

Tenebrionidae (Insecta: Coleoptera) from the Tunisian island group La Galite with comments on the zoogeography of the archipelago

Martin LILLIG¹

ABSTRACT. The Tenebrionidae from the Tunisian Galite archipelago stored in the Collection Nagel (housed in Centre for Biodocumentation, Landsweiler-Reden, Germany) are presented in this study. *Isomira melanophthalma* is recorded for the first time for the islands. A preliminary analysis of the immigration of the Tenebrionidae to the Galite archipelago indicates a close relationship to Europe rather than to the nearby African continent. Tenebrionidae may have colonised these islands via one or more of the following means: (i) floating debris, (ii) wind, (iii) former land bridges and (iv) accidental anthropogenic introduction.

KEY WORDS. Faunistics, zoogeography, Tunisia, Galite Islands, Tyrrhis.

INTRODUCTION

Located about 40 km North-North-West of the Tunisian Cap Serrat and 150 km South of the Sardinian Capo Spartivento, the island group of volcanic origin, Galite Islands, which is composed of the islands La Galite (c. 5,250 x 2,850 m, highest elevation of nearly 400 m.a.s.l.), Galitone (maximum diameter c. 750 m, highest elevation 158 m a.s.l.), Fauchelle (= Aguglia, maximum diameter c. 500 m, highest elevation 128 m.a.s.l.), Gallina (maximum diameter c. 300 m, highest elevation 60 m.a.s.l.), Gallo (maximum diameter c. 450 m, highest elevation 113 m.a.s.l.) and Pollastro (maximum diameter c. 100 m) (LANZA & BRUZZONE, 1959) (Fig. 1). LUCAS (1849a) reports on an uninhabited group of islands devoid of vegetation. A few decades later, it is recorded that the phanerophyte flora consisted of isolated, sparse bushes of *Pistacia lentiscus* and *Tamarix*. Trees did not exist on the islands (GESTRO, 1880) until later on, when *Pistacia* and *Tamarix*, vines (*Vitis* sp.), olives (*Olea europaea*), fig (*Ficus carica*), mulberry trees (*Morus nigra*) and eucalyptus trees (*Eucalyptus globulosus*) were recorded in 1970 (BACK, 1975).

The Coleoptera of the archipelago is little studied. Specimens were first collected in October 1840 on the island of La Galite. During this expedition, just one Tenebrionid species was found (LUCAS, 1849a, b). In the years 1875, 1876 and 1877 the Violante expedition reached the archipelago. Another four Tenebrionid species were discovered on the islands of La Galite, Galitone and Gallina (GESTRO, 1880). One was mentioned by GRIDELLI (1930). ARDOIN (1971) listed another eight species and subspecies, of which he described four as new to science. The material preserved in the Zoological Museum of the University of Florence and the Natural History Museum in Paris were collected by Lanza, Carfi, Adriani, Ceccanti and Romite. Lanza and Carfi collected beetles from the islands of La Galite, Galitone, Aguglia (Fauchelle), Gallina and Gallo in 1966 whereas Adriani, Ceccanti and Romite collected beetles on La Galite in 1968. Franz and Schmid visited the main island on

¹Krämersweg 55, 66123 Saarbrücken, Germany. E-mail: martin.lillig@t-online.de

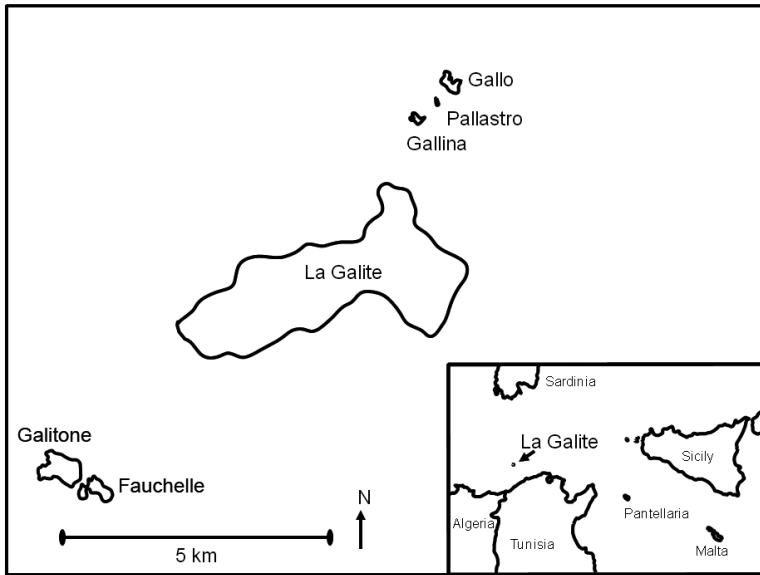


Figure 1: Map of the Galite islands.

September 6 and 7, 1981. They found four species of Tenebrionidae (FRANZ, 1982). Pascal and Renou collected in early May 2008 while L. Soldati collected in early July 2009 on several islands of the archipelago (SOLDATI, 2009).

Five species collected by Back, Charousset, Irmeler, Nagel, Schuberth and Vesmanis in the years 1970 to 1972 from the island of La Galite are stored in the collection Nagel, in the Centre for Biodocumentation, Landsweiler-Reden (Germany).

Acronyms

CN/ZfBS	Collection P. Nagel in Centre for Biodocumentation of the Saarland, Landsweiler-Reden, Germany
MCSNG	Museo Civico di Storia Naturale “G. Doria”, Genova, Italy

LIST OF SPECIES

Tentyria grossa angustata Kraatz, 1896

(Fig. 2)

Material examined: La Galite: 18-21.viii.1970, without collector (Back, Irmeler, Vesmanis ?), 14 exx.; 18-29.viii.1971, Charousset, Schuberth & Vesmanis, 173 exx.; 8-14.iii.1972, Charousset, 3 exx.; 7-14.v.1972, Charousset & Nagel, 3 exx.; v-vi.1972, Charousset & Nagel, Barber-Falle, 25 exx.; Sommer 1972, Charousset, Barber-Falle, 3 exx.; ix-x.1972, Charousset, 2 exx. (all CN/ZfBS); La Galite, ix.1875, Viaggio Violante, 2 exx.; La Galite, viii.1877, Violante, 3 exx.; La Galite, 18.viii.1877, Violante, 1 ex.; La Galite, 19.viii.1877, Violante, 1 ex.; Galitone, ix.1876, Violante, 1 ex.; Galitone, 27.ix.1876, Violante, 1 ex.; Gallina, 21.viii.1877, Violante, 1 ex. (all MCSNG).

