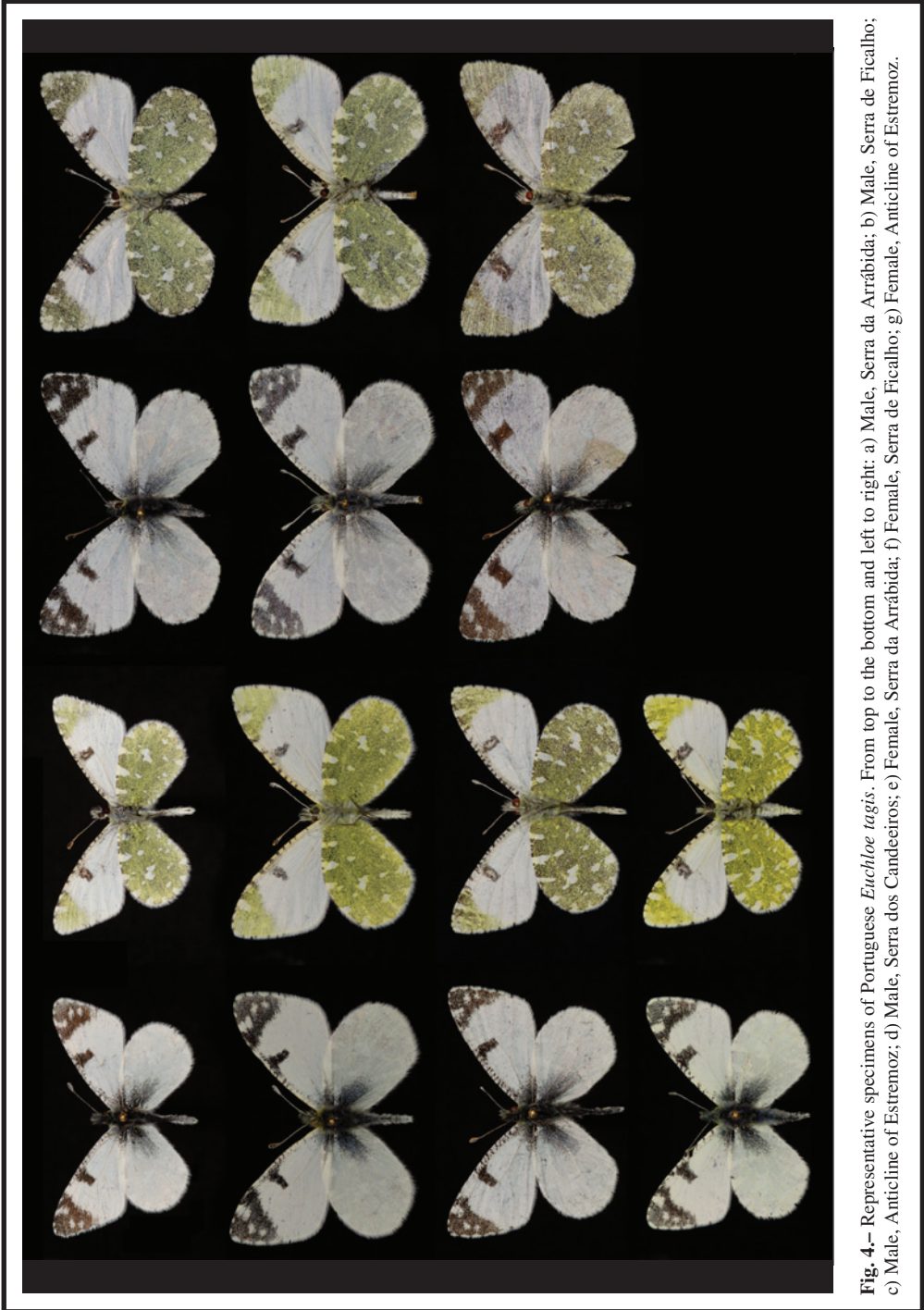


Fig. 4.— Representative specimens of Portuguese *Euchloe tagis*. From top to the bottom and left to right: a) Male, Serra da Arrábida; b) Male, Serra de Ficalho; c) Male, Anticline of Estremoz; d) Male, Serra dos Candeeiros; e) Female, Serra da Arrábida; f) Female, Serra de Ficalho; g) Female, Anticline of Estremoz.

colouration). Hindwing underside is of a very bright green (lowest RGB mean = 88,19) with abundant “jagged” bright white spots (especially the large discoidal and marginal spots) which appear highly contrasted. Under the microscope, when compared with bright (newly emerged) specimens from other populations (Serra de Ficalho, especially), the yellow scales are brighter coloured and in a much denser net while the concentration of black scales is much higher. Although OLIVARES & BACK (2004) minimize the underside ground colour as a taxonomic tool for *E. tagis*, because of their age, the author believes here this is not only a matter of how old the specimen is; difference from specimens coming from other populations is striking. Moreover, the overall colouration (light yellowish-white), contrast and shape of the hindwing white spots merit special considerations, this population maybe deserving subspecies status. This should become clearer when more specimens are available for study in a near future.

