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MOSQUITOES (DIPTERA CULICIDAE) OF FRIULI VENEZIA GIULIA (NORTH-EASTERN ITALY): ANNOTATED CHECKLIST, GEOGRAPHIC DISTRIBUTION AND HABITATS OF PRE-IMAGINAL STAGES

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Zamburlini R., Cargnus E., Zandigiacomo P. − Mosquitoes (Diptera Culicidae) of Friuli Venezia Giulia (north-eastern Italy): annotated Checklist, geographic distribution and habitats of pre-imaginal stages.

The updated Checklist of the Diptera Culicidae recorded in Friuli Venezia Giulia (north-eastern Italy) is reported. In addition to already published data since 1920s, recent and original data are provided. The list includes a total of 37 mosquito species (out of 66 species known for Italy) of which 31 currently present. The occurrence of *Anopheles hyrcanus, Culex martinii, Culiseta subochrea* and *Uranotaenia unguiculata* needs to be confirmed; *Ae. dorsalis* is of uncertain identification; *An. sacharovi,* the main past malaria vector, is presumably locally extinct. The list includes three exotic species, *Aedes albopictus* widespread in plain and hilly urban areas, *Ae. japonicus* and *Ae. koreicus*, both recently detected in some hilly and mountain areas. Data on the geographic distribution in the region and on the ecology of the pre-imaginal stages are provided. Many of the recorded species are of health concern as potential vectors of pathogens. Further studies, conducted mainly in the less investigated mountain areas, will probably enrich the regional mosquito fauna.

KEY WORDS: larval habitat, vectors, exotic species, biodiversity.

INTRODUCTION

The family of Culicidae (Diptera) comprises more than 3550 species distributed worldwide (HARBACH, 2016) of which about a hundred occur in Europe (BECKER *et al*., 2010; Schaffner F., pers. comm.). The Italian inventory of Culicidae is currently composed of 66 species (SEVERINI *et al*., 2009; CAPELLI *et al*., 2011; SEIDEL *et al*., 2016).

First investigations on Culicidae of the Friuli Venezia Giulia region (FVG) (north-eastern Italy) were carried out in the early decades of 1900 by the "Istituto Interprovinciale per la Lotta Antimalarica nelle Venezie" (Interprovincial Institute for the Fight against Malaria in the Venetian regions) on malaria vectors when the Adriatic Sea coastal area was affected by endemic malaria.

From 1927 to 1939 five species, at that time considered as different "races" of *Anopheles maculipennis* Meigen, were identified: *An. sacharovi* Favr (sub *An. elutus* Edwards, 1921), which was the main malaria vector, *An. atroparvus* Van Thiel*, An. maculipennis* (named "*typicus"*), *An. messeae* Falleroni and *An. claviger* (Meigen) [sub *An. bifurcatus* (Linnaeus, 1758)] (DE FAVERI, 1939; SEPULCRI, 1963). In the same period, within a study on the aquatic fauna of the Timavo River mouth (Trieste district), eight species were recognized: *An. maculipennis, Aedes caspius* (Pallas), *Ae. dorsalis* (Meigen) (mentioned as doubtful by the Author), *Ae. vexans* (Meigen), *Culex modestus* Ficalbi, *Cx. pipiens* Linnaeus, *Cx. territans* Walker (sub *Cx. apicalis* Adams, 1903) and *Coquillettidia richiardii* (Ficalbi) (sub *Mansonia richiardii*) (STAMMER, 1932).

Malaria was eradicated in the late 1940s mainly through extended reclamations of the brackish swamps which were the breeding habitat of the primary malaria vector *An. sacharovi* (SEPULCRI, 1963; ZAMBURLINI, 2000).

Investigations conducted in the northern Adriatic littoral area during 1950s and 1960s, a period of further strong reduction of natural habitats caused by increasing urbanization and agriculture expansion, showed the disappearance of *An. sacharovi* together with the persistence of the other previously recorded species of the *An. maculipennis* complex (SEPULCRI, 1963). During this time, renewed attention was paid to mosquito fauna mainly because of its economic impact on expanding tourism activities along the Adriatic coast. In this respect, in FVG 11 species were recorded: *Ae. caspius, Ae. cinereus* Meigen*, Ae. detritus* (Haliday)*, Ae. vexans, Cx. modestus, Cx. pipiens, Cx. territans, Cx. theileri* Theobald*, Culiseta annulata* (Schrank)*, Cs. morsitans* (Theobald) and *Cs. subochrea* (Edwards) (DECHIGI *et al*., 1967).

