

On the presence of the family *Torrenticolidae* Piersig (Acari, Hydrachnidia) in interstitial waters of Sicily (South Italy) : description of a new species

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Keywords : interstitial waters, water mites, *Torrenticolidae*, new species, Sicily.

Eleven species of the water mite family *Torrenticolidae* Piersig are reported from interstitial waters of Sicily. The male, female and deutonymph of *Torrenticola hyporheica* n.sp. are described. The morphological traits of the new species suggest adaptation to life in groundwaters and indicate affinities with other hyporheobiont species of the genus such as *T. ramigera* Szalay and *T. jeanneli* Motas & Orghidan. The high number of *Torrenticolidae*-species found in interstitial habitats may be related to the adaptive morphological features of members of this family and more directly to hydrogeological conditions on the island. *Torrenticola lativalvata*, *Torrenticola hyporheica* and *Torrenticola trinacriae* were the most abundant species collected. Marked differences between the distributions of species of the family in Sicily and Corsica are pointed out.

Sur la présence de *Torrenticolidae* Piersig (Acari, Hydrachnidia) dans les eaux interstitielles de Sicile (Italie) : description d'une nouvelle espèce

Mots clés : eaux interstitielles, hydracariens, *Torrenticolidae*, nouvelle espèce, Sicile.

Onze espèces d'hydracariens appartenant à la famille des *Torrenticolidae* Piersig ont été recueillies dans les eaux interstitielles de Sicile. Le mâle, la femelle et la deutonymphe de *Torrenticola hyporheica* n.sp. sont décrits. La morphologie de cette espèce semble bien adaptée à la vie dans le milieu hyporhéique comme cela a déjà été observé chez deux autres espèces hyporhéobiontes du même genre (*T. ramigera* et *T. jeanneli*). Les caractéristiques morphologiques adaptatives de la famille et les conditions hydrogéologiques de l'île justifient le nombre élevé d'espèces recueillies. *T. lativalvata*, *T. hyporheica* et *T. trinacriae* sont les espèces les plus abondantes.

Des différences notables ont été mises en évidence entre la distribution des espèces de cette famille en Corse et en Sicile.

1. Introduction

The distribution of water mites in Italian ground waters is poorly known. To date, only a few papers have addressed this topic (Schwoerbel 1961, 1962a, Bader 1983, Teschner 1988, Viets 1939), Gerecke (1991) recently investigated the water mite fauna of superficial and subterranean habitats in southern Italy. Some of these results are summarized here. In particular, we refer to the presence of the genera *Torrenticola* Piersig and *Pseudotorrenticola* Walter, in interstitial waters of Sicily. For the general distribution of mites of the family *Torrenticolidae* in Sicily and in the Mediterranean region, see the

detailed catalogue in Di Sabatino et al. 1992. Faunistic, taxonomic and ecological informations on many of the species included in this study, are reported in Di Sabatino & Cicolani (1989, 1990, 1992), Di Sabatino et al. (1992) and Cicolani & Di Sabatino (1990).

2. Methods

Samples were taken using the Karaman-Chappuis method (Delamare Deboutteville 1960) : small holes (25 to 50 cm. deep) were dug near water courses and, during periods of drought, characteristic of Sicilian running waters, similar samples were also taken directly from river beds. Water mites were separated from other fauna and preserved in Koenike fluid. Specimens were mounted in Faure medium for identification. All the material was collected by R. Gerecke.

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12 th contribution to the knowledge of the water mites of the Apennines.

3. Study Area

The investigated habitats were located in various mountain ranges throughout the island (Table 1). Fig. 1 : illustrates the locations of sampling stations and indicates those samples in which water mites were found. For a complete description of the study area see Gerecke (1991) and Di Sabatino et al. (1992). A complete list of water mite species collected is also reported by Gerecke (1991).

4. Species collected

Genus *Torrenticola* Piersig 1896

Torrenticola andrei (Angelier 1950).

Stations : Nebrodi 569I (2 males/0 females/0 nymphs). 1138I (1/1/0) ; Madonie 512I (1/0/0).

The species, typical of interstitial waters (Schwoerbel 1986), was represented by few individuals ; it is also present in the epigeal waters of the island (Di Sabatino et al. 1992). The species seems confined to groundwaters in the northernmost part of its distribution while in the Mediterranean area it is regularly distributed in superficial waters (Lundblad 1956, Angelier 1954).

Torrenticola anomala (Koch 1837)

Stations : Iblei 543I (1/0/0), 544I (0/1/0).

