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The distribution of the genus *Tarucus* Moore, [1881], in the Maghreb States of Morocco, Algeria and Tunisia, with notes on species identification (Lepidoptera, Lycaenidae)

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Summary

As part of a wider study of butterflies in the Maghreb States of Morocco, Algeria and Tunisia, a large amount of material of the genus *Tarucus* Moore, [1881], was examined with a view to determining the distribution of *T. theophrastus* (Fabricius, 1793), *T. rosaceus* (Austaut, 1885), and *T. balkanicus* (Freyer, 1845), in the Maghreb and to assess whether there were any external features which might allow the separation of species. Results indicate that published information relating to distribution, identification and host-plant association is often unreliable. The apparently local and scarce *T. balkanicus* may be identified with a high degree of certainty from wing markings, but *T. theophrastus* and *T. rosaceus* cannot be reliably separated other than by examination of the male genital armature. Examination of a large number of male genitalia established that a high percentage of populations sampled contained both *T. theophrastus* and *T. rosaceus*. It is suggested that the two species fly together more often than they do not, utilising whichever *Zizyphus* or *Paliurus* (Rhamnaceae) host-plants are available.

Résumé

En vue d'une meilleure connaissance des Lépidoptères des pays maghrébins du Maroc, d'Algérie et de Tunisie, une quantité substantielle de matériel du genre *Tarucus* Moore, [1881], a été réunie et examinée dans le but de préciser les répartitions de *T. theophrastus* (Fabricius, 1793), *T. rosaceus* Austaut 1885 et *T. balkanicus* (Freyer, 1845), au Maghreb et de savoir si quelques caractères externes pourraient permettre une différenciation spécifique. Les résultats montrent que les données déjà publiées quant à leurs distributions, identifications et plantes-hôtes ne sont pas toujours fiables. *T. balkanicus*, apparemment localisé et rare, peut-être identifié avec forte certitude par ses dessins alaires, alors que *T. theophrastus* et *T. rosaceus* ne peuvent être différenciés que par l'étude de l'armature génitale mâle. Un grand nombre de genitalia ont été examinés et il en ressort qu'un fort pourcentage des populations étudiées contient à la fois les deux espèces *T. theophrastus* et *T. rosaceus*.

Ces deux espèces volent donc conjointement plus fréquemment qu'on ne le pense, recourant tout autant au *Zizyphus* qu'au *Paliurus* (Rhamnaceae) comme plantes nourricières certaines.

Zusammenfassung

Als Teil einer umfassenden Studie der Tagfalterfauna der Maghreb Staaten von Marokko, Algerien und Tunesien, wurde auch sehr umfangreiches Material von Arten der Gattung *Tarucus* Moore, [1881], zusammengetragen. Dieses soll nun vorab untersucht und analysiert werden um die Verbreitung der Arten *T. theophrastus* (Fabricius, 1793), *T. rosaceus* (Austaut, 1885) und *T. balkanicus* (Freyer, 1845), in der Maghreb-Zone aufzuzeigen. Darüber hinaus soll festgestellt werden ob es irgendwelche äußerliche Merkmale gibt, die es erlauben, diese Arten danach zu unterscheiden. Die gewonnenen Ergebnisse deuten darauf hin, daß die bisher publizierten Angaben, die Verbreitung, die Identifizierung der Arten und deren Futterpflanzen betreffend, oft unglaubwürdig erscheinen. Die offensichtlich lokale und seltene *T. balkanicus* kann, mit einem großen Maß an Sicherheit, aufgrund der Flügelzeichnung, bestimmt werden. *T. theophrastus* und *T. rosaceus* hingegen, können nicht verläßlich, ohne Berücksichtigung ihrer Genitalien, voneinander getrennt werden. Eine große Zahl männlicher Genitalien wurde untersucht, wodurch gezeigt werden kann, daß ein hoher Prozentsatz der herangezogenen Populationen sich aus *T. theophrastus* und *T. rosaceus* zusammensetzt. Vermutlich fliegen diese beiden Arten öfters zusammen als getrennt, wobei sie entweder, je nach dem Vorkommen, *Zizyphus* oder *Paliurus* (Rhamnaceae) also Ablagepflanze annehmen.

Introduction

The Lycaenid genus *Tarucus* comprises ca 25 species distributed from north-western Africa to South East Asia. Males of many species are blue on the upperside (ups) and the females are brown with a variable pattern ; the underside (uns) of both sexes is creamy white with a pattern consisting of brown or black spots, streaks and lines. The separation of species is notoriously difficult using external features. In India and the Middle East, the butterflies inhabit very dry localities and the genus reaches its western limits in the semi-desert regions of south-western Morocco. In the Maghreb States three species fly : *T. theophrastus* (Fabricius, 1793), *T. rosaceus* (Austaut, 1885), and *T. balkanicus* (Freyer, 1845).