Starting from 1980s 10 more species were firstly detected in FVG: *An. hyrcanus* (Pallas), *An. plumbeus* Stephens, *Ae. cantans* Meigen, *Ae. geniculatus* (Olivier), *Ae. pullatus* (Coquillett)*, Ae. sticticus* (Meigen), *Cx. hortensis* (Ficalbi) and *Uranotaenia unguiculata* Edwards (ZAMBURLINI, 1996b), and *Ae. cataphylla* Dyar and *Ae. communis* (De Geer) (CARGNUS & ZAMBURLINI, 1999). Moreover, two records were the first for the whole Italian mosquito fauna: *Ae. annulipes* (Meigen) (ZAMBURLINI, 1996a) and *Ae. geminus* Peus (ZAMBURLINI & CARGNUS, 1998a).

Regarding the *An. maculipennis* complex, the absence of *An. sacharovi* in the coastal area was confirmed (ZAMBURLINI & CARGNUS, 1998b). In addition, a morphological study on the regional populations of *An. claviger* complex allowed to assign all individuals examined to the nominal species (ZAMBURLINI & CARGNUS, 1998c).

In 1995 the exotic *Ae. albopictus* (Skuse), or Asian tiger mosquito, was detected (ZAMBURLINI, 1995) and soon it became the most widespread and annoying mosquito

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throughout plain and hilly urban areas of the region (ZAMBURLINI & FRILLI, 2006).

From 2000s, the known composition of the regional mosquito fauna was not only confirmed (ZAMBURLINI & CARGNUS, 2009; TOMA *et al*., 2013; MANCINI *et al*., 2017) but also increased with some new records, such as the three native species *Ae. punctor* Kirby (ZAMBURLINI & CARGNUS, 2009), *Cx. impudicus* Ficalbi and *Cx. martinii* Medschid (TOMA *et al*., 2013), and the two exotic species *Ae. koreicus* (Edwards) (MONTARSI *et al*., 2015; ZAMBURLINI & CARGNUS, 2015), presumably introduced from the adjacent Veneto region where it was first detected (CAPELLI *et al*., 2011), and *Ae. japonicus* (Theobald) (SEIDEL *et al*., 2016).

The aim of this paper is to update the Checklist of the Culicidae of the FVG region, gathering all available data since the 1920s to 2017, and to provide information on the mosquito geographic distribution and pre-imaginal ecology, useful for conservation and medical purposes.

MATERIALS AND METHODS

STUDY AREA

The FVG region (7845 km²) from north to south comprises mountains (Carnic and Julian Pre-Alps and Alps), plains (Friulian plains and Morainic hills), sloping towards the northern Adriatic Sea coast, and the Karst plateau in the South-East. FVG has a moderately humid continental climate with a wide variability across the territory. The annual average temperature ranges from a minimum of 2.9 °C in the mountains to 14.5-15.5 °C along the coast. Annual average rainfall varies from 900 mm in the coast to 1200-1800 mm in the plain, hilly and mountain areas, and up to 3200 mm in some portions of the Julian Pre-Alps, with most rainfall occurring during the late spring and autumn (ARPA FVG - OSMER, 2014). For its climate and geomorphology, the region has a rich variety of aquatic ecosystems and a large array of natural and artificial stagnant water bodies where the immature stages of mosquitoes can find suitable development habitats.

COLLECTION OF MOSQUITOES

Mosquito collections have been carried out in numerous sites distributed in the four districts of FVG (Pordenone, PN; Udine, UD; Gorizia, GO; Trieste, TS) (Table 1). Sites N. 1-83 were visited from 1983 to 2017 by the Authors of this paper (original and/or already published data), while data related to sites N. 84-88 are taken from literature. The sites were included in six ecosystems, five natural and one urbanized, representative of the environmental diversity of the study territory (Table 2). The site with rice fields was located a few kilometers beyond the regional border in the adjacent Veneto region (N. 83, Bibione, Venezia district, VE). For the urban areas data were reported only for a few sites representative of the whole study territory.

