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OBSERVATIONS ON THE NORTHERNMOST PRESENCE OF XEROTHERMIC TENEBRIONIDS IN THE REGION FRIULI-VENEZIA GIULIA

OSSERVAZIONI SULLE PRESENZE PIÙ SETTENTRIONALI DI TENEBRIONIDI XEROTERMI NELLA REGIONE FRIULI-VENEZIA GIULIA

Abstract - A description of the main ecological characteristics of the xerothermic areas of the Region Friuli-Venezia Giulia (NE Italy) is given (geology, soils, climate and vegetation). The distribution of the Tenebrionids (Coleoptera Heteromera) present in this area is described, together with notes on their ecology. This Region represents the northernmost point of distribution for some of these species. The threat of disappearance of these species due to environmental degradation is clearly illustrated, pointing out the most dangerous human impacts on the environment in which they live.

Key words: Conservation, Ecology, Friuli-Venezia Giulia, Xerothermic Tenebrionids.

Riassunto breve - Vengono elencate le specie xerotermiche di Coleotteri Tenebrionidi e relative località, presenti alle rive del punto più settentrionale del Mar Adriatico, rivestito di una vegetazione del tipo sclerofillo, che può vivere grazie al substrato geologico (calcare), suolo (terra rossa) e clima mesofilo-subumido, con una temperatura media di 11-14°C, precipitazioni annue pari a 900-1.100 mm e un pluviometro (Lang) pari a 64-100. In quest'area protetta dal vento di NE ("bora") raggiungono il loro limite più settentrionale di diffusione i Tenebrionidi *Stenosis intermedia*, *Asida fascicularis*, *Dendarus dalmatinus*, *Gonocephalum pusillum*, *G. pygmaeum*, *Opatrum sabulosum subsp. lucifugum* e *Catomus consentaneus*.

Parole chiave: Conservazione, Ecologia, Friuli-Venezia Giulia, Tenebrionidi xerotermici.

Introduction

Among Mediterranean beetles, in all arid and semi-arid communities of the world, Tenebrionids are the most highly represented because of their morpho-physiological adaptations to dry, even extreme, situations. The lapidicolous, often sabulicolous habits, the abundance of wingless species (and higher taxa), the generally slow movements, the frequent nocturnal life, the euryphagous diet (often phytosaprophagous, or even polysaprophagous) perfectly adapt this insect family for living in all "mediterranean" ecosystems in the Old World, in America (sclerophyllous forests of both California and Chile), in South Africa and in Southern Australia.

Apart from my papers on the Tenebrionid beetles of Dalmatia, Puglia and coastal Basilicata (Province of Matera), Sicily and circum-sicilian islands (besides research on all arid parts of the Caribbean Sea and near coastal regions), I have recently studied the Tenebrionid fauna of the Region Friuli-Venezia Giulia (NE Italy). I only wish to present here some ecological considerations on the xerophilous Tenebrionids present in this Region, and compare their diffusion with that of other families of Coleopterous beetles, well represented in this fauna.

The environment

At the northernmost shores of the Adriatic Sea, at the highest latitude of the Mediterranean Sea (higher than the Gulf of Genova and the Gulf of the Lion), the coast shows a wide inlet opened to the West (Gulf of Trieste), protected by the Karst High-Plateau from the cold north-eastern winds. The average annual temperature is higher than 14 °C, and the corresponding rainfalls are lower than 1000 mm (the lowest of the whole Friuli-Venezia Giulia Region). Lang's rainfactor is lower than 70, which means a sub-humid climate. If we refer to the pre-war border of the Trieste territory, the sunny, south (or south-east) exposed area is still larger, so that it constitutes a broad area which is partly arenaceous, partly calcareous. It has a various slope, which is also very steep and is exposed to the sun as no other areas of Friuli-Venezia Giulia, but similar to that of many localities on the



Fig. 1 - The territory in which the xero-thermic species of Tenebrionids are living.
- Il territorio in cui vivono le specie xero-termiche di Tenebrionidi.

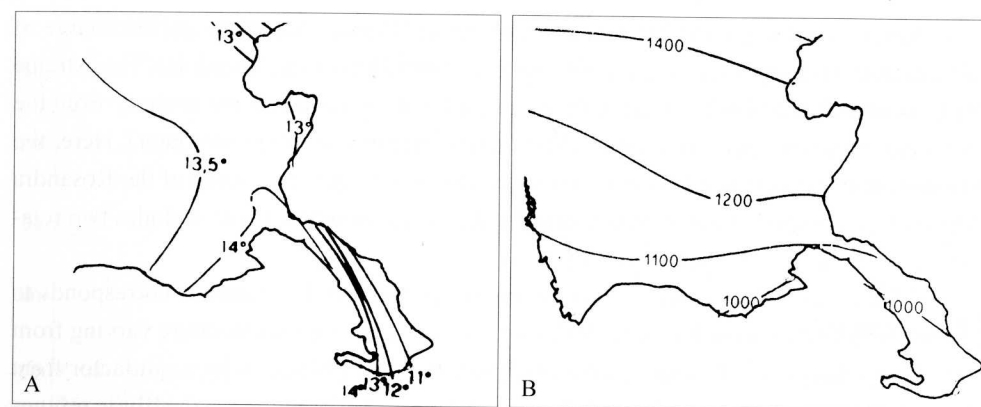


Fig. 2 - Average annual temperatures (A) and rainfall (B) in the Northern Adriatic Sea xerothermous area (from POLDINI, 1991).