Bethune-Baker (1918) published a revision of the genus world-wide. He did not give the origin of material examined but confined himself to general comments on distribution, describing *T. mediterraneae*, a synonym for *T. rosaceus*. In 1955, Evans revised the *Tarucus* of Europe,

North Africa and Asia, examining 4000 specimens, mainly in the collection of The British Museum (Natural History), London (BM(NH)), and listed the provenance of the material examined. The only other report dealing specifically with *Tarucus* in the Maghreb States was that of Baz (1988), who drew certain conclusions regarding the distribution of *T. theophrastus* in Morocco based on material collected at nine sites during two weeks in May 1987. In the light of the results of the present study, it would be surprising if many of these '*theophrastus*' are not in fact *rosaceus*.

One of the few contemporary butterfly books comprehensively incorporating north-western Africa is Higgins & Riley's "Butterflies of Britain and Europe" which is, as the author has commented previously (Tennent, 1993b : 257), often flawed so far as the North African fauna is concerned. In that book, *T. theophrastus* was described as flying around the host-plant, *Zizyphus vulgaris* (Rhamnaceae), usually in lowlands near the coast of North Africa ; *T. rosaceus* and *T. balkanicus* were also said to be found in the lowlands, probably to the foothills [of the Atlas mountains], flying near the host-plant, *Paliurus spinachristi* (Rhamnaceae). Maps accompanying Higgins & Riley's text showed the North African distribution of all three species limited to the Mediterranean coastal region, with a further isolated population of *T. rosaceus* in western Morocco.

In endeavouring to determine the distribution of *Tarucus* species in North Africa for a comprehensive work (Tennent, 1996 in prep.), the author experienced practical difficulty in separating *T. theophrastus* and *T. rosaceus* in the field. The suspicion that the authenticity of some previously published records was in doubt and the knowledge that *Tarucus* species extend to considerable altitudes in the High Atlas mountains as well as deep into the Sahara desert, prompted the present review.

Material examined

During field work in 1991-1994, a total of 303 male and 208 female *Tarucus* specimens was collected from 46 different localities in Morocco, Algeria and Tunisia. The study was seriously curtailed by the political situation in Algeria. The loan or gift of a further 14 male specimens was received from the Zoologisk Museum, Copenhagen (DK) and from entomologists in Marktleuthen (D), Bonn (D), San Gimignano (I) and Cannes (F). The comprehensive collections in the BM(NH), London, were also examined but dissection of specimens not forming part of the author's accumulated material was deemed unnecessary.

Collecting was arbitrary and the number of *Tarucus* specimens obtained from a locality is not indicative of abundance. The combined total of 317 male *Tarucus* from 58 localities in the Maghreb available for genitalic examination provided the data on which this study is based ; unless otherwise stated, material is in the author's collection.

Localities from which *Tarucus* material was available (see Fig. 1)

T1 — 5♂♂ — Tafraoute, Anti-Atlas (M), 1300 m, 13.9.91
T2 — 17♂♂, 7♀♀ — Sidi M'Zal (M), ca. 1300 m, 3-6.4.92 / 10.5.92 / 18.4.94
T3 — 2♂♂ — Agadir (M), 80 m, 19.4.94
T4 — 6♂♂, 4♀♀ — Ait Moussa, 29 km E of Agadir (M), 100 m, 28.5.93
T5 — 9♂♂, 4♀♀ — Taroudannt (M), 250 m, 12.9.91
T6 — 6♂♂, 3♀♀ — Ait-Iazza, E of Taroudannt (M), 300 m, 11.5.92 / 26.5.93
T7 — 5♂♂, 2♀♀ — 4 km N of Olad Berhil (Taroudannt) (M), 620 m, 26.5.93
T8 — 5♂♂ — 12-14 km W of Aoulouz (between Taroudannt and Taliouine) (M), 740 m, 26.5.93 / 31.3.94