References. La Galite, early October (LUCAS, 1849a, b sub *Tentyria solieri* Lucas, 1849); Gallina, viii.1877 (GESTRO 1880 sub *T. sardea* Solier, 1835); La Galite, Galitone, Gallina (GRIDELLI, 1930); La Galite, Galitone, Aguglia (= Fauchelle), Gallina, Gallo, all 29.v.-3.v.1966, La Galite, 5-25. viii.1968, viii.1969 (ARDOIN, 1971); La Galita, 6./7.ix.1981 (FRANZ, 1982); Île de la Galite, Gallo (SOLDATI, 2009).

Distribution. According to KOCH (1941, 1944) the “Rassenkreis” (racial circle) of *T. grossa* consists of: (i) *T. grossa grossa* Besser, 1832: Italy (KOCH 1941, 1944; CANZONERI 1977), Malta (LILLIG *et al.*, 2012a), Crete (KOCH, 1944; KÜHNELT, 1965), (ii) *T. grossa castrogironai* Escalera, 1923: Morocco (KOCH, 1941), *T. grossa grandis* Solier, 1835: Sicily (SOLIER, 1835), (iii) *T. grossa barbara* Solier 1835: Algeria (KOCH, 1944), Tunisia (NORMAND, 1936) and (iv) *T. grossa basalis* Schauffuss, 1869: Balears (KOCH, 1944).

Ecology. On Pantellaria, RATTI (1986) found the species in Spring and Summer under stones or dry cattle dung and in Autumn the species was found in high numbers under stones and under the bark of oaks. The nocturnal *Tentyria* are opportunistic detritivores (SOLDATI, 2009).

Notes. ESPAÑOL (1954) combines all subspecies mentioned by KOCH and *T. sicula* Solier as synonyms of *T. grossa*. However, ARDOIN (1973) recognizes differences between the nominate form and *T. grossa sardinensis* Ardoin, 1973 (= *T. sardea* auct. nec Solier, 1835) from Sardinia. Furthermore *T. grossa angustata* Kraatz, 1896 from Pantellaria and the Galite Islands (CANZONERI, 1972) must be taken into account. There is much controversial discussion around its status. While it is clearly distinguished by ARDOIN (1971) as a subspecies from the nominate form, RATTI (1986) treats it as a infrasubspecific form of *T. grossa grossa*. *T. grossa angustata* differs from the other taxa of the complex by having much weaker punctuation at the pronotum. RATTI (1986) recognizes tendencies for this feature to be reduced in some specimens of the taxon described as *T. sommieri* Baudi, 1874 from the island of Linosa and later, also found on the island of Lampione (CANZONERI, 1972 sub *T. grossa sommieri*). Therefore, CANZONERI (1972) considers *T. sommieri* as a synonym of *T. grossa angustata*. In LÖBL *et al.* (2008) both are treated as separate subspecies of *T. grossa*.

GRIDELLI (1930) also published *T. grossa angustata* for the island of Piana. The only specimen from this island in the Gulf of Tunis examined by the author (“March 22, 1876, Violante” MCSNG) however possesses a much more pronounced punctuation than the specimens of the Galite Islands. One of the two specimens collected in 1875 (MCSNG) carries a determinant label: “*T. grossa* var. *angusticollis* mihi, det. E. Gridelli”. This variation has not yet been described.

LUCAS (1849b) describes *Tentyria solieri* from Algeria: “partie sablonneuses de cercle de Lacalle; Elle habite aussi l’île de la Galite”. He compares his species with *Tentyria grossa*. KRAATZ (1865) considers *T. solieri* as a variety of *T. sicula* (= *grossa grossa*). The almost unpunctured pronotum indicates *T. solieri* could be *T. grossa angustata*. Since Lucas, only *T. grossa barbara* has been reported from Algeria. The presence of *T. grossa angustata* on the African mainland needs to be confirmed.

Stenosis brenthoides carfii Ardoïn, 1971

(Fig. 3)

Material examined: La Galite, iv-v.1972, leg. Charousset, 1 ex. (CN/ZfBS).**References.** Gallo, 2.vi.1966 (ARDOIN, 1971); La Galite, île Fauchelle, Gallo, Gallina (SOLDATI, 2009).**Distribution.** Archipelago La Galite. The nominate form is found in Italy (Elba, Pinosa, Gorgona, Toscana, Lazio, Campania, Calabria, Puglia) and Dalmatia (CANZONERI, 1970; GRIMM, 1985).**Ecology.** No data available.**Notes.** The abdomen of the specimen collected from La Galite, leg. Charousset is missing, which prevents a reliable determination. The convex pronotum with punctures up to the lateral margin indicates *Stenosis brenthoides* (see CANZONERI, 1970). The specimen has been identified as *S. brenthoides carfii* based on the very close resemblance of its forebody to the published description of *S. brenthoides carfii*.*? Stenosis sardoa* Küster, 1848 s. l.**References.** La Galite, viii.1969 (ARDOIN, 1971; CANZONERI, 1977; MIFSUD & SCUPOLA, 1998), Galite Archipelago (RATTI, 1986).**Distribution.** *Stenosis sardoa sardoa* (synonym according to RATTI, 1986: *S. sardoa duchoni* Antoine, 1949): southern France, Corsica, mainland Italy, Sardinia, Pantellaria, Tavolara, San Pietro, Sicily and Aeolian Islands; *S. sardoa ardoïni* Canzoneri, 1970: mountainous areas of central and northern Sicily (RATTI, 1986); *S. sardoa laeviventris* Desbrochers, 1881: Anatolia, Crimea (CANZONERI, 1970).**Ecology.** The species was found on Pantellaria among dry leaves and grasses (RATTI, 1986).**Notes.** The only known specimen from the Galite archipelago, a female, differs from the Sardinian specimens by a much stronger puncturing of the head and pronotum. Because of the absence of male specimens, ARDOIN (1971) refused the description of a new "race". The very similar species, *Stenosis intermedia* (Solier, 1838), *S. brenthoides* (Rossi, 1790) and *S. sardoa* (Küster, 1848) can be distinguished only by the male genitalia (see CANZONERI, 1977). As long as no male specimens are found, the identity of the specimen from the Galite Islands will remain uncertain.*Asida maltinii* Ardoïn, 1971**References.** La Galite, 5-25.viii.1969, Galitone, 30.v.1969 (ARDOIN, 1971); La Galite, île Fauchelle, Gallo (SOLDATI, 2009).**Distribution.** Known from La Galite, Gallo and Galitone.**Ecology.** Unknown.