All measured characters are summarized and compared with some available in the literature from other populations on Table 1.

Population	Quantitative characters												Qualitative characters			
	N		Fw length (mm)		Fw basal length (mm)		Fw width (mm)		Fw angle 1 (apex-base-termin)		Fw angle 2 (apex-termin-base)		RGB Mean	Upperside Fw	Underside	
	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀		Ground colour	Ground colour	White spotting
Arrábida	6	2	19,0 (16,9 - 20,9)	20,0	13,5	14,7	10,6	11,8	35,50	38,29	106,91	101,45	113,97	White	Yellowish green	Small and scarce
Ficalho	2	1	19,8 (19,6 - 20,0)	20,4	14,3	15,2	11,8	11,6	37,94	36,95	102,59	103,48	100,23	White - light creamish-white	Light-yellowish green	Small, abundant
Estremoz anticline	5	1	18,5 (17,5 - 19,1)	20,3	13,3	15,6	10,6	11,4	37,01	37,00	102,97	100,17	102,18	White	Dark yellowish green	Large, abundant
Candeeiros	1	---	18,7	---	13,7	---	11,3	---	39,25	---	100,35	---	88,19	Creamish-white	Bright, light green	Large, abundant
<i>E. t. granadensis</i> (1)			18,51											White	Variable	Variable
<i>E. t. alhajaræ</i> (1)			20,01											Slightly cream-coloured	Light green - yellowish green	Abundant
<i>E. t. castellana</i> (2)			14 - 15											White	Dark green	Medium, abundant
<i>E. t. bellezina</i> (2)			18 - 19											White	Dark green	Very large, abundant

Table 1.– Diagnostic characters involving some populations of *E. tagis* in Portugal and elsewhere. The numbers are referable to arithmetic means from the representative samples of each population in Portugal. ⁽¹⁾: OLIVARES & BACK (2004); ⁽²⁾: HIGGINS & RILEY (1983).

Conservation and comments on the discovered populations

Every place where the presence of *E. tagis* has been detected in Portugal in recent times, either the known colony of Arrábida or the newly discovered shares a number of characters concerning the habitat, presence of foodplant and geology which are important to summarize:

1.– Presence of the foodplant, crucifers of the genus *Iberis*, which in Portugal has five taxa: *Iberis ciliata contracta*, *Iberis ciliata welwitschii*, *Iberis procumbens procumbens*, *Iberis procumbens microcarpa* and *Iberis pectinata*. Abroad, it is known to feed on *Biscutella* spp. (TOLMAN & LEWINGTON, 1997) and *Eruca vesicaria* (OLIVARES & BACK, 2004) but I think these are only used as minor hostplants when *Iberis* is not readily available.

2.– A calcareous substrate, especially of Jurassic or Ordovician age is apparently needed and this is probably the main factor as it conditions the plant associations present and the presence of the foodplant.

3.– *E. tagis* seems to prefer altitudes above at least 300 m a. s. l. in Portugal (pers. obs.) and above 500 m in Extremadura, Spain (GARCÍA-VILLANUEVA *et al.*, 1997) and hilly situations with rock outcrops.

4.– The habitats where the butterfly is to be found are always the seral stages of the climactic forests of xerophilous hard-leaved oaks, namely of *Quercus faginea* (Arisaro-*Quercetum broteroi*) or *Quercus rotundifolia* (Myrto-*Quercetum rotundifoliae*) where *Quercus coccifera* is predominant.

Places with these characteristics are not very common in Portugal, where the predominant rock types are granites and schists making the potential distribution of *E. tagis* very patchy and irregular. The results presented in this work are important because once considered a very rare, endangered butterfly in Portugal (MARAVALHAS *et al.* 2003), the Portuguese Dappled White is now known to occur at least in four (five if the western Algarve records are true) different colonies in southern Portugal. A lowering in threatening level should be considered in due time for the elaboration of a Portuguese Red Data Book for Butterflies.