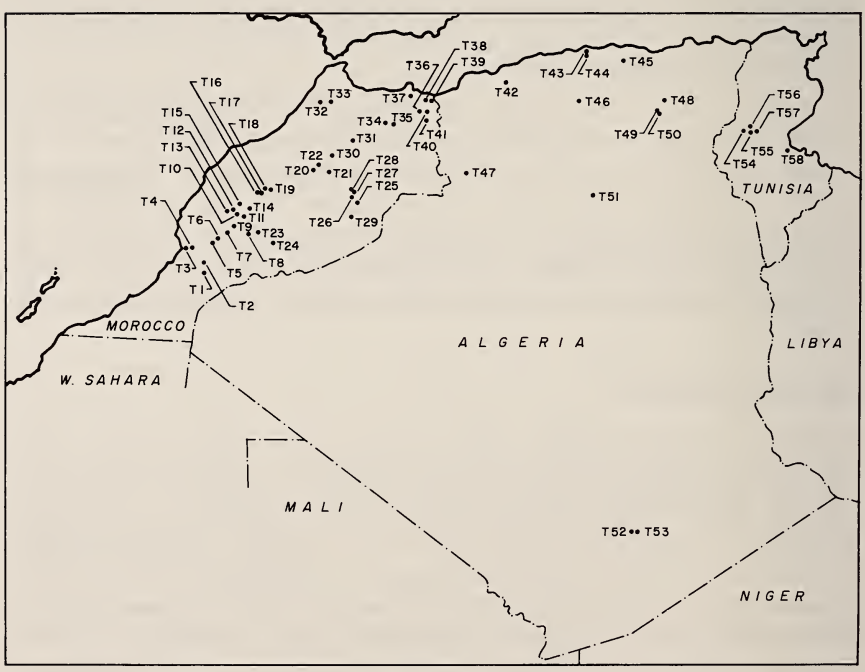

Fig. 1. Location of sites T1-T58.

T9 — 1♀ — Tizi-n-Test (M), 1100 m, 4.6.92
T10 — 1♂ — nr Asni (M), 1050 m, 6.9.91
T11 — 1♂, 2♀♀ — Oukaimeden (M), 2400 m, 3,5.9.91 / 14.6.94
T12 — 4♂♂ — Barrage de Lalla-Takerkoust (M), 600 m, 31.5.94
T13 — 2♂♂ — Amizmiz (High Atlas) (M), 900 m, 1.6.94
T14 — 7♂♂, 7♀♀ — Ouriki, SE of Marrakech (M), 820 m, 24.6.93
T15 — 5♂♂, 1♀ — Marrakech (M), 500 m, 31.5.94
T16 — 4♂♂, 2♀♀ — El Kelaa-des-Sraghna (M), 600 m, 1.9.91
T17 — 12♂♂, 9♀♀ — Khemis-des-Oulad-Ayad (El Kelaa-des-Sraghna) (M), 780 m, 10-11.7.93
T18 — 4♂♂ — 2 km S of Nid de Cigogne (El Kelaa-des-Sraghna) (M), 420 m, 10.7.93 / 27.5.94
T19 — 51♂♂, 15♀♀ — Bzou (ca. 30km E of El Kelaa-des-Sraghna) (M), 400 m, 9-10, 20.4.94
T20 — 4♂♂, 2♀♀ — 3 km SW of Ouaoumara, S of Khenifra (M), 820 m, 19.6.93
T21 — 3♂♂, 2♀♀ — R.P. 33, 11 km E of junction with R.24, (Khenifra) (M), 1050 m, 19.6.93
T22 — 7♂♂, 6♀♀ — Khenifra (M), S outskirts of town, 900 m, 3.6.93
T23 — 5♂♂, 7♀♀ — Tizi-n-Bachkoum (M), 1400 m, 10.9.91 / 14.3.94
T24 — 1♂ — nr. Bou-Azzer (Anti-Atlas) (M), 1320 m, 26.3.94
T25 — 16♂♂, 2♀♀ — Meski (Er Rachidia) (M), 1100 m, 1.4.92 / 25.5.93
T26 — 1♂, 1♀ — N outskirts of Er Rachidia, 1150 m, 25.5.93
T27 — 3♂♂, 2♀♀ — 30 km N of Er Rachidia (M), 1340 m, 25.5.93
T28 — 6♂♂, 4♀♀ — 12 km S of Rich, Ziz valley (M), 1400 m, 25.5.93
T29 — 1♂ — Tafilalt, vic. Aoufouss (M), 1000 m, 3.6.90, W. ten Hagen leg.
T30 — 1♂ — R.P. 24, 22 km S of Azrou (M), 1100 m, 3.6.93
T31 — 1♂, 1♀ — nr Sefrou (M), 900 m, 27.8.91
T32 — 10♂♂, 11♀♀ — 9 km S of Mechra-Bel-Ksiri (M), 100 m, 6.6.93
T33 — 22♂♂, 7♀♀ — nr Ouezzane (M), 120 m, 23.8.91
T34 — 5♂♂ — 8 km W of Guercif (M), 480 m, 13.6.93
T35 — 3♂♂ — 20 km E of Guercif (M), 600 m, 24.4.92
T36 — 4♂♂ — 7 km NE of El Aïoun (M), 650 m, 13.6.93
T37 — 3♂♂, 1♀ — 6 km E of Driouch (Nador) (M), 380 m, 25.5.93
T38 — 1♂, 1♀ — 10 km W of Berkane, N slopes of Monts de Beni-Snassen (M), 380 m, 14.5.93
T39 — 2♂♂, 1♀ — Berkane (M), 300 m, 14.6.92
T40 — 2♂♂ — near El Aïoun, Oujda (M), 500 m, 22.5.82, F. Fabiano (coll. Fabiano)
T41 — 1♂ — Commune d'el Aouinet, 24 km S of Oujda (M), 880 m, 13.5.93
T42 — 8♂♂, 2♀♀ — 10 km SW of Relizane (A), 300 m, 11.5.93
T43 — 1♂ — Gorges de la Djemaa, env. d'Alger (A), [? alt], 30.6.55, G. Barragué leg.
T44 — 1♂ — Rassauta, dep. d'Alger (A), [? alt], 13.9.57, G. Barragué leg.