Larvae and pupae were collected by a standard dipper in different types of stagnant water bodies. Eggs of *Ae. albopictus* were sampled by means of ovitraps (ZAMBURLINI & FRILLI, 2006). Adults were caught by a manual electric aspirator. Gravid females of the *An. maculipennis* complex were captured in cattle farms located only in former malarial areas of the low Friulian plains.

SPECIES IDENTIFICATION AND NOMENCLATURE

The species identification of individuals, preserved in 70% ethanol (larvae and pupae), dried (adults) or slide mounted in Faure's liquid (4^{th}-5^{th} instar larvae, male genitalia), was undertaken by morphological criteria based on the keys of GUTSEVICH *et al.* (1974), TANAKA *et al*. (1979), ROMI *et al*. (1997), SEVERINI *et al*. (2009) and BECKER *et al*. (2010). The larvae and pupae of *An. maculipennis* complex, morphologically not identifiable to species level, were indicated as *An. maculipennis* s.l. The collected females of *An. maculipennis* complex were individually identified to species after laying eggs in laboratory, on the basis of the egg colour pattern as described by ANGELUCCI (1955). For some species, collected immatures were reared in laboratory up to the adult stage in order to observe the diagnostic characters. Most of the material studied by the Authors of this paper is stored in the Culicidae collection of the Department of Agricultural, Food, Environmental and Animal Science - Entomology, by the University of Udine (Italy).

The nomenclature adopted in this paper follows those of KNIGHT & STONE (1977), KNIGHT (1978) and WARD (1984, 1992), while for the tribe Aedini the genera and subgenera refer to WILKERSON *et al*. (2015).

RESULTS AND DISCUSSION

RECORDED SPECIES

The updated Checklist of Culicidae of FVG comprises 37 species belonging to six genera. Thirty-two species were collected by the Authors of this paper (of which 22 were already recorded by other Authors) and other five (*An. sacharovi*, *Ae. dorsalis*, *Cx. impudicus*, *Cx. martinii* and *Cs. subochrea*) were collected by other Authors and reported in literature (Table 3). Presently, the occurrence of 31 species is to be considered as certain. It remains to confirm the occurrence of four species, up today singly reported: *An. hyrcanus* and *U. unguiculata* [mentioned in ZAMBURLINI (1995)] both detected only as larvae, and *Cs. subochrea* (DECHIGI *et al*., 1967) and *Cx. martinii* Medschid both observed as single adult, the latter as a female (TOMA *et al*., 2013; L. TOMA pers. comm.). In addition, the presence of *Ae. dorsalis* is to be confirmed as the identity of the collected larvae was mentioned as doubtful by the Author being they difficult to distinguish from those of *Ae. caspiu*s (STAMMER, 1932). Finally, the malaria vector *An. sacharovi* is to be considered as locally extinct because it has never been observed since the late 1940s (SEPULCRI, 1963; ZAMBURLINI & CARGNUS, 1998b).

SPECIES IDENTIFICATION

Among the 32 species collected by the Authors of this paper, 24 were identified both as immatures and adults, four species only as larvae (*Ae. detritus, An. hyrcanus, Cx. theileri* and *U. unguiculata*), three species of the *An. maculipennis* complex on the basis of egg features (*An. atroparvus, An. maculipennis* s.s. and *An. messeae*) and one species (*Cq. richiardii*) only as adult females.

GEOGRAPHIC DISTRIBUTION OF SPECIES IN FVG

Most of the taxa (30) are reported from the northern Adriatic Sea coast and Friulian plains (sites between 0-280 m a.s.l.) (urban areas excluded) (Table 3 and Table 4 in Supplementary material). In particular, *Ae. caspius*, *Ae. detritus*, *An. hyrcanus* and *U. unguiculata* have been detected only in sites placed at lower elevations (0-3 m a.s.l.), as well as the three identified species of the *An. maculipennis* complex: *An. atroparvus*, *An. maculipennis* s.s. and *An. messeae*. Moreover, the five species not collected by the Authors of this paper, i.e. *Cx. impudicus* and

Table 1 – Sites of collection of Culicidae in Friuli Venezia Giulia (north-eastern Italy). The sites indicated in bold (N. 84-89) refer to species not collected by the Authors of this paper but reported in literature. One site (N. 83) is from the nearby Veneto region.