Nonetheless, it is clear from the records globally (GARCÍA-BARROS *et al.* 2004) and presented here that this is a stenochorous species, limited to the right kind of habitat and dependent on rare crucifers. Not being found on other substrates other than those of calcareous origin, colonies are rather isolated from each other because of unsuitable habitat between them. This may be reflected in some genetic differentiation as there are several described subspecies in Spain, France, Italy, Algeria and Morocco. The status of the various populations is somewhat unresolved and until there is genetic evidence, any grouping is just tentative. The author believes all the Portuguese populations south of river Tagus are closely related (*E. t. tagis*) even though there seems to be some contact with other taxa (*alhajarae* and *castellana*). Their vicariance thus, may be fairly recent while the population north of river Tagus is more differentiated and may represent an undescribed subspecies requiring separate conservation measures. *E. tagis* is ecologically so different from the other species of the genus in Portugal and the Iberian Peninsula, its presence alone in a given place should be regarded as a bioindicator of a healthy but sensible ecosystem. The habitats where it is found are very rich in plant and animal species and prone to endemism. Because butterflies usually share their sympathy among people as few other animal groups do, *E. tagis* (together with orchids) is a good umbrella species for conservation of these habitats.

Nationally, as Serra da Arrábida and Serra dos Candeeiros are Natural Parks and Serra de Ficalho and Adiça are NATURA 2000 sites, only the populations from the Anticline of Estremoz are not inside a legally protected area. They are undoubtedly the most endangered because intensive extraction of ornamental marbles is still taking place in the region and brings much income to local people. The other populations share the threat of wildfires (especially problematic at Serra de Aire & Candeeiros Natural Park which has its natural vegetation reduced to the earliest stages of succession in most of the area and is subject to almost annual fires) and clearance for olive-tree crops, which has not taken place recently. Such an interesting species therefore deserves special attention and adequate habitat management for its presence and genetic background should be maintained together with its special ecosystem.

Distribution of *Euchloe tagis* in Portugal

The knowledge that *E. tagis* has highly specialized ecological requirements raises doubts concerning the reliability of certain earlier records of the species. Some historical records come from localities I would consider doubtful for this species especially because of low altitude and absence of foodplant, like the Algarve records which are either from siliceous soils with unsuitable habitat (29SNB33 in GARCÍA-BARROS *et al.* 2004) or in rather developed, low altitude localities without the foodplant but with the right geology (Luz and Quinta da Rocha in CORLEY *et al.* 2000; Corley pers. comm.). Although I consider these three records from the western Algarve as unconfirmed, they have been included in the Portuguese distribution of the butterfly particularly because colonies

of the species are expected in the Algarve on the wide calcareous belt known as “Barrocal” which has its western limits near Luz and Quinta da Rocha.

Records of *E. tagis* in Portugal are summarized on Fig. 1, showing previous records (grey) and the newer records (black). This species was known only from near the coast, there being no connection with the populations in southern Spain (GARCÍA-VILLANUEVA *et al.* 1997, GARCÍA-BARROS *et al.* 2004). Now it is obvious that *E. tagis* may be much more widespread in southern and central Portugal and new colonies can be expected to be found. Because of the very precise requirements this species apparently has in Portugal, a 10 km square grid map has been produced showing suitable places where *E. tagis* has not been cited but may possibly be found (Fig. 2). This map is merely indicative of the possible presence of the Portuguese Dappled White and should be interpreted as the conjunction of several abiotic (altitude above 300 m, calcareous mountains and outcrops) and biotic (scrubland and maquis with basophile elements where the foodplant is present) features known to be favourable to the presence of the butterfly. However, colonies could occur at lower altitudes where other local conditions permit, or conversely the potential vegetation of an area might be ideal but has been destroyed by human activity and is no longer able to sustain *E. tagis*.

Final Remarks

The Portuguese Dappled White, although first described in Portugal more than 200 years ago has remained almost unknown in the country. Only now are we beginning to understand the life history, requirements and ecology of this butterfly with several colonies now known from the country as well as the foodplants and habitats used. Recent studies by Spanish and Italian lepidopterists, however have unveiled much of its biology and systematics in other countries where this species is to be found showing a high degree of differentiation.

This work shows that this stenochorous, rare and specialized species is more widespread than previously thought. If oriented surveys are made towards this species, other colonies may be found where the right kind of ecosystem is present. Moreover, the systematic relationship between the many subspecific taxa throughout the range of this species is still unknown and authors have based their descriptions and biogeographical assumptions merely on morphological distinctness and distribution. A full genetic analysis using molecular markers may solve these taxonomic problems and provide the basis for an integrated conservation of the species as a whole and at a smaller scale. Evaluating which populations are most in need of conservation measures either because of external factors or those derived from loss of genetic variability will be crucial for the regional management policies on this species and its habitats.