T45 — 1♂ — Lalla Marnia (A), [? alt], 15.5.15, Dr H. C. Nissen leg. (coll. Zool. Museum Copenhagen)
T46 — 2♂♂ — Guelt-es-Stel (A), [ca. 1100 m], 26.8.51, G. Barragué leg. (coll. Barragué) ; 14.9.17, [Dr H. C. Nissen leg.] (coll. Zool. Museum Copenhagen)
T47 — 1♂ — Aïn Sefra (A), [? alt], 17.5.13, [Dr H. C. Nissen leg.] (coll. Zool. Museum Copenhagen)
T48 — 32♂♂, 11♀♀ — El Kantara (A), 6-900 m, 30.6.92 / 17-20.4.93
T49 — 1♂ — Col de Sfa [N of Biskra] (A), [? alt], 15.4.09, Dr. H. C. Nissen leg. (coll. Zool. Museum Copenhagen)
T50 — 1♂ — 3-5km NW of Biskra (A), [? alt.] 17.3-5.4.84, H. Falkenhahn leg. [ex. entomologisches museum Dr. Ulf Eitschberger]
T51 — 1♂ — Ghardaia (A), [? alt], 20.4.11, Dr H. C. Nissen leg. (coll. Zool. Museum Copenhagen)
T52 — 1♂ — 12 km E of Source Chapuis, Hoggar mountains (Tamanrasset) (A), 1540 m, 28.4.93
T53 — 7♂♂, 1♀ — Source Chapuis, Hoggar mountains (Tamanrasset) (A), 1540 m, 27/28.4.93
T54 — 1♂ — 3-5 km SW of Gafsa (T), 400 m, 4.3.84, H. Falkenhahn leg. [ex. entomologisches museum Dr. Ulf Eitschberger]
T55 — 2♂♂, 1♀ — Dj. Hachichina, SE of Gafsa (T), 100 m, 5.4.93
T56 — 6♂♂, 4♀♀ — Dj. Sif El Leham, 12 km N of T55 (T), 300 m, 6.4.93
T57 — 2♂♂ — El Amayem, 16 km E of El Guetter (T), 30.3.93 / 7.4.93
T58 — 1♂ — 15km E of Matmata (T), 100 m, 6.4.91, W. ten Hagen leg.

The distribution of *Tarucus* species in the Maghreb

The primary aim of this study was to determine the distribution of the three *Tarucus* species within the political boundaries of Morocco, Algeria and Tunisia. As will be discussed, although *balkanicus* may usually be readily identified using external features (i.e., wing markings), *theophrastus* and *rosaceus* may not and it was necessary to examine the genitalia of 170 male *theophrastus* and *rosaceus* in order to gain knowledge of their distribution. The results are reproduced in Tab. 1.

Species confirmed (*theophrastus* and *rosaceus*) from the 38 localities from which more than one male was available are recorded in Tab. 2.

Although *theophrastus* and *rosaceus* were found flying together in almost two-thirds of the localities from which Tab. 2 was produced, it does not necessarily follow that, where only one species was identified, the other does not also occur. Indeed, in 26 localities sampled from where six or less males were available, both species were found,

Table 1

Male T. theophrastus and *T. rosaceus* identified from genitalic examination.