- Temperature medie annue (A) e precipitazioni (B) nell'area dell'Adriatico settentrionale (da POLDINI, 1991).

Dalmatian coast. Importantly from an ecological perspective, it has total protection against the cold NE wind (locally "bora"). This is due to the presence of the western calcareous edge of Trieste "Karst" (or Carso), which prevents the wind blowing towards the coast all along a belt from Sistiana (not far from Monfalcone) to Grignano-Miramare (slightly west of Trieste) (fig. 1).

The nature of the substrate (mostly calcareous, from the Lower Eocene to the Upper Cretaceous) and soil (a kind of terra rossa; see later), adjacent to the southern exposure, have permitted - since pre-glacial epochs - the development and preservation of a sclerophyllous vegetation with *Quercus ilex* L. (holmoak), *Pinus halepensis* Mill., *Pistacia terebinthus* L., *Phillyrea latifolia* L., *Rhamnus catharticus* L., *Osyris alba* L., associated with *Stipa bromoides* (L.) Dörf., *Euphorbia fragifera* Jan, *Euphorbia wulfenii* Hoppe ex Koch and several species of *Satureja* L. (POLDINI, 1989). From a strictly geographical point of view, the area represents the extreme north-western limit of the Balcanic Peninsula. Indeed, Istria is arenaceous in the North, but mostly calcareous, and represents a northwards extension of the Quarner Islands (Veglia or Krk, Cherso or Kres, Lussino or Lošinj) which can be ascribed, as stated by the authors of "Italia Fisica", TOURING CLUB ITALIANO (1957, p. 14) to the Dalmatian archipelago, and then to Balcania.

In all of the xerothermic belt extending along the Gulf of Trieste, the surface hydrography is scarce, with the hypogeous or karstic prevailing, for example the Timavo mouth near Duino (fig. 2).

The subaereous-surface hydrography is present only in the arenaceous zone near Trieste, as, first the Rosandra Valley running towards Zaule at the northern edge of M. Carso (M. Kras, m 458, calcareous), second, a little southwards the Risano River, passing from limestone

to sandstone, and finally, the Dragogna River (Dragonja) flowing at the northern edge of calcareous Istria towards the extreme NW part of it (P.ta Salvore or Rt Savudrija). The extreme south-eastern edge of the Karst High Plateau near Basovizza protects the territory from the cold wind permitting the development of a mediterranean vegetation (see later). Here, the thermophilous Tenebrionid *Catomus consentaneus* KÜSTER can live, south of the Rosandra Valley. M. Kras, another south facing territory protected from the “bora” includes two relatively xerothermic localities, Ospo and S. Servolo (fig. 1).

The area with the greatest concentration of xerothermic Tenebrionids corresponds to the two figures taken from POLDINI (1991) (fig. 2) with an average temperature varying from $> 14^{\circ}\text{C}$ to values $< 11^{\circ}\text{C}$, and to the rainfall values 900-1100 mm, with a rainfactor from 64 to c. 1000 (mesophilous-subhumid climate). All the localities belong to the Illyric refuges from the last major glacial expansions (KLEBELSBERG, 1948).

The substrate of the whole territory is essentially calcareous with an exception for the western arenaceous part belonging to the Upper Eocene, including the town of Trieste and immediate outskirts (Roiano, Rozzol, Farneto, Barcola, Servola today included in the town proper) and the northern part of Istria up to the Rosandra Valley (lower course), Risano and Dragogna Valleys. In a few parts and towards the sea, a narrow belt of alluvial soil (Quaternary) is present. Inland, the sandstone is followed by the edge of the Karst, a marly-limestone, from the Middle Eocene, that extends eastwards (from Basovizza to S. Servolo) and is followed inland by another narrow Tertiary belt, belonging to Lower Eocene (liburnic limestone). This is in direct contact with the Secondary Cretaceous or Karst proper.

The soils formed by erosion of these types of rocks are represented by a sandy soil very poor in iron oxide (Fe_2O_3), going from 1,1 to 2,0%, rich in siliceous sand, developed on arenaceous rocks, and a kind of “terra rossa” rich in iron oxide (4,81-6,97%) and aluminium oxide (Al_2O_3). According to KUBIENA’s classification of soils (1952) this soil can be defined as allitic terra rossa or Mediterranean allitic terra rossa, loose, with a strong clotting and scarce plasticity, known from Istria and Dalmatia. SUSMEL (1988, p. 523 f11) calls it “mediterranean fersiallitic terra rossa”.