Note. ARDOIN (1971) compares the species with the similar *A. corsica* Laporte de Castelnau, 1833 from Corsica and Sardinia.

***Akis barbara* Solier, 1836**

(Fig. 4)

Material examined: La Galite: 18-21.viii.1970, without collector (Back, Irmeler, Vesmanis ?), 1 ex.; 18-29.viii.1971, Charousset, Schuberth & Vesmanis, 107 exx.; 7-14.v.1972, Charousset & Nagel, 6 exx.; v-vi.1972, Charousset & Nagel, Barber-Falle, 13 exx.; Summer (?) 1972, Charousset, Barber-Falle, 4 exx.; ix-x.1972, Charousset, Barber-Falle, 2 exx. (all CN/ZfBS).

References. La Galite, 29.v-3.vi.1966, 5-25.viii.1968 (ARDOIN, 1971 sub *Akis spinosa barbara*); La Galita, 6./7.ix.1981 (FRANZ, 1982 sub *Akis spinosa barbara*); la Galite (SOLDATI, 2009).

Distribution. Tunisia, Galite, Linosa, Pantellaria, Lampedusa, southern Sardinia (CANZONERI, 1972; RATTI, 1986).

Ecology. Mostly synanthropic and on ruderal sites, rarely under stones, diurnal and nocturnal (RATTI, 1986).

Note. ARDOIN (1971) reports *A. spinosa barbara* Solier, 1836 from the Galite Islands. SCHAWALLER (1987), referring to GEBIEN (1936), treats this taxon as a variety of *A. italica* Solier, 1836.

KRAATZ (1865) points out the great variability of *A. spinosa* and regards *A. barbara* as its synonym. For KOCH (1937; 1939) Libyan specimens belong to *A. spinosa barbara*, although, unlike the original description (“elytro utroque costis tribus angustatis, elevatis, vix granulatis”), they are characterized by distinctly notched dorsal costae and lateral margins of which both can be smooth in rare cases. Koch places *A. barbara* sensu Koch to *A. spinosa* in spite of the dorsal costae close to the suture, a feature which characterizes *A. italica*. He denies the occurrence of *A. barbara* in southern Italy (including Sicily) and Tunisia, where for him only *A. spinosa* occurs.

Examining the type of *A. barbara*, ARDOIN (1973) highlighted morphological similarities to *A. spinosa* and explicitly confirmed Koch’s opinion on the affiliation of *A. barbara* to *A. spinosa*. However, he refers *A. spinosa barbara* to the populations of Sardinia (ARDOIN, 1973) and the Galite Islands (ARDOIN, 1971), which contradicts KOCH (1937; 1939) in respect to the distribution and morphology.

The examined specimens from the Galite Islands belong to *S. barbara* because of the arrangement of their elytral costae and because of the smooth costae, which are weakly granulated in only a few specimens. The second dorsal costa, reaching almost the base, is also a taxonomically useful characteristic.

According to FERRER (2008), *A. barbara* is a variety and therefore a junior synonym of *A. trilineata* Herbst, 1799 known from the Italian mainland, Sardinia, Libya and Algeria. The specimens from La Galite are reported as a bona species by SOLDATI (2009).

The synanthropic species may have been transported to the island by humans (SOLDATI, 2009).

Akis maresi Ardoïn, 1971

References. Aguglia [= Fauchelle], 1.vi.1966, Galitone, 30.v.1966 (ARDOIN, 1971); Galitone, viii.1877 (GESTRO, 1880 sub *A. punctata* (Thunberg, 1787)); Île Fauchelle, Gallo (SOLDATI, 2009).

Distribution. Reported from Fauchelle and Galitone.

Ecology. Unknown.

Note. According to ARDOIN (1971), *A. maresi* is closely related to *A. spinosa* sensu auctores (= *trilineata* sensu FERRER 2008).

Possibly the species has become extinct (SOLDATI, 2009).

Scaurus atratus Fabricius, 1775

(Fig. 5)

Material examined: La Galite: 18-21.viii.1970, Back, Irmiler & Vesmanis, 1 ex.; 18-29.viii.1971, Charousset, Schuberth & Vesmanis, 8 exx.; 7-14.v.1972, Charousset & Nagel, 15 exx.; v-vi.1972, Charousset & Nagel, Barber-Falle, 25 exx.; Sommer 1972, Charousset, Barber-Falle, 1 ex.; ix-x.1972, Charousset, 4 exx.; ix-x.1972, Charousset, Barber-Falle, 3 exx. (all CN/ZfBS).

References. La Galite, Galitone, Aguglia [= Fauchelle], Gallo (all 29.v-3.vi.1966), La Galite, 5-25.viii.1968 (ARDOIN, 1971), Gallina (GESTRO, 1880); La Galite, 6./7.ix.1981 (FRANZ, 1982); La Galite (SOLDATI, 2009).

Distribution. Algeria, Tunisia, Galite, Pantellaria, southern Italy, Sardinia, Sicily and other Italian islands, southern France (RATTI, 1986) and Corsica (CANZONERI, 1970).

Ecology. Found under stones (RATTI, 1986).

Opatrum (Colpophorus) lanzai Ardoïn, 1971

Reference. Galitone, 30.v.1966 (ARDOIN, 1971).

Distribution. Known only from Galitone.