Locality	Males examined	*rosaceus*	*theophrastus*
T1	3	1	1
T2	4	2	2
T3	2	2	-
T4	2	1	1
T5	3	1	2
T6	3	2	1
T7	5	5	-
T8	3	-	3
T9	-	-	-
T10	1	-	1
T11	1	-	1
T12	3	1	2
T13	2	-	2
T14	2	1	1
T15	2	1	1
T16	3	1	2
T17	9	-	9
T18	2	1	1
T19	16	2	14
T20	4	-	4
T21	3	-	3
T22	2	1	1
T23	2	1	1
T24	1	1	-
T25	2	1	1
T26	1	1	-
T27	3	3	-
T28	2	1	1
T29	1	1	-
T30	1	1	-
T31	1	-	1
T32	7	-	7
T33	10	-	10
T34	2	1	1
T35	2	1	1
T36	4	1	3
T37	3	-	3
T38	1	1	-
T39	2	1	1
T40	2	1	1
T41	1	-	1
T42	8	6	2
T43	1	-	1
T44	1	-	1
T45	1	-	1
T46	2	1	1
T47	1	1	-
T48	11	1	10
T49	1	1	-

Table 1 (cont.)

Locality	Males examined	*rosaceus*	*theophrastus*
T50	1	1	-
T51	1	1	-
T52	1	-	1
T53	7	-	7
T54	1	1	-
T55	2	-	2
T56	6	6	-
T57	2	2	-
T58	1	1	-

including 3 out of the 7 localities from where only two males were available. The main finding of this study is that the two species fly together in most localities and it may be inferred that they do so in most if not in all localities. Higher altitudes of the Moroccan High Atlas and desert regions of southern Algeria may prove to be an exception to this assumption. All 8 males examined from the Hoggar mountains in southern Algeria, proved to be *theophrastus* and the author knows of no confirmed record of *rosaceus* from that region. Speidel & Hassler (1990 : 115-116), in briefly discussing *Tarucus* species in the Hoggar, listed both *theophrastus* and *rosaceus* but accepted that only the former was confirmed from there. There are several *balkanicus* from southern Algeria in the BM(NH) collections and Stempffer (in Chopard & Villiers, 1950 : 269) recorded both *mediterraneae* [*rosaceus*] and *balkanicus* from the Aïr region of northern Niger, directly south of the Hoggar.

Judging from the results of this study and from other material available, *balkanicus* appears to be a very local butterfly in the Maghreb and its true distribution is still not clear. It obviously flies in Mediterranean coastal regions (although the author has not actually seen material from there) as well as deep into the Sahara desert. Data incorporated in Fig. 2 for this species has been gleaned from material in the BM(NH),

Table 2

Presence of *T. theophrastus* and *T. rosaceus* in localities from where more than one male was available.

	Localities	Percentage
Both species present	23	60.5
T. theophrastus only	10	26.3
T. rosaceus only	5	13.2

including that examined by Bethune-Baker and Evans in their respective generic reviews, confirmed by them through genitalic examination, and should not be taken as an attempt to provide a comprehensive review of the distribution of that species in North Africa. The genitalia of none of these specimens have been examined by the author. By comparison, both *theophrastus* and *rosaceus* are widespread throughout the region up to 1300-1400 m, wherever suitable host-plants occur. Above that altitude, *Tarucus* spp. are less frequent, presumably due to a lack of host-plant availability. Geographical localities of specimens identified during this study are plotted on Fig. 2.

The identification of *Tarucus* species in north-western Africa

The secondary aim of this study was to assess the usefulness of external features in allowing species identification with certainty, without the necessity for genitalic examination. Previous authors have differed on the importance of reported features for the identification of specimens (see Bethune-Baker, 1918 ; Evans, 1955). The present author's results show that, although *T. balkanicus* may be identified with a degree