Only in some small fissures inside the limestone, below the roots of *Globularia cordifolia* L., has some soil rich in humus developed. We may consider this as a rendsina, with a value of 54% of organic substance (FIRTSCH in MARCHESETTI, 1895, p. XXI). This of course can have some influence on diffusion and existence of Tenebrionids and especially on their larvae. The dependence of Tenebrionids from soils in the Mediterranean dominion has been thoroughly investigated by the author for the Dalmatian species (cfr. MARCUZZI, 1968 and MARCUZZI & DALLA VENEZIA, 1968). However nothing has been done so far in Friuli-Venezia Giulia.

The climate of the territory, unfortunately, is not well studied, and today we have only

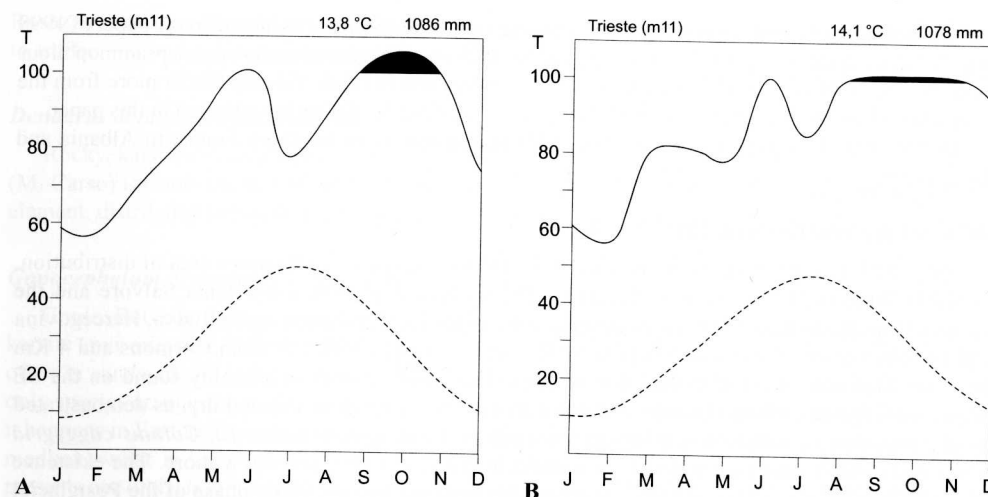


Fig. 3 - Ombrothermic diagrams (Gaussen) of Trieste for the 1868-1896 period (A) and for a period preceding 1957 (B).

- Diagrammi ombrotermici (Gaussen) di Trieste per il periodo 1868-1896 (A) e per un periodo precedente il 1957 (B).

the data existing for Trieste. The macroclimate is different from the topo- or even microclimates existing in the xerophilous stations that are protected from NE winds. Trieste, on the contrary, is well exposed to them, at least in the lower parts, close to the sea, or up to the edge of the Karst.

For Trieste the climate is represented by means of two ombrothermic diagrams (Gaussen) from two periods, one going from 1868 to 1896 (corresponding almost to a cycle of 33 years; cfr. POLLI, 1952) and one from the last century, preceding 1957 (TOURING CLUB ITALIANO, 1957, with no indication of the period) (fig. 3). From a comparison of the two climograms, in the last century temperature was lower ($13,8^{\circ}\text{C}$) and rainfall higher (1086 mm) so that Lang’s factor was greater (78) indicating a very slight increase of humidity. The difference consists of a concentration of rainfall near October in the XIX century, compared with the last one, and a spring maximum of rainfall in the past century in June, compared to April.

Results

The Tenebrionids of Friuli-Venezia Giulia reaching in the xerothermic parts of the territory of Trieste their northernmost limit of distribution (or one of their northern limits in Europe) are the following species:

Stenosis intermedia (SOLIER, 1838)

The species is quoted from Monfalcone by MAGISTRETTI & RUFFO, 1960, among the xerothermic

elements characteristic of the prealpine xerophilous oasis. The species is indicated in my paper of 1998 at p. 178 from Grado, Lignano, Punta Sdobba and Monfalcone. The element is however a psammophilous more than terricolous, xerothermic element, since it depends in Friuli-Venezia Giulia more from the microclimate of sandy shores, than on the xeric ecoclimate of the region investigated in this paper.

Distribution: European shores of Central Mediterranean, from Southern France to Albania and Ionic islands.

***Asida fascicularis* GERMAR, 1817 (fig. 4)**

The only locality where the species has been found north of its well known area of distribution, of North Western Balcan type, is Rosazzo. The species is present from Punta Salvore and the valley of the Quieto River to Pola, North Quarnero Islands and Dalmatia, up to Budva, Hercegovina and Bosnia, besides the isle of Vis (Lissa). Rosazzo is a hill 7 Km NW from Cormons and 4 Km NE from Manzano, west of Collio, 176 m high. The animal has been probably found on the SE slope, sun-exposed, where the topo- (or eco-) climate is relatively warm and dry, as demonstrated by the presence of some xerophilous plants such as *Pistacia terebinthus* L., *Cotinus coggygia* Scop. and *Convolvulus cantabrica* L. (see maps in POLDINI, 1991), and a few more. The existence of *Asida fascicularis* at this latitude can be attributed to the hypsothermic phase of the Postglacial period. Today of course no encounter is possible between this population (provided we may speak still of a "population") with those inhabiting Istria. Not only, but the existence of the species at



Fig. 4 - Localities from which *Asida fascicularis* was known.
- Località da cui era conosciuta l'*Asida fascicularis*.