Ecology. No data available.

Note. ARDOIN (1971) places this species near *O. emarginatum* Lucas, 1849 from Algeria, Tunisia, Sardinia and Malta.

Isomira (Isomira) melanophthalma (Küster, 1846)

(Fig. 6)

Material examined: La Galite, 7-14.v.1972, leg. Charousset & Nagel, 1 ex. (CN/ZfBS).

Distribution. Italy, Sicily, Sardinia, Corsica, Balearic Islands, Dalmatia, Algeria (WEISE, 1974), Malta (LILLIG *et al.*, 2012b), Portugal (SEABRA, 1943), Morocco (ESCALERA, 1914) and according to LÖBL *et al.* (2008) also in Bosnia Herzegovina.

Ecology. The species of the genus *Isomira* are normally found on flowers (REITTER, 1911).

***Crypticus (Crypticus) gibbulus* (Quensel, 1806)**

(Fig. 7)

Material examined: La Galite: 18-21.viii.1970, without collector (Back, Irmeler, Vesmanis ?), 2 exx.; 18-29.viii.1971, Charousset, Schuberth & Vesmanis, 9 exx.; 1-20.vii.1972, Charousset, 1 ex.; Sommer 1972, Charousset, Barber-Falle, 1 ex. (all CN/ZfBS).

References. La Galite, 6./7.ix.1981 (FRANZ, 1982); La Galite (SOLDATI, 2009).

Distribution. Morocco, Algeria, Tunisia, Iberian Peninsula, Balearic Islands, Corsica, Sardinia, Sicily, Syria, Cyprus, Israel, France and Jordan (CHIKATUNOV *et al.*, 1999; LÖBL *et al.*, 2008).

Ecology. The species is found under stones (CHIKATUNOV *et al.*, 1999; MIFSUD & SCUPOLA, 1998).

***Phaleria acuminata* Küster, 1852 s. l.**

Material examined: La Galite, viii.1877, 5 exx., 18.viii.1877, 29 exx., 19.viii.1877, 14 exx., Violante (MCSNG).

Reference. La Galite, viii.1877 (GESTRO 1880 sub *Ph. oblonga* Baudi, 1876).

Distribution. Widespread in several Mediterranean sub-areas. In the western Mediterranean the nominate form occurs on Sardinia. *Ph. acuminata tunisia* Reitter, 1916 is to be found in Tunisia. According to CANZONERI (1968), some West-Mediterranean populations cannot be assigned to any subspecies.

Ecology. Like *Trachyscelis aphodioides*, a psammohalobiont coastal dweller (GRIMM, 1986).

Note. GESTRO (1880) published the species as *Phaleria oblonga*, which is synonymous with *Ph. acuminata* (see CANZONERI, 1968).

The population from La Galite differs from specimens of the Tunisian mainland (*Ph. acuminata tunisia* Reitter, 1916) by a somewhat finer puncturing and less shagreen of the pronotum. In these features, it resembles other West-Mediterranean populations.

***Trachyscelis aphodioides* (Latreille, 1809)**

Material examined: La Galite, viii.1877, Violante, 1 ex. (MCSNG).

References. La Galite, viii.1877 (GESTRO, 1880).

Distribution. Coasts of the Mediterranean Sea, North-West African Atlantic, Cape Verde and Canary Islands, Black Sea (GRIMM, 1985), introduced to the Americas (STEINER, 2004).



2



3



4



5



6



7

Figures 2 - 7: *Tentyria grossa angustata* Kraatz, 1896; 3: *Stenosis brentoides carfi* Ardoïn, 1971 (forebody); 4: *Akis barbara* Solier, 1836; 5: *Scaurus atratus* Fabricius, 1775; 6: *Isomira (Isomira) melanophthalma* (Küster, 1846); 7: *Crypticus (Crypticus) gibbulus* (Quensel, 1806).

Ecology. *Trachyscelis aphodioides* is a halopsammophilous species (GRIMM, 1981; 1986), which is found under various detritus in the vegetation-free zone of beaches (BONOMETTO & CANZONERI, 1970) and on coastal dunes between the roots of halophilous plants (NABOZHENKO & PURCHART, 2017), often together with *Ammobius rufus* Lucas, 1849 (*pers. observation*).

Ecology

With 12 known species, the Tenebrionidae are not highly represented in the Galite archipelago. Of these species, nine are terricolous, collected in pitfall traps and under stones. *Trachyscelis aphodioides* and *Phaleria acuminata* are two widespread sabulicolous species mostly found on beaches and sand dunes.

Species of the genus *Stenosis* are sometimes found associated with ants (BAKR *et al.*, 2007).

Isomira melanophthalma is the only known Tenebrionid species found on the island group which visits flowers.

Akis and *Scaurus* are two genera whose representatives show tendencies to the synanthropic way of life (GRIMM, 1985). Widespread synanthropic species (e.g. *Tenebrio* spp., *Tribolium* spp.) have not yet been found on the islands. Xylobiont species, living under tree bark (e.g. *Corticus* spp.) or on tree fungi (e.g. *Bolitophagus* spp.) find no suitable habitat on the islands because of the small number of woody plants.

Crypticus gibbulus and *Isomira melanophthalma* were the only two winged species found. Both are common in the Mediterranean Basin.

ZOOGEOGRAPHY

Distribution of species on the islands of the archipelago

The highest number of species was found in La Galite, the largest of the islands. The island Pollastro has not yet been examined. According to the island biogeography theory of MACARTHUR & WILSON (1963), the highest species density is expected on the largest island. Differences in distance and location to the potential source of settlement are of little importance for the Galite islands.

Tentyria grossa angustata and *Scaurus atratus* colonise all islands. Galitone is high in endemism, with three species endemic to the archipelago.

Table 1. Tenebrionidae, known to date from the islands of the Galite archipelago.

A = ARDOIN (1971), F = FRANZ (1982), GE = GESTRO (1880), G = GRIDELLI (1930), MS = MIFSUD & SCUPOLA (1998), L = LUCAS (1849a,b), R = RATTI (1986), S = SOLDATI (2009), x = CN/ZfBS.