Only two individuals of this species were collected in the area of Iblei Mountains.

Table 1. Sicily : list of interstitial sample-sites. (F = river ; T = stream ; F.ra = « Fiumara »).

Tableau 1. Sicile : liste des stations interstitielles prospectées : (F = rivière ; T = cours d'eau ; F.ra = petit cours d'eau).

site n°	watercourse	locality	Prov. date	Alt. m. asl	Conduc. mS/cm
PELORITANI MOUNTAINS					
573I	F.ra di FLORESTA	S.Lucia	(ME) 16/09/87	660	0.51
576I	F.ra di FRANCO	Itala	(ME) 20/09/87	400	0.53
591I	T.FIUMEDINISI	P.Strumbo	(ME) 04/10/87	420	
593I	T.FIUMEDINISI	Migliuso	(ME) 04/10/87	270	0.41
NEBRODI MOUNTAINS					
569I	F.CARONIA	T.Marchina	(CT) 11/09/87	150	0.49
1138I	T.SARACENA	Chiusitta	(ME) 20/10/90	1200	-
MADONIE MOUNTAINS					
510I	F.POLLINA	Buonanotte	(PA) 14/10/86	50	0.95
511I	T.in V.MULINI	Castelbuono	(PA) 14/10/86	350	0.78
512I	T.VICARETTO	Castelbuono	(PA) 14/10/86	320	0.48
SICANI MOUNTAINS					
472I	F.SOSIO	S.Carlo	(PA) 25/08/86	200	0.63
473I	F.VERDURA	Calamonaci	(AG) 25/08/86	95	0.99
IBLEI MOUNTAINS					
534I	F.MANGHISI	Noto	(SR) 11/11/86	390	0.46
543I	F.ANAPO	Cassaro	(SR) 01/12/86	360	0.66
544I	F.MANGHISI	M. Papa	(SR) 01/12/86	390	0.49
551I	T.S.CHIARA	Noto	(SR) 30/08/87	300	0.45
552I	F.ra GRANDE	Sortino	(SR) 30/08/87	450	0.43
553I	F.ra GRANDE	C.Carubba	(SR) 30/08/87	320	0.32
NW-MOUNTAINS					
493I	T.BATTICANO	Corleone	(PA) 11/09/86	375	0.73