Rosazzo is menaced by the low density of the population and the degradation of the small hill, due to traffic and anthropization (see below).

***Dendarus dalmatinus* (GERMAR, 1824) (fig. 5)**

Rocky, karstic environment near Prosecco, Sistiana, Malchina and the southern slope of M. Kras (M. Carso) towards the Rosandra Valley, San Servolo. Lapidicolous, terricolous, rather xerophilous element, distributed in Southern Italy (Adriatic shores) and Balcania, as far north as Trieste territory.

***Gonocephalum granulatum nigrum* (KÜSTER, 1849) (fig. 6)**

Grado, Belvedere (Lagoon of Grado), Monfalcone, Bistrigna, Doberdò (north of Monfalcone, in karstic environment), Duino, as far west as Lignano, near the sea, on dry, sunny soils, under stones, often in sandy-marly soils. In Friuli-Venezia Giulia as far south as Pola (MÜLLER, 1921). It is the only species among those quoted here which can sometimes determine serious damages to crops as it happens in Eastern Europe. In Russia it is so common and harmful to possess a vulgar name (mal'i medljak) what is very rare for a beetle. It is distributed in Southern Europe (Trieste possibly presents one of the northernmost localities), Caucasus, Northern Africa, Italy, Sicily, Corsica, Balcania, as far east as Semipalatinsk, Zaisan and Kuldja (MEDVEDEV, 1968). It behaves as a xerothermic element only in Northern Adriatic area, since in Southern Italy and Sicily it can live also in some hilly

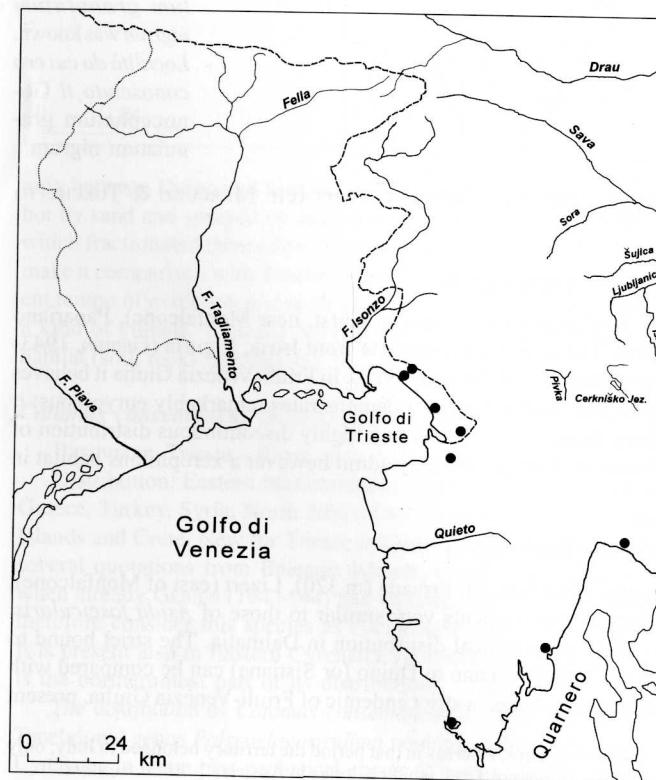


Fig. 5 - Localities from which *Dendarus dalmatinus* was known.
- Località da dove era conosciuto il *Dendarus dalmatinus*.



Fig. 6 - Localities from which *Gonocephalum granulatum nigrum* was known.
- Località da cui era conosciuto il *Gonocephalum granulatum nigrum*.

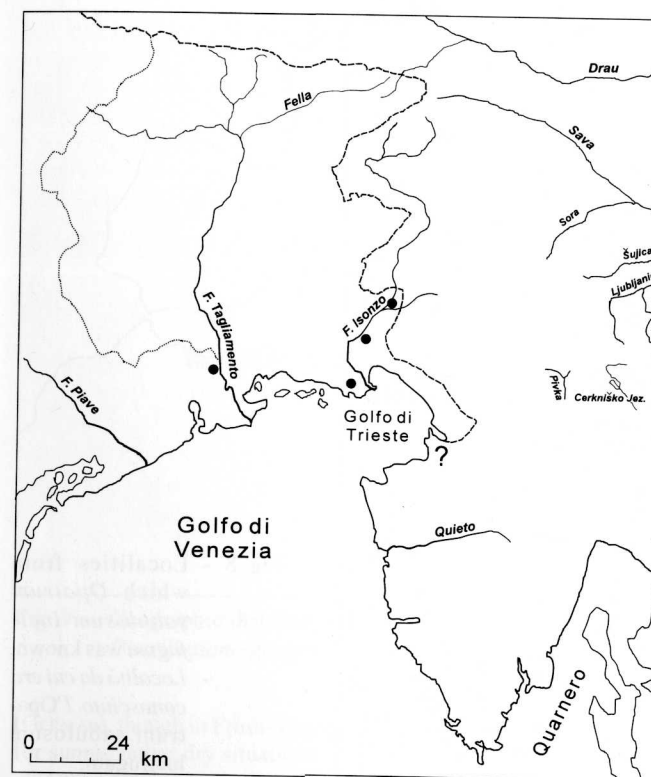


Fig. 7 - Localities from which *Gonocephalum pygmaeum* was known.
- Località da cui era conosciuto il *Gonocephalum pygmaeum*.

localities, so that it can be considered a rather euryoikous element (cfr. MARCUZZI & TURCHETTO LAFISICA, 1977).