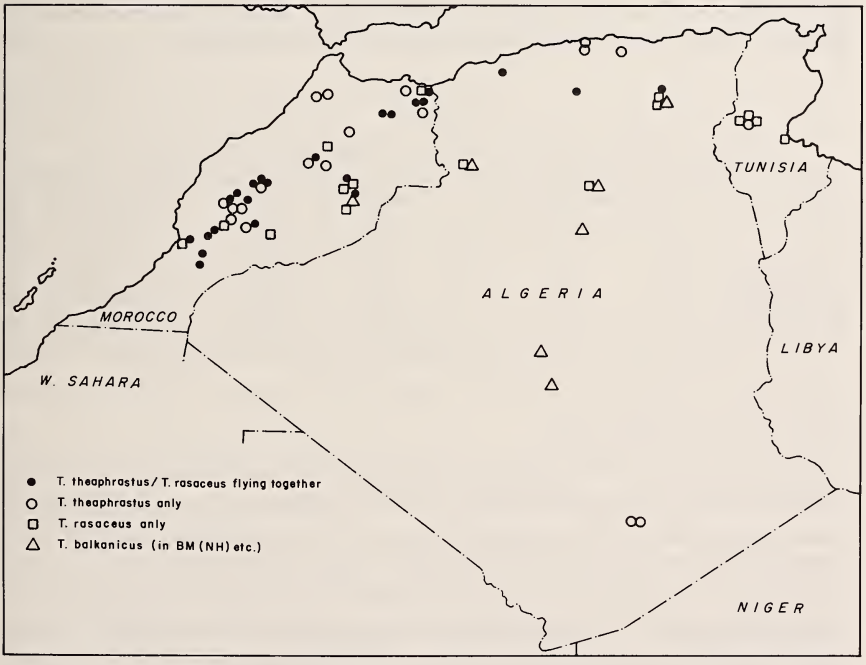

Fig. 2. Identification of *Tarucus* spp. from study sites.

of success from wing markings alone, external features (i.e., wing colouration and markings) are unreliable for separating *T. theophrastus* and *T. rosaceus* in North Africa and are, at best, only moderately useful as a guide. Additionally, since the two species apparently fly together more often than they do not, host-plant association is even more unreliable as a means of species identification. The only certain method of separating *theophrastus* and *rosaceus* is by genitalic examination. The features most frequently given for identification are critically examined.

External features

Overall size

Forewing length (fwl), measured from the wing apex to the base, of more than 200 male *Tarucus* specimens examined from North Africa is given in Tab. 3 ; it should be noted that overall size is variable in relation to local ecological conditions with, as might be expected, eremic populations being generally slightly smaller. The average fwl of 7 male *theophrastus* from the Hoggar mountains in southern Algeria is 10.12 mm. It will be seen that overall size does not vary to any significant degree and is of no value in species identification.

Table 3

Male forewing length (fwl) of *Tarucus* species in North Africa.

Species	Males examined mm	Smallest mm	Largest mm	Mean ± SD mm
T. balkanicus	40	9.3	12.1	10.75 ± 0.84
T. theophrastus	111	8.9	12.9	10.95 ± 0.73
T. rosaceus	60	9.4	12.0	10.74 ± 0.66

Upperside wing markings

It transpired that the author's material from north-western Africa contained only *T. theophrastus* and *T. rosaceus* and it was apparent from examination of material contained in the collections of the BM(NH) that *T. balkanicus* is the only one of the three species under consideration which may be identified with any certainty using external features. The most obvious feature is the presence of prominent black postdiscal (pd) and discoidal spots on the upperside forewing (upf) and the author has not seen any specimens of *balkanicus* in which

this feature is lacking, although Larsen (1983 : 398) noted that these spots are sometimes absent in material from the Middle East. Conversely, 1 male *theophrastus* and 4 male *rosaceus* from localities T6, T21, T38, T50 and T57 displayed (aberrant) upf black markings similar to those of *T. balkanicus* and a number of other specimens appeared to display these features, although on closer examination it was found that this was due to underside (uns) markings showing through to the upperside (ups).

Higgins & Riley (1983), also gave the size and shape of the upf discoidal spot as a useful guide to separation, stating (1983 : 57-58) that in *theophrastus* the spot is "dark and oblong", "more linear and less conspicuous" in *rosaceus* and "obvious and dark" in *balkanicus*. The size and shape of the upf discoidal spot in North African material examined is immensely variable and is of no value for identification purposes.

Male upperside colour

The original description of *T. rosaceus* (Austaut, 1885 : 141-142) was based on "a dozen" males from "high situations" in Algeria and Morocco which, among other features, were said to be smaller than *theophrastus*, rosy-blue on the ups rather than dark-blue violet and with slightly diaphanous wings allowing the uns markings to show through to the ups. Bethune-Baker (1918 : 277, 281, 286) stated that the male ups ground colour (gc) is "deep lustrous violet" in *balkanicus*, "lilac-blue" in [*rosaceus*] and "violet-blue or lilac-blue" in *theophrastus*. D'Abrera (1993 : 470) stated that *rosaceus* maybe distinguished from its congeners by the fact that the ups purple colour has "hints of pink in it" and Higgins & Riley (1983 : 58) stated that *rosaceus* "resembles *theophrastus* but with a faint pinkish tint". Larsen (1983 : 397) stated that, in the case of *rosaceus* (in Saudi Arabia), "the lilac-violet ground colour distinguishes it from [*theophrastus* and *balkanicus*]" and a number of other authors have made similarly conflicting statements.