Species	La Galite	Galitone	Fauchelle	Gallina	Pallastro	Gallo
<i>Tentyria grossa angustata</i> KRAATZ, 1896	A, F, G, L, S, x	A, G	A	A, GE, G		A, S
<i>Stenosis brenthoides carfi</i> ARDOIN, 1971	S, x		S	S		A, S
<i>Stenosis sardoa</i> KÜSTER, 1848 s. l.	A, MS, R, S					
<i>Asida maltinii</i> ARDOIN, 1971	A, S	A	S			S
<i>Akis barbara</i> SOLIER, 1836	A, F, S, x					
<i>Akis maresi</i> ARDOIN, 1971		A, GE	A, S			S
<i>Scaurus atratus</i> FABRICIUS, 1775	A, F, S, x	A	A	A, GE		A
<i>Opatrum lanzai</i> ARDOIN, 1971		A				
<i>Isomira melanophthalma</i> (KÜSTER, 1846)	x					
<i>Crypticus gibbulus</i> (QUENSEL, 1806)	F, S, x					
<i>Phaleria acuminata</i> KÜSTER, 1852 s. l.	GE					
<i>Trachyscelis aphodioides</i> (LATREILLE, 1809)	GE					
Known species	10	5	5	3	0	5

Distribution patterns of the Tenebrionidae (Fig. 8)

An exact zoogeographical analysis cannot be carried out on the basis of the few known species on the islands, especially as the phylogeny of the Tenebrionids is not sufficiently understood. In most cases morphological similarities are considered as a criterion for kinship relations. No phylogenetic investigations on the species inhabiting the Galite island group have been carried out. Therefore, the following remarks are to be regarded as provisional results to be confirmed by phylogenetic studies.

1. Mediterranean chorotype (see VIGNA TAGLIANTI *et al.*, 1993; 1999)

The most common species is the nearly circum-mediterranean *Trachyscelis aphodioides* found in Cabo Verde, Canary Islands, southern Europe, North Africa and the Black Sea (GRIMM, 1986). Furthermore, it was introduced to the North, Centre and South America (STEINER, 2004).

The psammophilous *Phaleria acuminata* s. l. lives on beaches and dunes and is widespread around the Mediterranean basin. *Crypticus gibbulus* inhabits similar habitats however is not limited to the coastal region.

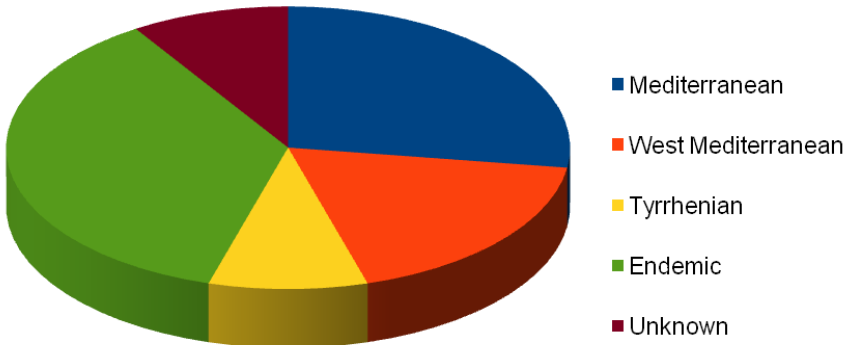


Figure 8: Chorotypes and elements of the Tenebrionidae from la Galite Archipelago.

2. West-Mediterranean chorotype (see VIGNA TAGLIANTI *et al.*, 1993; 1999)

Akis barbara is restricted to the coastal regions of Algeria and Tunisia including la Galite, Linosa, Pantellaria, Lampedusa and southern Sardinia (CANZONERI, 1972; RATTI, 1986; FERRER, 2008; SOLDATI 2009).

Scaurus atratus has a typical West-Mediterranean distribution.

Isomira melanophthalma colonizes the African and European parts of the western Mediterranean. In spite of the extension to the Balkans, this species is placed in this chorotype.

3. Tyrrhenian elements (see VIGNA TAGLIANTI *et al.*, 1993)

Beside to the Galite islands, *Tentyria grossa angustata* occurs only on Pantellaria, located East of Tunisia. It does not live on the European mainland. A possible presence in North Africa (surrounding La Calle = El Kala) requires confirmation. *T. grossa* s.l. belongs to the West-Mediterranean chorotype.

4. Endemic taxa (see VIGNA TAGLIANTI *et al.*, 1993; 1999)

Four of the 12 taxa are endemic to the islands: *Stenosis brenthoides carfii*, *Akis maresi*, *Asida maltinii* and *Opatrum lanzai*.

According to DE LATTIN (1967) the Galite islands are located in the area of the Atlanto-Mediterranean secondary centre (Iberian peninsula and Maghreb) and not in the Tyrrhenian (Corsica, Sardinia) or Adriato-Mediterranean (Italy including Sicily). For the herpetofauna this view is supported by LANZA & BRUZZONE (1959) and SCHNEIDER (1971). Also the ants (BERNARD, 1959) and the macrolepidoptera can be clearly assigned to North Africa. Among the Lepidoptera, no representative of the Tyrrhenic or Adriato-Mediterranean fauna was found (BACK, 1975). On the other hand, the Tenebrionidae appear to have closer zoogeographical relations to the Tyrrhenian secondary centre. This is mainly due to

the two *Stenosis* spp. The close relative of the Gallo endemic *S. brenthoides carfi*, *S. brenthoides* s. str., populates the Italian mainland and some outlying islands. ARDOIN (1971) underlines a morphological difference of the only known specimen of *Stenosis sardoa* s.l. of Galite islands to the Sardinian population. He renounced the description of a new taxon, since the males were unknown to him. ARDOIN (1971) compares the endemic *Asida maltinii* with the very similar *A. corsica* Laporte de Castelnau, 1833 limited to Corsica and Sardinia. *Akis maltesi* shows characteristics that occur within the genus only in the southern European *A. bacarozzo* (Schrank, 1786) s. l. However, ARDOIN (1971) places this species close to *A. spinosa* (= *trilineata* sensu Ferrer, 2008).