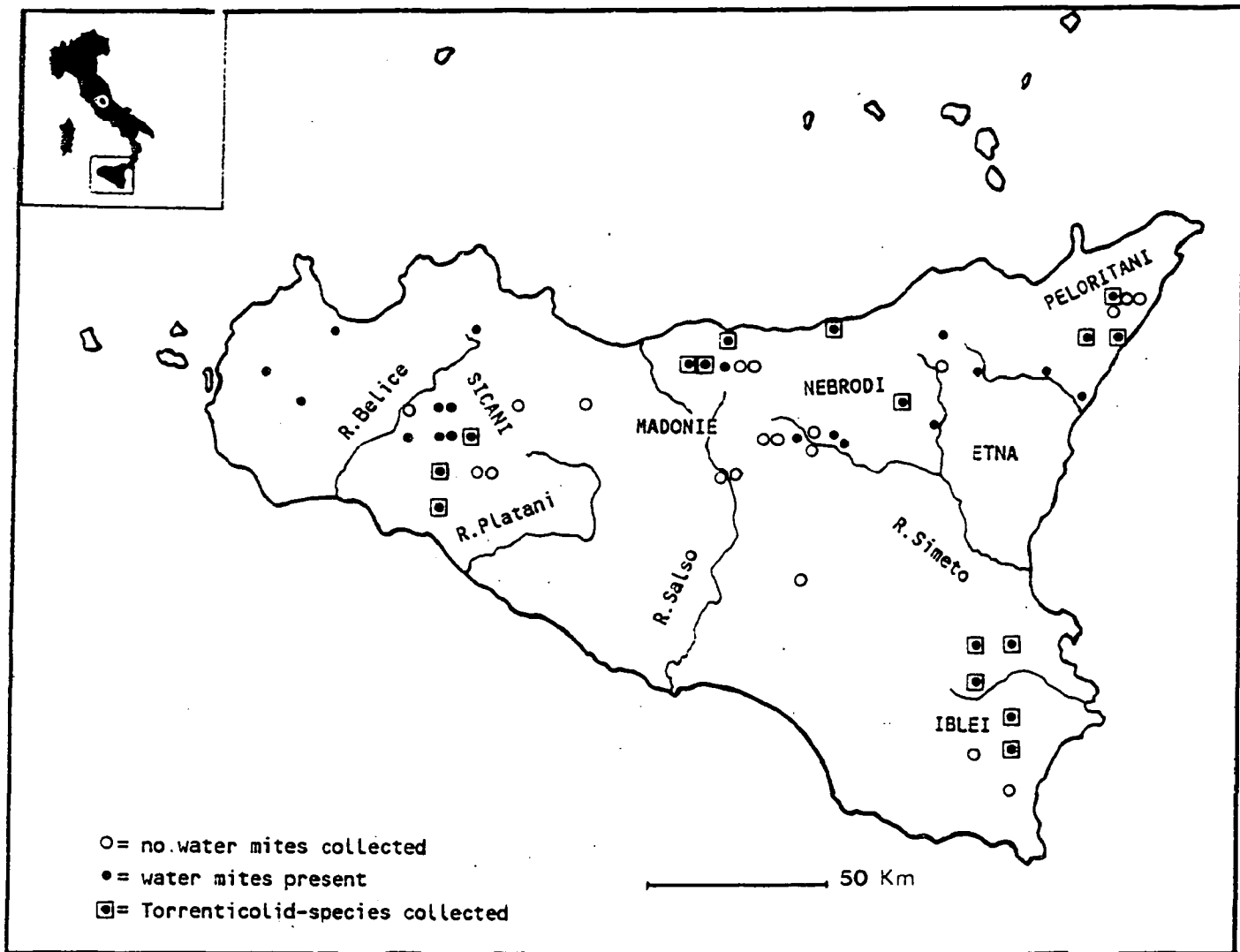


Fig. 1. Study area and distribution of the collecting sites.

Fig. 1. Région étudiée et emplacement des stations prospectées.

Torrenticola barsica (Szalay 1933)

Stations : Nebrodi 569I (1/2/0) ; Peloritani 591I (0/1/0) ; Iblei 544I (0/1/0) ; NW-Mountains 493I (0/1/0).

Members of this surface-living species were occasionally collected in hyporheic habitats.

Torrenticola brevirostris (Halbert 1911)

Stations : Madonie 511I (0/3/0).

The presence of this species in interstitial habitats was probably accidental.

Torrenticola hyporheica n.sp.

Material : Peloritani 573I (7/2/0), 574I (1/0/0), 576I (3/1/2), Nebrodi 1138I (1/1/0) ; Madonie 511I (0/1/0) ; Sicani 473I (0/1/0).

Locus typicus : site n° 573I, Peloritani Mts., fumarata di Floresta in locality S. Lucia (ME), UTM : WC 20 09, 450 m. asl, temperature 19.9°C, conduc-

tivity of interstitial water 0.63 mS/cm ; 16/09/87. Types and paratypes are in the author's collection (L'Aquila) and the collection of R. Gerecke (München).

Description :

— Holotype, Male (prep. 701) from *locus typicus*.

Dorsum (Fig. 2a) with dorsal shield, 570 μm long and 400 μm wide, composed of a large plate with two pairs of small platelets on the anterior margin. Length of anterior platelet 117 μm , posterior platelet 172 μm . Ocular pigment extremely reduced. Venter (Fig. 2b) with capitular bay 129 μm deep and 98 μm wide ; ventral length of body 665 μm , ventral width 446 μm . Total length of first coxal plates 274 μm , medial length of coxae II + III 90 μm ; genital field round, 129 μm long and 105 μm wide. Suture lines of fourth coxae extending posteriorly beyond genital field and strongly curved. Distance