It is true that some *Tarucus* do have a rather pinkish or lilac hue when seen in certain lights, but it is equally clear that, in North Africa at least, this is not a feature which is helpful in separating the species. In the case of mixed *rosaceus* / *theophrastus* populations examined, no constant difference in ups coloration has been discerned between the species and it may be that the 'rosy hue' is due to some other factor. Whatever the case, assessment of perceived minor differences in colour must be subjective and, in North Africa, are of little value in species determination.

Underside wing markings

Recent authors, including Higgins & Riley (1983 : 57-58), Larsen (1983 : 397) and D'Abrera (1993 : 470), have given certain differences in uns wing markings as features by which the three species may be separated ; the author has examined all these features in relation to accurately determined North African material and has found that, although some features often give good indication of a species, they are just as often wrong and are, in most cases, unreliable. The features most often presented are :

1. The short streaks/spots which combine to form the uns pd band are joined to form an irregular (jagged) line in *balkanicus* but remain as individual spots or streaks in *theophrastus* and *rosaceus*.

Comment. This holds good for almost all specimens of *balkanicus* examined (in a few individuals, the pd line is 'broken' by the veins), but applies equally to a moderate proportion of *rosaceus* and to several *theophrastus* examined ; combined with the upf markings already discussed, it apparently provides the means to positively identify male *balkanicus* in a large majority of cases, but is by no means definitive.

2. The underside forewing (unf) black submarginal and pd lines of *theophrastus* are broken by the veins which remain pale coloured from the cell to the wing margin, whereas in *rosaceus* and *balkanicus* there are normally no gaps in the lines in the apical area ; the veins are black where they cross the line(s).

Comment. This is not a reliable feature in North Africa ; a small number of well-marked (i.e., heavily marked) *theophrastus* examined have an unbroken pd line and a high proportion of *rosaceus* have the pd line broken by the veins. The size, shape and density of all uns markings are very variable.

3. The unf dark transverse 'stripe' common to all three species consists of 2 streaks of unequal length. In *balkanicus* and *theophrastus*, these streaks are in line ; in *rosaceus* the streaks are turned away from each other at the central point near the cell where they might otherwise meet.

Comment. When the author first began to examine assembled material it was noted that the transverse line varied in this manner and observations based on this feature formed the basis for the first 'batch' of genitalic examinations carried out. However, it soon became apparent that it did not hold true in a significant percentage of cases. In the case of well-marked *theophrastus* the two streaks, which may

be of different breadths and lengths, are often joined to form a straight line ; in *rosaceus* the lines are less likely to be joined and more likely to have the 'ends turned away' from each other, but in some cases the reverse is true.

The character is very variable and butterflies displaying transitional features are common ; although it may be said that individuals with a 'straight' transverse line or lines are likely to be *theophrastus* and that those with the central ends strongly turned away are quite likely to be *rosaceus*, individual variation is so great that the feature is no more than a useful guide. In a number of specimens these markings are asymmetrical and indicate *theophrastus* on one side and *rosaceus* on the other!

Identification of females

The primary aim of this study was to establish the distribution of the three *Tarucus* species in the Maghreb and this was achieved without the necessity of addressing the question of whether it was possible to separate females. Some authors (e.g., Higgins & Riley), have made an effort to provide a guide by evaluating the extent of female ups blue/white scaling ; the author believes that the considerable amount of individual variation makes this impossible. Underside markings will generally allow identification of female *balkanicus*, using features already discussed for the male, but for *theophrastus* and *rosaceus*, other than uns features common to both sexes which provide an (unreliable) indication of species, the author knows of no certain way to separate the females.

Host-plant association

Higgins & Riley (1983 : 57-58) gave *Zizyphus vulgaris* (Rhamnaceae) as the host-plant of *theophrastus*, and *Paliurus spinachristi* (Rhamnaceae) as the host-plant of both *balkanicus* and *rosaceus* ; the unstated inference, since all *Tarucus* are notably sedentary and seldom stray more than a few metres from their host-plant, being that *theophrastus* and *rosaceus* are unlikely to be sympatric but that *balkanicus* and *rosaceus* may fly together. It transpires that the first of these inferences is far from the truth.

It is not altogether clear on what Higgins & Riley (1983) based these comments, since there are considerable data available concerning *Tarucus* host-plants, particularly in the Middle East, clearly suggesting that the three species routinely utilise the same host-plants. Selected

published records concerning *Zizyphus* and *Paliurus* host-plant associations of the three *Tarucus* species are summarised in Tab. 4.