5. Unknown.

Stenosis sardoa of La Galite could also be a population of *S. intermedia* or *S. brenthoides*. All three species have never been discovered in North Africa. The unique known specimen seems to belong to an undescribed taxon (ARDOIN 1971).

Only two taxa occurring on the Galite archipelago are also known from North Africa. SOLDATI (2009) recognizes that Tyrrhenian elements (including the endemic taxa) are dominant in the Tenebrionidae. The North African chorotype is not present on the islands, so probably the migration of the taxa (or their ancestors) originated from Europe.

DISCUSSION

For the Tenebrionidae, four hypothetical routes of migration to the Galite islands are conceivable:

1. By floating debris. Due to the current conditions in the Mediterranean Sea, sea-drenching is only possible for species of African origin. The analysis of the distribution patterns shows that no purely North African taxon of the Tenebrionidae occurs in the Galite archipelago.
2. By wind. This seems to be possible just for very small apterous or brachypterous and for larger winged species.
3. By former land bridge. The speciation of the endemites, whether at species or subspecies level, extends over a period of time well before the oncoming shipping traffic. A Galite land bridge from Sardinia to Tunisia and Sicily, whose remnants should be the Galite Islands (HOLDHAUS, 1924), has been speculated about several times (SCHNEIDER, 1971).

During the Riss glaciation, 350,000 and 120,000 years ago, the sea level was about 120 m lower than today. Thus, the distance between Galite and the African mainland decreased to about 15 km and the distance between Galite and Sardinia decreased to about 130 km. An earlier land connection between Africa and Sicily is dated at the Miocene/Pliocene period (STÖCK *et al.*, 2008).

POINAR (1992) considers that a period of the existence of most insect species from around 2-3 million years. Thus, it would be possible that species that had originated in the middle Pliocene period, have survived until today. Fossil findings from Californian Tenebrionidae show that species can persist unchanged from the Pleistocene to the present day (DOYEN & MILLER, 1980). It appears doubtful, however, that there are Tenebrionidae whose existence extends far into the tertiary, especially since there are no Tenebrionid species from tertiary amber known (DOYEN & POINAR, 1994). The oldest known fossils of the Tenebrionidae are from the Middle Eocene. From this time, some of the still existing genera have been found (POINAR, 1992; SOLDATI & NABOSZHENKO, 2017). Up to the Pliocene

period, the migration of beetles from the north could have been possible, from which the species of the genera which are now living there would have developed. CONDAMINE *et al.* (2013) postulate the first diversification of the Mediterranean *Blaps* (this genus does not occur on the Galite archipelago) in the Oligocene about 28 million years ago. The oldest known species of the genus *Asida*, a genus represented on La Galite from the Eocene Baltic amber, lived about 40 million years ago (SOLDAI & NABOSZHENKO, 2017). Thus, it cannot be ruled out that descendants of the species which have reached the Galite Islands in the Tertiary period, have evolved into today's endemics.

4. By anthropogenic accidental introduction. The carryover by man is to be assumed for the widespread of species whose island populations are not different from others. This possibility of distribution in the western Mediterranean is accepted e.g. for reptiles (SCHNEIDER, 1971) and the beetle *Paussus favieryi* Fairmaire, 1851 (NAGEL, 1987). BERNARD (1959) considers 90% of the beetle species from the Galite Islands as introduced from Europe.

ACKNOWLEDGEMENTS

Thanks are due to Prof. (em.) Dr. Peter Nagel (Basel) for the inspiration for this paper and valuable discussions. Special thanks go to Dr. Harald Schreiber and Andreas Werno (Landsweiler-Reden) for providing access to the Tenebrionidae of the Galite Islands deposited in the Centre for Biodocumentation of the Saarland, Landsweiler-Reden, and to Dr. Roberto Poggi (Genova) for making the Tenebrionidae collected by the Violante Expedition available for this study. Cordial thanks to Edgar Müller (Saarwellingen) for producing the photographs and Ms Simone Cutajar (Marsaskala) for reviewing the present work as well as Prof. David Mifsud (Msida) for his kind assistance in many ways.

REFERENCES

- ARDOIN, P. (1971) Tenebrionidae (Coleoptera) récoltés par l'expédition Mares dans l'Archipel de la Galite, Tunisie. *Nouvelle Revue d'Entomologie*, 1(1): 45–52.
- ARDOIN, P. (1973) Contribution à l'étude des Tenebrionidae (Coleoptera) de Sardaigne. *Annales de la Société entomologique de France (N.S.)*, 9(2): 257–307.
- BACK, H.-E. (1975) Zur Schmetterlingsfauna des La Galite-Archipels. I. Großschmetterlinge. *Bonner zoologische Beiträge*, 26: 257–263.
- BAKR, R. F., FADL, H. H., BADAWY, R. M. & SHARAF, M.R. (2007) Myrmecophile insecta associated with some ant species (Hymenoptera-Formicidae) in Egypt. *Proceedings of the 2nd International Conference of the Entomological Society of Egypt*, 1: 207–235.
- BERNARD, F. (1959) Les fourmis des Iles Pelargie. - Comparaison avec d'autres faunes insulaires. *Rivista di Biologia Coloniale*, 16: 67–79.
- BONOMETTO, L. & CANZONERI, S. (1970) I Tenebrionidae delle spiagge e dune del litorale di Venezia. *Bollettino del Museo civico da Venezia*, 20-21: 223–231.
- CANZONERI, S. (1968) Materiali per una monografia delle *Phaleria* del sottogenere *Phaleria* Latr. XX Contributo alla conoscenza dei Coleoptera Tenebrionidae. *Memorie della Società entomologica Italiana*, 47: 117–167.
- CANZONERI, S. (1970) I Tenebrionidae delle Isole Egadi (XXII Contributo allo studio dei Tenebrionidi). *Memorie del Museo civico di Storia naturali di Verona*, 17: 55–89.
- CANZONERI, S. (1972) Nuovi dati sui Tenebrionidae di "piccole isole" italiane, con descrizione di *Alphasida tirellii moltonii* n. spp. (XXVIII Contributo alla conoscenza dei Tenebrionidi). *Atti della Società Italiana di Scienze Naturale e del Museo civico di Storia naturale di Milano*, 113(3): 288–296.