Acknowledgements

I am most grateful to Manuel Dinis Cortes and António Bívar de Sousa for companionship and collaboration in the field, without them this work would have been much more difficult to accomplish. Also to Lúcia Porto Góis, Maria Vitória Marabuto, Florentino Marabuto and Antónia Brito for support during the writing of the manuscript and to João Pedro Cardoso for loan of specimens and friendship through the writing process of the paper. Finally, the author especially wishes to thank Martin Corley on ideas concerning the manuscript, for its linguistic revision and help with literature.

BIBLIOGRAPHY

- CASINI, P. M., 1993.– Première station pour l'Italie péninsulaire d'*Euchloe tagis* Hübner (1804) et description de la ssp. nov. *calvensis* (Lepidoptera: Pieridae).– *Linneana Belg.*, **14**(1): 3-13.
- CASINI, P. M., 1996.– Deux nouvelles stations d'*Euchloe tagis* (Hübner, 1804) en Italie centrale. Élevage d'*Euchloe tagis calvensis* Casini (1993), *Euchloe ausonia* (Hübner, 1804) et *Anthocharis cardamines*

- (Linnaeus, 1758) au Mont Calvi (Livorno, Italie centrale) (Lepidoptera: Pieridae).– *Linneana Belg.*, **15**(7): 275-280.
- CORLEY, M. F. V., GARDINER, A. J., CLEERE, N. & WALLIS, P. D. 2000.– Further additions to the Lepidoptera of Algarve, Portugal (Insecta: Lepidoptera).– *SHILAP Revta. lepid.*, **28**(111): 245-319.
- GARCÍA-BARROS, E., MUNGUIRA, M. L., MARTÍN CANO, J., ROMO BENITO, H., GARCÍA PEREIRA, P. & MARAVALHAS, E. S., 2004.– Atlas de las mariposas diurnas de la Península Ibérica e islas Baleares (Lepidoptera: Papilionoidea & Hesperioidea).– *Monografías S.E.A.*, **11**. 1-228.
- GARCÍA-VILLANUEVA, V., BLÁZQUEZ CASELLES, A., NOVOA PÉREZ, J. M. & NIETO MANZANO, M. A. 1997.– *Atlas de los lepidópteros ropalóceros de extremadura (Hesperioidea & Papilionoidea)*: 122 pp. Instituto Extremeño de Entomología. Badajoz.
- HIGGINS, L. G. & RILEY, N. D., 1983.– *Butterflies of Britain & Europe*: 384 pp. HarperCollins Publishers, London.
- MARAVALHAS, E., 2003.– *As borboletas de Portugal*: 455. Ed. Vento Norte.
- MENDES, C. A., 1910.– Lepidopteros de Portugal. II. Lepidopteros de Val de Rosal (Caparica de Monte) em 12 e 13 de Abril.– *Brotéria*, **9**: 129-132.
- OLIVARES, J. O. V. & BACK, W., 2004.– *Euchloe tagis* (Hübner, [1804]) (Lepidoptera, Pieridae) en Andalousie et description d'une sous-espèce nouvelle.– *Linneana Belg.*, **19**(5): 229-240.
- PINTO-GOMES, C. J., 1995.– *A Serra de Ficalho, Flora e vegetação*: 153 pp. Ministério do Ambiente e Recursos Naturais. Direcção regional do ambiente e recursos naturais do Alentejo.
- STRAUSS, R. E., 1990.– Patterns of quantitative variation in lepidopteran wing morphology: the convergent groups Heliconiinae and Ithomiinae (Papilionoidea: Nymphalidae).– *Evolution*, **44**(1): 86-103.
- TOLMAN, T. & LEWINGTON, R., 1997.– *Collins Field Guide to Butterflies of Britain & Europe*: 320 pp. HarperCollins Publishers, London.
- VIEILLEDENT, P., 1905.– Lepidópteros da Região de Setúbal.– *Brotéria*, **4**: 185-206.
- ZERKOWITZ, B., 1946.– The Lepidoptera of Portugal.– *Jl N. Y. ent. Soc.*, **54**(1-3): 51-87; 115-166; 211-261.

E. M.
Rua Maestro Frederico de Freitas, 5-7º- Dto.
P-1500-399 Lisboa
PORTUGAL / PORTUGAL
E-mail: edu_marabuto@netcabo.pt

(Recibido para publicación / Received for publication 6-IX-2007)
(Revisado y aceptado / Revised and accepted 5-X-2007)