Gonocephalum pygmaeum (VON STEVEN, 1829) (fig. 7)

Gorizia (SEIDLITZ, 1898, p. 443), Sagrado (western limit of Karst, near Monfalcone), Papariano (lower Isonzo River, on the left shore). The insect is known also from Istria, Liguria (GEBIEN, 1943-'44), Veneto and Trentino-Alto Adige (CANZONERI & VIENNA, 1987). In Friuli-Venezia Giulia it behaves as a xerothermic animal, though in its area of distribution it demonstrates remarkably euryoikous: it is known from Alto Adige⁽¹⁾, Southern France, what points to a highly discontinuous distribution of relict type, in the whole limited to Southern Europe. We may admit however a xerophilous habitat in Friuli-Venezia Giulia.

Opatrum sabulosum lucifugum KÜSTER, 1849 (fig. 8)

Duino, foci del Timavo (S. Giovanni), Sistiana, M. Ermada (m 320), Lizert (east of Monfalcone), today practically disappeared. Ecological requirements very similar to those of *Asida fascicularis*, with which the insect shares a part of its geographical distribution in Dalmatia. The strict bound to sclerophyllous vegetation along the sea from Grignano to Duino (or Sistiana) can be compared with that shown by a plant, *Centaurea kartschiana* Scop., a strict endemic of Friuli-Venezia Giulia, present

only between Duino and Sistiana (c. 2.5 Km), which "likes best the rocks falling sheer to the sea, red-hot by sand and sprayed by sea water. It took its origin from an Illyric-Dalmatian stem of *Centaurea* which fractionated themselves in a series of small endemics" (POLDINI, 1971, p. 602). Also if we cannot make a comparison with Tenebrionids living together with this endemic *Centaurea*, which have different tempo of evolution and ecological requirements, we may however say that this vegetal endemic is a kind of climatic indicator very much alike our beetles, very sensitive to environment and micro-habitat (soil, rocks, geology etc.).

Catomus consentaneus (KÜSTER, 1851) (fig. 9)

Basovizza, Trieste - Karst, at m 377.

Distribution: Eastern Mediterranean and Sicily (SEIDLITZ, 1898). France (not quoted by Portevin), Greece, Turkey, Syria, North Africa (from Egypt to Maghreb), Sicily, Albania, Ionian Islands, Egean Islands and Crete. New for Trieste territory. ESPAÑOL (1954) says that he considers "very doubtful the several quotations from Balearic Islands, being a species more typical of Eastern Mediterranean", when already GEBIEN (1943-'44) had recorded the species from France, Algeria and Tunisia. We may therefore consider this species as circummediterranean with a very ancient discontinuous diffusion. It is present also in Eastern Cyrenaica (Tobruk and Porto Badia; GRIDELLI, 1930). The Trieste Karst is the northernmost part of its distribution.

The distribution of *Catomus consentaneus* in North Africa is perfectly in harmony with that of the Tenebrionid genus *Polycloeogastrium* pointing to the existence of a land connection between Crete and Cyrenaica in some past geological epoch. Whereas this distribution is rare among Coleoptera, it seems

(1) Erroneously GEBIEN (1936-1942, p. 466) writes Tirol, whereas in that period the territory belonged to Italy; only after the war it has been called locally "Süd Tirol", but not Tirol, which belongs to Austria.



Fig. 8 - Localities from which *Opatrum sabulosum lucifugum* was known.
- Località da cui era conosciuto l'*Opatrum sabulosum lucifugum*.