- CANZONERI, S. (1977) Contributo alla conoscenza dei Tenebrionidi appenninici (XXXI Contributo allo studio dei Tenebrionidi). *Bollettino del Museo civico di Storia naturale di Verona*, 4: 227–285.
- CHIKATUNOV, V., PAVLIČEK T., & NEVO, E. (1999) Coleoptera of “Evolution Canyon“, Lower Nahal Oren, Mount Carmel, Israel. I. Families: Buprestidae, Carabidae, Cerambycidae, Glaphyridae, Hybosoridae, Hydrophilidae, Lucanidae, Scarabaeidae, Tenebrionidae and Trogidae. Pensoft, Sofia-Moskau, 174 pp.
- CONDAMINO, F.L., SOLDATI, L., CLAMENS, A.-L., RASPLUS, J.-Y. & KEOAT, G.J. (2013) Diversification patterns and processes of wingless endemic insects in the Mediterranean Basin: historical biogeography of the genus *Blaps* (Coleoptera: Tenebrionidae). *Journal of Biogeography*, 40: 1899–1913.
- DOYEN, J. T. & MILLER, S. (1980) Review of Pleistocene Darkling Ground Beetles of the California Asphalt Deposits (Coleoptera: Tenebrionidae, Zopheridae). *Pan-Pacific Entomologist*, 56(1): 1–10.
- DOYEN, J.T. & POINAR, G. O. (1994) Tenebrionidae from Dominican amber (Coleoptera). *Entomologica scandinavica*, 25: 27–51.
- ESCALERA, M. M. DE LA (1914) Los Coléopteros de Marueccos. *Trabajos del Museo Nacional de Ciencias Naturales de Madrid, Serie Zoológica*, 11: 1–553.
- ESPAÑOL, F. (1954) Los tenebriónidos (col.) de Baleares. *Trabajos del Museo de Ciencias Naturales de Barcelona, N. S. Zoológica*, 1(5): 1–96.
- FERRER, J. (2008) Aportación al conocimiento del género *Akis* HERBST, 1799 (Coleoptera, Tenebrionidae, Pimeliinae). *Boletín de la Sociedad Entomológica Aragonesa*, 43: 153–172.
- FRANZ, H. (1982) Beitrag zur Kenntnis der Coleopterenfauna der Insel Galita. *Sitzungsberichte der Österreichischen Akademie der Wissenschaften, mathematisch-naturwissenschaftliche Klasse, Abteilung I*, 191: 231–240.
- GEBIEN, H. (1936) Katalog der Tenebrioniden. Teil I. *Publicazioni del Museo entomologico “Pietro Rossi“*, Duino, 2: 505–883.
- GESTRO, R. (1880) Appunti sull’Entomofauna tunisiana. *Annali del Museo civico di Storia naturale di Genova*, 15: 405–424.
- GRIDELLI, E. (1930) Risultati zoologici della missione inviata della R. Società Geographica Italiana per l’esplorazione dell’Oasi di Giarabub (1926–1927). *Annali del Museo civico di Storia naturale di Genova*, 54: 1–485.
- GRIMM, R. (1981) Die Fauna der Ägäis-Insel Santorin. Teil 2 Tenebrionidae (Coleoptera). *Stuttgarter Beiträge zur Naturkunde, Serie A (Biologie)*, 348: 1–14.
- GRIMM, R. (1985) Zur Kenntnis der Tenebrioniden aus Süditalien (Insecta: Coleoptera). *Stuttgarter Beiträge zur Naturkunde, Serie A (Biologie)*, 379: 1–32.
- GRIMM, R. (1986) Tenebrionidae vom Maltesischen Archipel (Insecta: Coleoptera). *Stuttgarter Beiträge zur Naturkunde, Serie A (Biologie)*, 392: 1–17.
- HOLDHAUS, K. (1924) Das Tyrrhenisproblem. Zoogeographische Untersuchungen unter besonderer Berücksichtigung der Koleopteren. *Annalen des naturhistorischen Museums Wien*, 37: 1–200.
- KOCH, C. (1937) Wissenschaftliche Ergebnisse über die während der Expedition Seiner Durchlaucht des Fürsten Alessandro C. della Torre e Tasso in Lybien aufgefundenen Tenebrioniden. *Publicazioni del Museo entomologico „Pietro Rossi“*, Duino, 2: 285–500.
- KOCH, C. (1939) Die Käfer der libyschen Ausbeute des Herrn Georg Frey. *Mitteilungen der Münchner Entomologischen Gesellschaft*, 29: 216–293.
- KOCH, C. (1941) Phylogenetische, biogeographische und systematische Studien über ungeflügelte Tenebrioniden (Col. Tenebr.). *Mitteilungen der Münchner Entomologischen Gesellschaft*, 31: 252–314.
- KOCH, C. (1944) Die Tenebrioniden Kretas (Col.). *Mitteilungen der Münchner Entomologischen Gesellschaft*, 34: 255–363, Taf. 18–29.