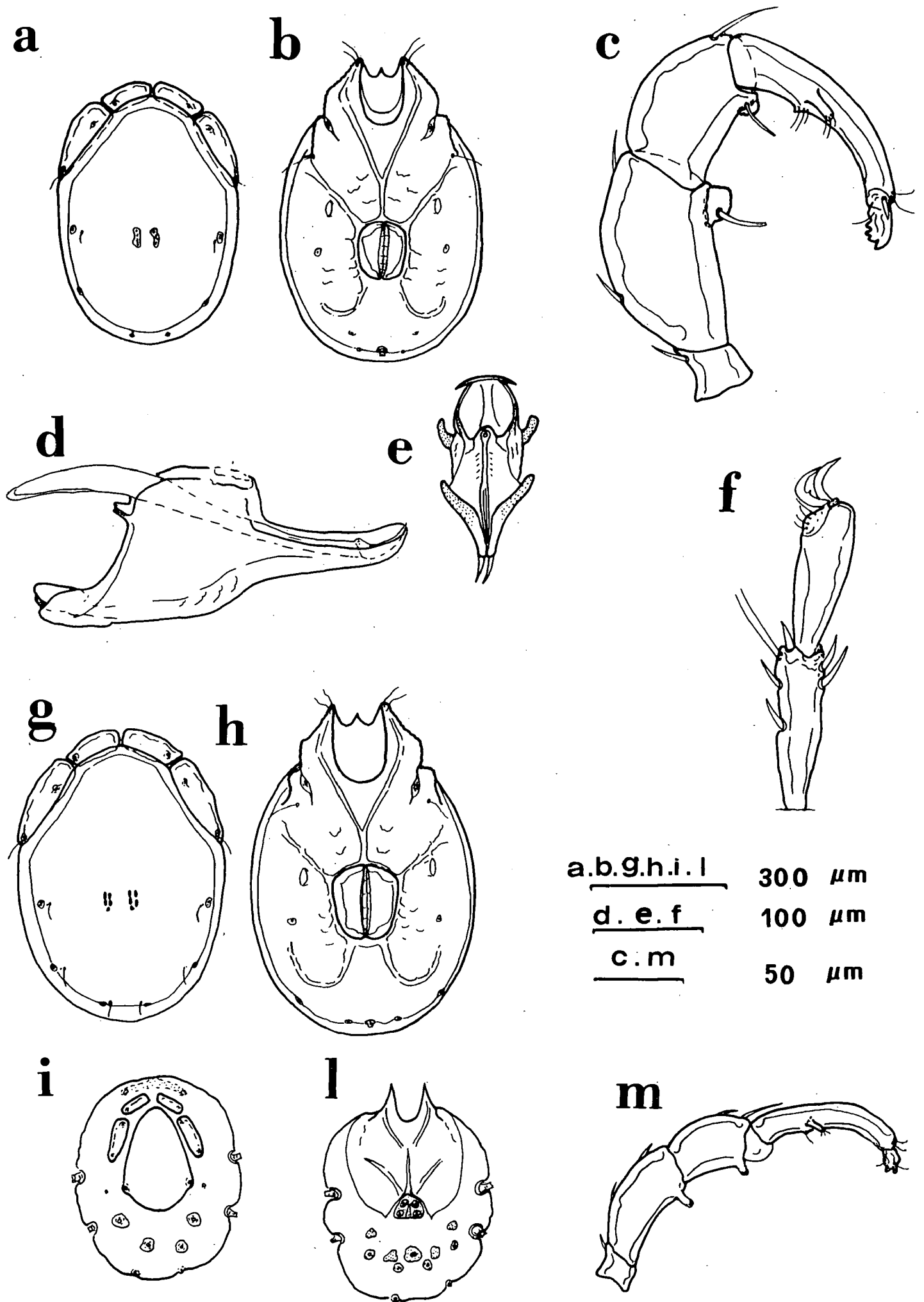


Fig. 2. *Torrenticola hyporheica* n.sp. (a-f male ; g, h female ; i-m deutonymph) : a, g, i = dorsal view ; b, h, l = ventral view ; c, m = palps ; d = infracapitulum ; e = ejaculatory complex ; f = IV-Leg-5 and 6.

Fig. 2. *Torrenticola hyporheica* n.sp. (a-f mâle ; g, h femelle ; i-m deutonymphe) : a, g, i = vue dorsale ; b, h, l = vue ventrale ; c, m = palpes ; d = infracapitulum ; e = organe éjaculateur ; f = patte IV - articles 5 et 6.

from posterior margin of genital field to excretory pore 150 μm , to posterior edge of ventral shield 167 μm .

Gnathosoma with infracapitulum (Fig. 2d) 335 μm long and 119 μm high ; chelicera 356 μm long with a short terminal claw. Palp as in fig. 2c with dimen-

sions as in Table 2. Ventral projection of P-II and P-III characteristic. P-IV with an accessory medial tubercle bearing three terminal short hairs.

Legs with measurements as in Table 2. Two short hairs inserted on distal margin of III and IV-Leg-5 (Fig. 2f).

Table 2. Leg and palp measurements (in μm) of male and female of *T. hyporheica* n.sp.

Tableau 2. Longueurs des pattes et des palpes (en μm) des ♂ et ♀ de *T. hyporheica* n.sp.