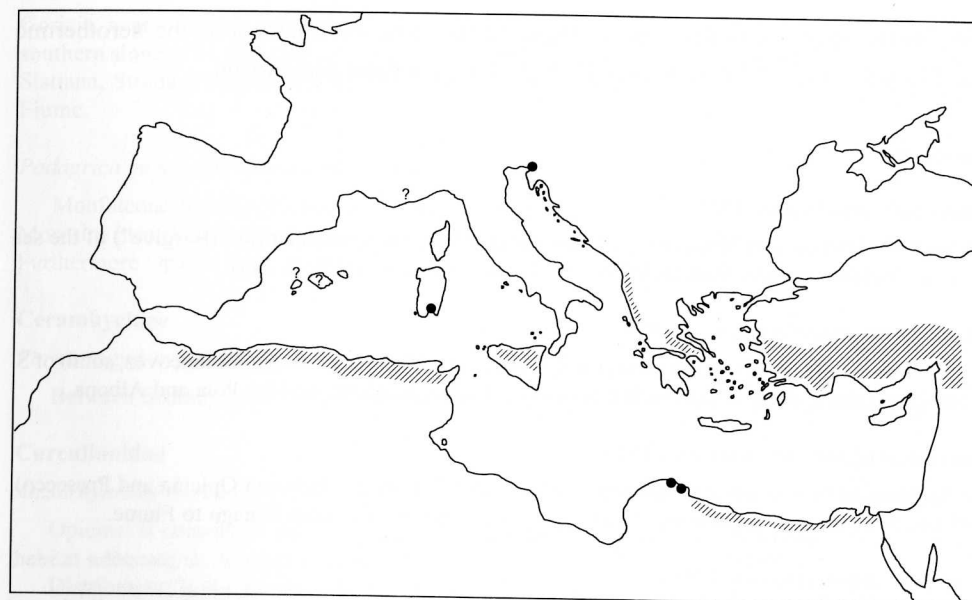


Fig. 9 - Geographic distribution (somewhat schematic) of *Catomus consentaneus*.
- Distribuzione geografica (alquanto schematica) di *Catomus consentaneus*.

rather frequent among higher plants, such as *Lonicera etrusca* Santi, *Sherardia arvensis* L., *Anthemis pseudocotula* Boiss, *Chrysanthemum coronarium* L. *Carduus pycnocephalus* L. (reaching also Venezia Giulia) and *Carthamus lanatus* L. s. l. These elements were present in the past on the shores of Eastern Mediterranean (at least) and later their diffusion area underwent a reduction (Favarger in litt.). The reasons of this reduction could be individuate in the diminution of rainfalls during the last 5000 years (MARCUSZI, 1976a, pp. 12-13, and BUTZER, 1961). The presence of *Catomus consentaneus* in Cyrenaica (eastern part) is common to several plants present in Southern Europe (Crete, sometimes Greece) and both extremes of Northern Africa, Egypt and Maghreb (cfr. also POLUNIN, 1987).

The finding of *Catomus consentaneus* at Basovizza, near the southern edge of the Carso above the town of Trieste (SE sectors of it; cfr. fig. 1) in the vegetal association *Stipo-Salvietum officinalis*, subassociation *Agropyretum pungentis*, corresponds to the northernmost station of some stenomediterranean vegetal species such as *Satureja subspicata* Bartl. ex Vis., *S. s. liburnica* Šilic and sometimes hybrids as *S. x karstiana* Justin (POLDINI, 1989, p. 244). The extension of *Catomus consentaneus* can be compared with that of south-eastern Mediterranean European plants. According to POLDINI (1989, p. 247) "the garrigue with *Salvia* Linné entered into the empty spaces of *Quercus ilex* Linné forests can be considered of primary nature". This association is present also at Banne, distant 6 km west of Basovizza, on the southern edge of Karst high-plateau, continuous up to Prosecco along the Vicentina Road.

Catomus consentaneus is very likely a lapidicolous species, as is *Catomus rotundicollis* KÜSTER, known from several parts of Italy and islands.

A species which cannot be considered strictly xerothermic stenoikous is *Odocnemis exaratus*

(GERMAR), though in Friuli-Venezia Giulia and in its total area of distribution it shows a clear preference for sunny, rather dry situations.

In the littoral part of Friuli-Venezia Giulia it has been found up to Gorizia (m 509, Trieste, San Giovanni al Timavo (Timavo-mouth), Sistiana, Duino, Grignano, Barcola, Opicina, Basovizza, Ermada, M. Kras (m 450), Noghere (disappeared). Localities not belonging to xerophytic environments are Gradisca, Percedol, M. Lanaro (m 546), Villanova del Quieto (Istria) and Alberoni (lower Isonzo), belonging to the *Quercus-Ostryetum*. Furthermore the species is present all along the shores of Istria up to Fiume.

Distribution: Adriatic littoral of Northern Balcania, Gargano, Romagna and Sicily. Typical relict distribution of transadriatic type. Eastwards extended up to Hercegovina and Hungary (GRIDELLI, 1950).

Ecology: lapidicolous, sometimes on oak-buds (MÜLLER, 1921).

Comments

The importance of the xerothermic isle of the northernmost Adriatic Sea, on the life of Coleopterous beetles is shown by other species whose distribution overlaps the northernmost part. We must infer that their ecological valence is very similar, if not the same, to the Tenebrionids discussed here.

These species belong to other well represented families, such as Carabidae, Chrysomelidae and Curculionidae, which constitute in most xerothermic Italian areas, as well as in Dalmatia, the nucleus of the Coleopterous fauna. We will limit ourselves to cite

some of the most interesting species living in the same environment as the xerothermic Tenebrionids in Friuli-Venezia Giulia, so to provide a valid comparison.

Carabidae

Amara montana DEJEAN, 1828

Between Barcola and Miramare, near the marine fresh-water resultant (or "risorgive") of the sea shore at Aurisina, besides Pola and Quarnero Islands (MÜLLER, 1926, p. 205).