- KRAATZ, G. (1865) Revision der Tenebrioniden aus der alten Welt aus Lacordaire's Gruppen der Erodiides, Tentyriides, Akisides, Piméliides und der europäischen *Zophosis*-Arten. Berlin, 393 pp.
- KÜHNELT, W. (1965) Catalogus Faunae Graeciae. Pars 1. Tenebrionidae. *To Vouno* 1965: 1–60.
- LANZA, B. & BRUZZONE, C. L. (1959) Erpetofauna dell'arcipelago della Galita (Tunisia). *Annali del Museo civico di Storia naturale di Genova "Giacoma Doria"*, Duino, 71: 41–56.
- LATTIN, G. DE (1967) Grundriß der Zoogeographie. Stuttgart, 602 S.
- LILLIG, M., BORG BARTHET, H. & MIFSUD, D. (2012a) An identification and informative guide to the Tenebrionidae of Malta (Coleoptera). *Bulletin of the entomological Society of Malta*, 5: 121–160.
- LILLIG, M., MIFSUD, D. & GRIMM, R. (2012b) Faunistic and taxonomic updates on the Tenebrionidae of Malta (Coleoptera). *Bulletin of the entomological Society of Malta*, 5: 111–119.
- LÖBL, I., MERKL, O., ANDO, K., BOUCHARD, P., EGOROV, L.V., IWAN, D., LILLIG, M., MASUMOTO, K., NABOZHENKO, M., NOVÁK, V., PETTERSON, R., SCHAWALLER, W. & SOLDATI, F. (2008) Family Tenebrionidae Latreille, 1802. In: LÖBL, I. & SMETANA, A. [Eds.]: *Catalogue of Palaearctic Coleoptera*. Vol. 5. Tenebrionoidea: 105–352. Apollo Books, Stenstrup, 670 pp.
- LUCAS, H. (1849a) Exploration scientifique de l'Algérie pendant les années 1840, 1841, 1842. *Sciences physiques, Zoologie I*.
- LUCAS, H. (1849b) Exploration scientifique de l'Algérie pendant les années 1840, 1841, 1842. *Sciences physiques, Zoologie II*.
- MACARTHUR, R.H. & WILSON, E.O. (1963) An Equilibrium Theory of Insular Zoogeography. *Evolution*, 17(4): 373–387.
- MIFSUD, D. & SCUPOLA, A. (1998) The Tenebrionidae (Coleoptera) of the Maltese Islands (Central Mediterranean). *Annali del Museo civico di Storia naturale di Genova "Giacoma Doria"*, Genova, 92: 191–229.
- NABOZHENKO, M. V. & PURCHART, L. (2017) Western Palaearctic *Trachyscelis* Latreille, 1809 (Coleoptera: Tenebrionidae: Trachyscelini). *Annales zoologici*, 67 (3): 561–575.
- NAGEL, P. (1987) *Arealsystemanalyse afrikanischer Fühlerkäfer (Coleoptera, Carabidae, Paussinae)*. Ein Beitrag zur Rekonstruktion der Landschaftsgenese. 233 pp., Stuttgart.
- NORMAND, H. (1936) Contribution au Catalogue des Coléoptères de la Tunisie. 10^e fascicule. *Bulletin de la Société d'Histoire Naturelle d'Afrique du Nord*, 27: 355–383.
- POINAR, G. O. (1992) Life in Amber. Stanford University Press, Stanford, 350 pp.
- RATTI, E. (1986) Ricerche faunistiche del Museo civico di Storia Naturale di Venezia nell'isola di Pantellaria. I. Notizie introduttive; Coleoptera Tenebrionidae. *Bollettino del Museo Civico di Storia Naturale di Venezia*, 35 (1984): 7–41.
- REITTER, E. (1911) Fauna Germanica. Die Käfer des Deutschen Reiches Vol. 3, Stuttgart, 436 pp., 128 pls.
- SCHAWALLER, W. (1987) Revision westpaläarktischer Tenebrionidae. Teil 1. Die Arten der Gattung *Akis* Herbst. *Stuttgarter Beiträge zur Naturkunde*, Serie A (Biologie), 403: 1–21.
- SCHNEIDER, B. (1971) Das Tyrrhenisproblem. Interpretation auf zoogeographischer Grundlage. Dargestellt an Amphibien und Reptilien. PhD thesis, University of the Saarland, Saarbrücken, 362 pp.
- SEABRA, A. F. DE (1943) Contribuições para o inventário da fauna lusitânica. *Insecta Coleoptera. Memórias e estudos do Museu Zoológico da Universidade de Coimbra*, 142: I-XX, 1–153.
- SOLDATI, L. (2009) Coléoptères et autres insectes de l'archipel de la Galite. Mission de terrain Juillet 09 - Rapport Septembre 2009. *Conservatoire de l'espace littoral et des rivages lacustres*, 7 pp.
- SOLDATI, F. & NABOZHENKO, M.V. (2017) *Asida groehni* sp. nov., the first and the oldest fossil representative of the subfamily Pimeliinae from Eocene Baltic amber (Coleoptera: Tenebrionidae: Asidini). *Annales zoologici*, 67 (3): 555–559.

- SOLIER, A.J.J. (1835) Essai sur les Collaptèrides (Suite). *Annales de la Société entomologique de France*, (1) 4: 249–419, pl. 5–9.
- STEINER, W.E. jr. (2004) The Genus *Trachyscelis* (Coleoptera: Tenebrionidae) in North America: Synonymy, Origin, Distribution, and Decline. *The Coleopterists Bulletin*, 58 (3): 335–343.
- STÖCK, M., SICILIA, A., BELFIORE N.M., BUCKLEY, D., LO BRUTTO, S., LO VALVO, M. & ARCULEO, M. (2008) Post-Messinian evolutionary relationships across the Sicilian channel: Mitochondrial and nuclear markers link a new green toad from Sicily to African relatives. *BMC Evolutionary Biology*, 8: 56.
- VIGNA TAGLIANTI, A., AUDISIO, P.A., BELFIORE, C., BIONDI, M., BOLOGNA, M.A., CARPANETO, G. M., DE BIASE, A., DE FELICI, S., PIANTELLA, M., RACHELI, T., ZAPPAROLI, M. & ZOIA, S. (1993) Riflessioni di gruppo sui corotipi fondamentali della fauna W-paleartica ed in particolare italiana. *Biogeographia, Lavori della Società italiana di Biogeografia, Nuova Serie* 16 [1992]: 159–179.
- VIGNA TAGLIANTI, A., AUDISIO, P.A., MAURICIO, B., BOLOGNA, M.A., CARPANETO, M.G., DE BIASE, A., FATTORINI, A., PIATTELLA, E., SINDACO, R., VENCHI, A. & ZAPPAROLI, M. (1999) A proposal for a chorotype classification of the Near East fauna, in Framework of the Western Palaearctic region. *Biogeographia, Lavori della Società italiana di Biogeografia, Nuova Serie*, 20: 31–59.
- WEISE, E. (1974) Die *Isomira*-Arten (Col., Alleculidae) Mitteleuropas und des Mittelmeer-Raums. *Entomologische Blätter zur Biologie und Systematik der Käfer*, 70: 65–127.