Segments Legs	MALE						FEMALE					
	1	2	3	4	5	6	1	2	3	4	5	6
I	35	55	70	85	100	80	29	65	74	90	102	92
II	36	57	71	86	109	104	32	68	75	90	109	102
III	36	66	71	93	111	107	32	70	78	98	117	110
IV	102	80	95	119	142	130	102	78	102	137	149	127
Palps	P-I 30	P-II 107	P-III 83	P-IV 128	P-V 23		P-I 37	P-II 116	P-III 90	P-IV 130	P-V 26	

Ejaculatory complex (Fig. 2e) typical of the genus (Cicolani & Di Sabatino 1990), total length (excluding apical setae) 160 μm , diameter of proximal chamber 57 μm . Proximal horns and anterior keel well developed, proximal and distal arms strongly sclerotized.

— Female (paratype n° 702 from *locus typicus*).

Dorsum (Fig. 2g) : dorsal shield 655 μm long and 437 μm wide, length of anterior platelet 125 μm , posterior 207 μm . Ocular pigment almost absent. Venter (Fig. 2h) : total length 731 μm , maximal width 590 μm ; capitular bay 137 μm deep and 104 μm wide. Length of first coxal plates 278 μm , coxae II + III 70 μm ; genital field pentagonal in shape, 164 μm long and 141 μm wide. Suture lines of fourth coxae more pronounced than in male. Distance from posterior margin of genital field to excretory pore 188 μm , 204 μm to posterior edge of body. Individual ovigerous with two eggs 150 μm in diameter. Gnathosoma with infracapitulum as in male, 374 μm long and 133 μm high, rostrum extending 145 μm from insertions of palps, chelicera 390 μm long. Morphology and chaetotaxy of palps as in male, with dimensions as in Table 2.

Legs : morphology and chaetotaxy as in male, measurements given in Table 2.

— Deutonymph (from Station 576I)

Body soft and round, 380 μm in length and 313 μm in width.

Dorsum (Fig. 2i) with dorsal plate 205 μm long and 152 μm maximal width and two pairs of small platelets of which anterior is 55 μm long and posterior 98 μm .

Venter (Fig. 2l). Capitular bay 78 μm long and 66 μm wide, coxal plates 260 μm in length, suture line of coxae II + III not completely fused medially, 65 μm long. Provisional genital field 45 μm long and 52 μm wide, with two pairs of genital acetabula. Palps (Fig. 2m) : P-II and P-III slender, bearing well developed and toothed ventral projections, P-IV with characteristic medial tubercle. Dorsal lengths of segments as follows : P-I 14 μm , P-II 62 μm , P-III 48 μm , P-IV 72 μm and P-V 14 μm .

Remarks

The characteristic medial tubercle on P-IV is also found in two other hyporheobiont species of *Torrenticola*, *T. jean-neli* Motas and Orghidan and *T. ramigera* Szalay. The shape of the ventral projection on P-II and P-III appears to represent a synapomorphy shared with *T. ramigera*. These two species are compared in Table 3 on the basis of morphological indices previously used to discriminate Italian species of the genus (Cicolani & Di Sabatino 1990).

Table 3. Comparison of morphological indices between *T. hyporheica* n.sp. and *T. ramigera*. (A = ratio width/length of dorsal shield ; B = ratio medial length coxae II + III/total length coxae I ; C = ratio width/length of genital field ; D = ratio dorsal length P-II/P-IV ; E = ratio distance genital field terminal end of body/ventral length. All indices expressed as percentages).

Tableau 3. Comparaison des indices morphologiques de *T. hyporheica* n.sp. et *T. ramigera*. (A = rapport largeur/longueur du bouclier dorsal ; B = rapport largeur/longueur du champ génital ; D = rapport longueur dorsale P-II/P-IV ; E = rapport de la distance du champ génital à l'extrémité terminale du corps/longueur ventrale. Tous les indices sont exprimés en pourcentages).

Morph. indices	<i>T. hyporheica</i>		<i>T. ramigera</i>			
	♂	♀	♀	♂	♀	
		Types	Szalay, 1947	Angelier, 1950		
A	70.1	66.7	61.7	63.2	61.2	
B	32.8	25.1	24.9	19.5	13.1	
C	81.4	85.9	83.8	80.3	82.4	
D	83.5	89.2	88.6	96.5	—	
E	25.1	22.8	35.1	27.9	31.2	

Based on measurements of *T. ramigera* reported by Szalay (1947), they appear to differ in the length and width of the body (index A), the lengths of the palpal segments and the size of the postgenital area (index E). These differences seem to be confirmed by the measurements of *T. ramigera* given by Angelier (1950) in the original description of the male (Table 3). It should be noted that slide-mounted specimens from Corsica in the Viets collection, labelled as « *T. ramigera* -S.M.F. 8016- Angelier 2195 » exhibit a different and unique morphology of the ventral projection on P-II and P-III. Moreover, the medial tubercle on P-IV is located anterior to the ventral tubercle. These differences suggest that the specimens described by Angelier may belong to another species which seems more similar to *T. jeanneli* than *T. ramigera*.