Laemostenus venustus (DEJEAN, 1828)

Southwards of Gorizia, Pieris (near Monfalcone, along the lower Isonzo), Coloncovez, south of S. Maria Maddalena, in the south-eastern sectors of Trieste; Noghère, besides Pola and Albona.

Olisthopus glabricollis (GERMAR, 1817)

Arenaceous hills south-exposed near Trieste, Strada Vicentina (between Opicina and Prosecco), between Sistiana and Monfalcone, Noghère, besides littoral Istria from Umago to Fiume.

Acinopus picipes (OLIVIER, 1795)

Littoral zone from Trieste to Duino, S. Giovanni near Timavo mouth, Monfalcone, Zaule and Noghère, besides Strugnano, Pola and Fiume.

Ophonus incisus (DEJEAN, 1829)

Between Barcola and Miramare, between Prosecco and Gabrovizza, Fiume.

Brachynus plagiatus REICHE, 1868

Isola Morosini, Noghère and Osopo, besides Quieto Valley and Lake of Arsa in Istria.

Zabrus ignavus CSIKI, 1907

Gorizia (MÜLLER, 1926, p. 207), northern limit of the species in Italy and probably absolute. Western Mediterranean (MARCUSZI & TURCHETTO LAFISICA, 1977, p. 14).

Laemostenus (Pristonychus) algerinus (GORY, 1833)

Trieste (S. Giovanni), besides Parenzo and Pola, often in cellars and other subterranean cavities. Western Mediterranean, from Morocco and Spain to Dalmatia (MÜLLER, 1926, p. 236). Eutroglophilous element (MAGISTRETTI, 1965, p. 433).

Lamprias fulvicollis thoracica (HOPPE, 1825)

La Rocca (Monfalcone), Duino, Boschetto (Trieste), Cattinara, in the past also at Zaule. Besides Cittanova (Istria) and Fiume.

Chrysomelidae

Crioceris paracenthesis (LINNÉ, 1767)

Gorizia, on *Asparagus acutifolius* L. (northern limit of distribution); Cormons (13 km west of

Gorizia, near a locality where *Asida fascicularis* has been found); Kronberg, east of Nova Gorica, southern slope of M. San Gabriele, sun exposed; Pietra Rossa (karstic swamp north of Monfalcone); Sistiana, Strada Vicentina, Cedas and Barcola. In Istria from Ancarano and Salvore southwards, Fiume.

Podagric menetriesi (FALDERMANN, 1837)

Monfalcone (beach); Belvedere (shores of Grado Lagoon), Pieris (west of Monfalcone), Isola Morosini (near Isonzo mouth), San Giovanni di Duino, all situations protected from the N-E winds. Furthermore Opatija (near Fiume) (on *Althaea officinalis* L., MÜLLER, 1949-53, p. 565).

Cerambycidae

Parmena pubescens hirsuta KÜSTER, 1846

Between Sistiana and Duino, besides from Punta Salvore to Quarnero Islands and Dalmatia.

Curculionidae

Anisorhynchus monachus (GERMAR, 1817)

Opicina. It constitutes the only finding of the insect in Karst, where it probably found a micro-habitat adequate to its requirements.

Distribution: in the Northern part of the Mediterranean basin, from Spain to Dalmatia. In Italy it was known before only in Central and Southern parts, besides islands (PESARINI, 1972).

To the xero-thermic elements of High Adriatic Sea also a Scarabeid beetle belongs, *Scarabaeus affinis* BRULLÉ, present from Monfalcone to Sistiana. Besides it is known from Istria.

Tenebrionidae however, also in Friuli-Venezia Giulia, show their clear preference for xerothermic situations, a sign of their remote origin from semi-arid and arid zones in many parts of the World and all around the Mediterranean Sea. Indeed, on a total of 57 species so far known for Friuli-Venezia Giulia (MARCUSZI, 1998) 7, i.e. practically one tenth of total species (if we do not include *Odocnemis exaratus* GERMAR, 1817, a sub-xerophilous element) are present exclusively in xerothermic situations. Unfortunately, different from what happens for not xerophilous elements, they are much more threatened in their existence and possibility of survival than the remaining species.

Protection of the species

The listed species are few and limited to a very few localities. Some of them were possibly present only in the past, when MÜLLER's work on Adephaga (1926) was written. Some species may have been quoted from Gorizia or Pola and Fiume during SEIDLITZ' period (1898) or by other authors. For Tenebrionid beetles see the list issued in Gortania (MARCUSZI, 1998). As the author states in this work, the territory of Trieste has been deeply degraded since 1895 (when Marchesetti's flora has been issued) because of the increase of population