In many Middle Eastern localities, as Tab. 4 makes clear, all three *Tarucus* species utilise whatever *Zizyphus* or *Paliurus* host-plants are available ; it is also quite clear that *rosaceus* and *theophrastus* often fly together and that in fact all three *Tarucus* species may sometimes be sympatric. For example, Larsen (1983 : 397) reported finding *theophrastus* and *rosaceus* on the same *Z. spinachristi* trees in Jordan and said that all three species were found in one Saudi Arabian locality.

Table 4

Selected published host-plant records of *T. balkanicus*, *T. rosaceus* and *T. theophrastus*. All host plants belong to the genera *Zizyphus* or *Paliurus*

Reference	Host plants recorded for		
	T. theophrastus	*T. rosaceus*	*T. balkanicus*
Graves, 1925 (Arabia)	—	*Z. lotus*	*Z. spinachristi*
Higgins & Riley, 1983 (Europe / N. Africa)	*Z. vulgaris*	*P. spinachristi*	*P. spinachristi*
Manley & Allcard, 1970 (Spain)	*Z. lotus*	—	—
Larsen, 1974 (Lebanon)	*Z. vulgaris* *Z. spinachristi* *P. spinachristi* *P. vulgaris*		
Larsen, 1980 (Oman)	*Z. spinachristi*	*Z. spinachristi*	*Z. spinachristi*
Benyamini, 1984 (Sinai)	—	*Z. spinachristi*	*Z. spinachristi*
Larsen & Nakamura, 1983 (E. Jordan)	—	*Z. spinachristi*	*Z. spinachristi* *Paliurus* sp.
Larsen, 1983 (Arabia/Dhofar)	*Z. spinachristi* *Z. leucodermis*	*Z. spinachristi* *Z. leucodermis*	*Z. spinachristi* *Z. leucodermis* *Z. nummularia*

The same appears to be the case in North Africa. Not initially appreciating the significance of misleading published data concerning host-plant associations, the author neglected to take a sample of host-plant from each locality where *Tarucus* was collected, but since the only samples taken (of *Z. lotus* from T19 and *P. spinachristi* from T25) each supported both *rosaceus* and *theophrastus*, it seems likely that in most North African localities the two species are sympatric regardless of which host-plant is utilised. Observations at 2400m below Oukaimeden in the Moroccan High Atlas (T11), suggest that host-

plants other than *Zizyphus* or *Paliurus* may occasionally support *T. theophrastus*.

Genitalia

Although external features seldom give more than an indication of the identity of *theophrastus* and *rosaceus*, all three *Tarucus* species in the Maghreb are easily identifiable from examination of the male genital armature. It is unnecessary to look further than the valve, which in *theophrastus* tapers to an apex terminating in three deeply divided and very distinctive spines or teeth, quite unlike any other member of the genus. The harpe is short, approximately half the length of the valve. In *rosaceus* the shape of the apex of the valve appears quite variable, but generally tapers abruptly to a pointed apex ; the harpe is long and gently curved, reaching almost to the apex of the valve, whilst in *balkanicus* the shorter and more strongly curved harpe rises from the rounded edge of the valve and extends well beyond the valve apex. Since the author's material comprises only *theophrastus* and *rosaceus*, a number of male *balkanicus* from Jordan were examined for the purpose of comparison.

The valves have been illustrated by several authors (Bethune-Baker, 1918 : pl. 16, pl. 18 ; Stempffer, 1942 : 121 ; Higgins, 1975 : 116-117 ; Larsen, 1983 : 398) and of these, Stempffer and Larsen provided the most accurate and useful figures. Surprisingly, Higgins' figure is of the least practical value and gives a misleading impression of the valve, particularly in the case of *theophrastus*. The primary differences between the valves of the three species are shown in Fig. 3.

Conclusions

The conclusions of this study may be summarised as follows :

1. Wing markings will allow identification of both sexes of *T. balkanicus* in the great majority of cases. Only genitalic examination will allow separation of male *theophrastus* and *rosaceus* with any certainty ; the author knows of no method of separating the females of these two species.

2. *T. balkanicus* is apparently widespread but very local in the Maghreb. *T. theophrastus* is widespread and often common throughout the region up to 1400 m and may occasionally be found up to 2400 m or more ; it has been recorded from relatively high levels of the Moroccan High Atlas mountains and from the Hoggar mountains of southern Algeria.

Fig. 3. Valves of 1 — *T. balkanicus* ; 2 — *T. rosaceus* ; 3 — *T. theophrastus*.

T. rosaceus is also widespread and is apparently sympatric with *T. theophrastus* in many (or most) suitable localities at low or moderate altitudes.

3. All three species probably utilise whatever *Zizyphus* or *Paliurus* host-plant species are available in the Maghreb.

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