The new species can be distinguished from *T. ramigera* by the extreme reduction of the ocular pigment, the less elongated bodyshape, the smaller post-genital area and the ventral projection on P-II being larger and in the form of a thin toothed lamina (Fig. 2c) rather than a cone.

Torrenticola lativalvata Viets 1952

Stations : Peloritani 593I (2/0/0). Sicani 472I (0/1/3). 473I (0/1/1). Iblei 534I (6/4/0), 551I (3/3/0), 552I (1/1/0), 553I (24/22/8).

It is the most abundant species in the superficial waters of Sicily (Di Sabatino et al. 1992). Adults are capable of migrating to the hyporheic habitat during periods of drought and strong reduction of flow. These conditions are particularly typical of habitats in the Iblei Mountains where 90 percent of the specimens of *T. lativalvata* were collected.

Torrenticola cf. lusitanica (Lundblad 1941)

Stations : Nebrodi 569I (1/0/1), Madonie 512I (1/0/0). Iblei 552I (0/1/0). NW-Mountains 493I (3/6/0).

The species inhabits superficial waters throughout the island, and occurs only occasionally in the hyporheic habitat.

Torrenticola stadleri (Walter 1924)

Stations : Nebrodi 11381 (0/0/1) ; Madonie 511I (1/2/0).

The species was occasionally collected in two sites in Nebrodi and Madonie. Interestingly, in Corsica, it was one of the two Torrenticolid-species (with *T. andrei*) found to be relatively abundant in interstitial waters (Angelier 1953).

Torrenticola trinacriae Di Sabatino & Cicolani 1990

Stations : Peloritani 573I (1/0/0). Nebrodi 569I (1/1/0). Madonie 510I (2/0/1). Sicani 472I (1/0/1). Iblei 534I (0/1/0). NW-Mountains 493I (3/6/0).

The species was recently described from Sicily, and was collected in both superficial and interstitial waters throughout the island. The morphological features of *T. trinacriae* and its relative abundance in interstitial waters, seem to indicate that the species is hyporheophilic.

Torrenticola ungeri (Szalay 1927)

Stations : Peloritani 593I (1/0/0).

Only one male of this hyporheobiontic species (Schwoerbel 1986) was found in hyporheic waters. On the contrary, it was well distributed in superficial waters of the island. Both in Corsica (Angelier 1953, 1954). Spain (Lundblad 1956) and Southern Italy (Cicolani & Di Sabatino 1990), *T. ungeri* appears to be mainly confined to superficial habitats.

Genus *Pseudotorrenticola* Walter 1906

Pseudotorrenticola rhynchota Walter 1906

Stations : Iblei 534I (0/1/0), 544I (0/1/0), 551I (1/2/2), 553I (0/1/0).

This species has frequently been found in the interstitial habitat of European running waters (Schwoerbel 1986). In Sicilian groundwaters, it was collected only in the Iblei Mountains.

5. Discussion

Ten of 11 Torrenticolid-species collected in 18 interstitial sampling sites were also found in superficial waters on Sicily. Only the new species *T. hyporheica* appears restricted to hyporheic habitat and has morphological specializations for subterranean living. Four other species, *T. meridionalis*, *T. elliptica*, *T. algeriensis* and *T. crenobia*, were collected in Sicilian surface waters but have not been sampled in groundwater (Table 4, Fig. 3). The most abundant species in interstitial habitats was *T. laticlavata*, followed by *T. hyporheica* and *T. trinacriae*.

As mentioned above, only *T. hyporheica* n.sp. is strictly hyporheobiontic. *T. laticlavata* is the most euryecious species inhabiting all types of Sicilian running waters and springs (Di Sabatino et al. 1992).

The species, along with *T. trinacriae* and *P. rhynchota*, can be considered as hyporheophilic. *Torrenticola anomala*, *T. barsica*, *T. brevirostris* and *T. stadleri* are typical of superficial waters and occur only occasionally in the hyporheic zone.