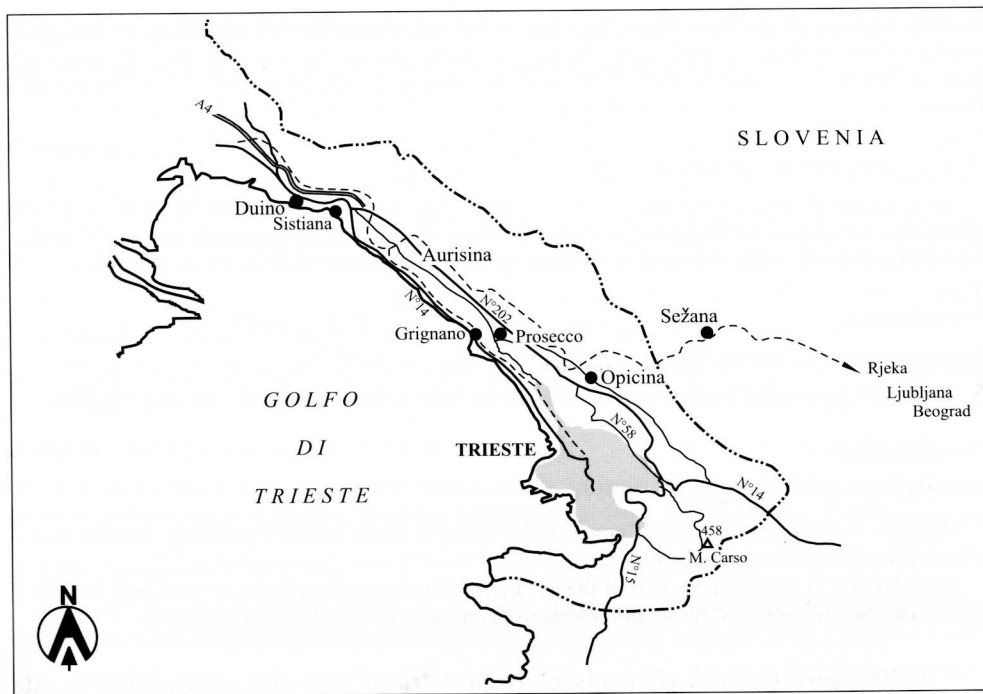


Fig. 10 - The roads passing through the territory in which the xero-thermic Tenebrionids are (or were) living. A comparison with fig. 1 shows the increase of the town of Trieste from the end of the XIX century to the last years, with the inclusion of several suburbs or fractions situated at the feet of the Karst and the low course of some rivers or brooks which in the past reached the gulf.

- *Le strade che attraversano il territorio in cui vivono i Tenebrionidi xerothermici. Un confronto con la fig. 1 mostra l'aumento della città di Trieste dalla fine del secolo XIX ad oggi con l'inclusione di vari suburbi situati ai piedi del Carso e del corso inferiore di alcuni fiumi che in passato sboccavano nel Golfo.*

(from 232.359 in 1911 to 280.700 in 1951). Still greater is the increase in the town, as shown in fig. 13 of my paper issued in "Gortania", which occurred from 1895 to 1965, with the incorporation into the city of some suburbs or small fractions such as Rozzol, Roiano, Guardiella, Scorcola etc..

The tourism, particularly the balneary tourism (with access to the sea) has increased significantly thanks to the communications system, particularly in the Sistiana-Barcola tract (3,5 km from Trieste) and inland, between Sistiana-Prosecco or Opicina, where most heavy traffic with Slovenia (ex-Yugoslavia) passes. An excessive number of roads is indeed present in the very territory where the xerothermous species are concentrated: National road n. 202 Sistiana-Opicina, National n. 58 Opicina-Trieste, National n. 15 Trieste-Slovenian border (Rabuiese), Highway A4, so far extended up to Opicina; two railways: the

Venice-Trieste and the Bivio-Aurisina-Opicina Campagna-Slovenian border near Orleg (or Orlek), National Road n. 14 Sistiana-Trieste, or "Litoranea", the most sunny and protected from winds, where heaviest traffic is present. All this means that in a belt 3-5 km wide (near Aurisina-S. Croce or from Trieste to Basovizza), two railways, one highway, two National Roads, besides the normal regional roads Monfalcone-Prosecco, and from here Prosecco-Trieste and Prosecco-Monrupino-Slovenia, are included. It means more surface dedicated to roads rather than the biotic environment (plants and animals). And this is the place where we must try to protect xerophilous beetles.

The rich insect life in Zaule and Noghere (Tenebrionid beetles included) has disappeared leaving the place to industry (oil refineries of Aquilina, etc.) with increased traffic and pollution of air, water and soil.

For all these reasons, we have little hope for the preservation of winged and wingless insects such as the Tenebrionids, which are furnished with poor means of locomotion and are bound to their microhabitats (lapidicolous, corticolous, myrmecophilous, etc.).

Unfortunately studies on the quantitative ecology of Tenebrionids in Friuli-Venezia Giulia have not been initiated. Geoadephaga of Trieste Karst have been studied by BRANDMAYR & COLOMBETTA (1981) from the quantitative perspective. The threat of alterations to arthropods communities in Carabids has also been studied in Southern Italy (BRANDMAYR & PIZZOLOTTO, 1995) and impact assessment (EIA) has been investigated in the Aspromonte region by PIZZOLOTTO (1993). In Puglia and province of Matera (Basilicata) the effects of increase of population and still more of tourism on Coleopterous insects with special emphasis on Tenebrionids have been illustrated by MARCUZZI (1994). Consequently Friuli-Venezia Giulia urgently requires investigations of this nature.

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