The high number of species of *Torrenticola* found in Sicilian groundwaters probably reflects the capability of these mites to invade the hyporheic zone opportunistically during periods of reduced flow. The mobility of deutonymphs and adults between interstitial and superficial waters is undoubtedly facilitated by their well sclerotized and flattened bodies (Angelier 1962, Cook 1969, Schwoerbel 1964, Petrova 1984).

The hydrogeological characteristics of Sicily also must play a key role by favouring the colonization of subterranean environment. The majority of Sicilian running waters are characterized by extreme instability (variation of flow, periods of drought, high temperature and salinity) and the continuity (spatial and temporal) of aquatic ecosystems depends upon access to groundwater.

The presence in superficial waters of Sicily and other Mediterranean regions of species such as *T. andrei*, *T. madritensis*, *T. ungeri* that are considered as strictly hyporheobiontic in the Alps and

Table 4. Presence and abundance of water mite species of the family Torrenticolidae in superficial and interstitial waters of Sicily.
Tableau 4. Présence et abondance des espèces d'Hydracariens de la famille des Torrenticolidae dans les eaux superficielles et interstitielles de Sicile.

species	superficial		interstitial	
	n	%	n	%
<i>T.algeriensis</i>	14	0.93	0	-
<i>T.andrei</i>	4	0.27	5	3.13
<i>T.anomala</i>	20	1.33	2	1.25
<i>T.barsica</i>	403	26.8	6	3.75
<i>T.brevirostris</i>	237	15.8	3	1.88
<i>T.crenobia</i>	89	5.93	0	-
<i>T.elliptica</i>	11	0.73	0	-
<i>T.hyporheica</i>	1	0.07	20	12.5
<i>T.laticlavata</i>	454	30.2	80	50.0
<i>T.lusitanica cfr</i>	43	2.86	13	8.13
<i>T.meridionalis</i>	8	0.53	0	-
<i>T.stadleri</i>	88	5.86	4	2.5
<i>T.trinacriae</i>	36	2.4	18	11.3
<i>T.ungeri</i>	72	4.79	1	0.63
<i>P.rhynchota</i>	22	1.46	8	5.0
Total	1502	100	160	100

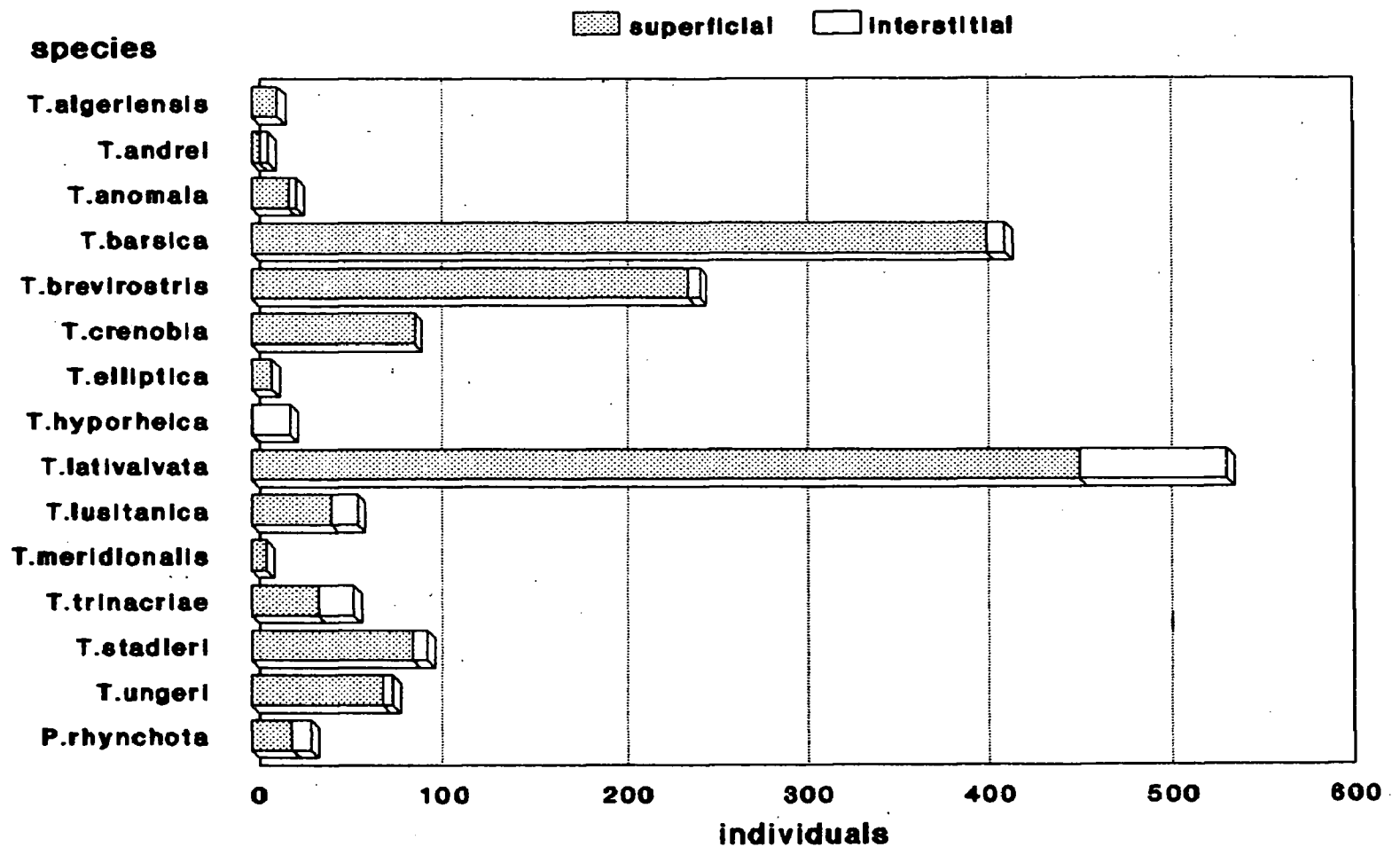


Fig. 3. Abundance of Torrenticolid-species in samples from superficial and interstitial waters of Sicily.

Fig. 3. Abondance des espèces de Torrenticolidae capturées dans les eaux superficielles et interstitielles de Sicile.

Central Europe (Schwoerbel 1962b, 1986) could be related to the diverse impacts of quaternary glaciations in these areas. Also ecological factors such as stream fluctuations and instability of aquatic ecosystems may reduce the effects of interspecific competition in the superficial habitat, and could explain increased vertical migration in streams in the Mediterranean region (Cicolani & Di Sabatino 1990).

A preliminary comparison with Corsica, the only well investigated Mediterranean island (Angelier 1953, 1954, Santucci 1970, 1971, 1977, Viets 1954), shows strong faunistic differences. In Corsica, only four of the 13 reported species of *Torrenticolidae* are present in groundwaters (Table 5). Eight species are common to Corsica and Sicily. Four of these (*T. anomala*, *T. stadleri*, *T. brevirostris* and *P. rhynchota*) are widely distributed in the Palearctic and the rest (*T. andrei*, *T. barsica*, *T. lativalvata* and *T. ungeri*) inhabit the whole Mediterranean region and western-Europe.

The Sicilian fauna closely resembles that of southern Italy (Cicolani & Di Sabatino 1990) with 9 species in common, 2 of which (to date) are limited to this area.

Table 5. Species of the family *Torrenticolidae* found in interstitial and superficial waters of Corsica and Sicily. (- = absent; O = sampled only in superficial waters; + = sampled only in interstitial waters; ⊕ = sampled in both habitats).

Tableau 5. Espèces de *Torrenticolidae* trouvées dans les eaux interstitielles et superficielles de Corse et de Sicile. (- = absence; O = présence seulement dans les eaux superficielles; + = présence seulement dans les eaux interstitielles; ⊕ = présence dans les deux habitats).

species	CORSICA	SICILY
<i>T.algeriensis</i>	-	O
<i>T.andrei</i>	⊕	⊕
<i>T.anomala</i>	O	⊕
<i>T.barsica</i>	O	⊕
<i>T.brevirostris</i>	O	⊕
<i>T.cavifrons</i>	O	-
<i>T.crenobia</i>	-	O
<i>T.elliptica</i>	-	O
<i>T.hyporheica</i>	-	+
<i>T.lativalvata</i>	O	⊕
<i>T.lusitanica cfr</i>	-	⊕
<i>T.minutirostris</i>	O	-
<i>T.meridionalis</i>	-	O
<i>T.ramigera ?</i>	⊕	-
<i>T.remy</i>	O	-
<i>T.stadleri</i>	⊕	⊕
<i>T.trinacriae</i>	-	⊕
<i>T.ungeri</i>	O	⊕
<i>P.rhynchota</i>	⊕	⊕

Further research in the Mediterranean area will be needed to allow correct zoogeographic interpretation of these results.

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