Site N.	Municipality (District acronym)	Site of collection	Coordinates	Altitude m a.s.l.
1	Aviano (PN)	Cimitery of Marsure	46°05’28.56”N, 12°35’32.17”E	226
2	Chions (PN)	Bosco di Torrate	45°53’37.28”N, 12°48’01.64”E	26
3	Cordenons (PN)	Risorgive fiume Meduna	45°58’46.61”N, 12°42’17.66”E	35
4	Montereale Valcellina (PN)	Cimitery	46°09’59.20”N, 12°39’39.12”E	331
5	Morsano al Tagliamento (PN)	Bosco di golena del Torreano	45°51’39.11”N, 12°58’18.53”E	10
6	Polcenigo (PN)	Risorgive fiume Livenza - Santissima	46°01’17.56”N, 12°28’43.53”E	30
7	Pravisdomini (PN)	Palude di Barco	45°49’34.87”N, 12°40’05.20”E	4
8	San Vito al Tagliamento (PN)	Grave fiume Tagliamento, loc. Rosa	45°55’25.78”N, 12°54’32.52”E	12
9	San Vito al Tagliamento (PN)	Urban area	45°55’04.73”N, 12°51’26.26”E	32
10	Sequals (PN)	Torbiera	46°10’34.74”N, 12°51’35.33”E	207
11	Valvasone (PN)	Grave fiume Tagliamento	46°00’42.70”N, 12°54’25.98”E	68
12	Amaro (UD)	Urban area	46°22’22.57”N, 13°05’32.19”E	295
13	Ampezzo (UD)	Palude di Cima Corso	46°23’43.76”N, 12°44’40.56”E	850
14	Aquileia (UD)	Bonifica IV Partita	45°46’05.40”N, 13°21’39.40”E	2
15	Attimis (UD)	Area umida ex polveriera Racchiuso	46°09’54.30”N, 13°19’42.49”E	180
16	Carlino (UD)	Bosco Bolderatis	45°47’15.10”N, 13°12’27.50”E	5
17	Carlino (UD)	Bosco Sacile	45°47’23.49”N, 13°11’11.09”E	5
18	Carlino (UD)	Valle Zellina, strada Chiamana	45°47’44.08”N, 13°11’48.41”E	1
19	Cassacco (UD)	Torbiera Chichinot, Raspano	46°12’04.55”N, 13°10’30.26”E	196
20	Castions di Strada (UD)	Bosco Boscat	45°50’00.19”N, 13°10’02.99”E	20
21	Castions di Strada (UD)	Palude Moretto	45°53’48.60”N, 13°09’42.06”E	19
22	Castions di Strada (UD)	Palude Selvote	45°53’12.58”N, 13°11’33.99”E	15
23	Cavazzo Carnico (UD)	Palude Vuarbis	46°21’30.62”N, 13°03’06.71”E	278
24	Cervignano del Friuli (UD)	Bosco Pradiziolo	45°49’18.95”N, 13°18’52.89”E	19
25	Fagagna (UD)	Prati umidi Quadris	46°08’04.88”N, 13°04’27.25”E	172
26	Forni di Sopra (UD)	Urban area	46°25’18.54”N, 12°34’57.18”E	907
27	Forni di Sotto (UD)	Urban area	46°23’33.62”N, 12°40’10.90”E	751
28	Lignano Sabbiadoro (UD)	Valle del Pantanel	45°41’13.26”N, 13°06’05.05”E	0
29	Lignano Sabbiadoro (UD)	Valle via Tagliamento	45°42’55.60”N, 13°04’21.32”E	1
30	Lignano Sabbiadoro (UD)	Urban area	45°40’06.80”N, 13°06’14.71”E	3
31	Lignano Sabbiadoro (UD)	Crop fields	45°39’51.15”N, 13°05’57.99”E	3
32	Majano (UD)	Torbiera di Casasola	46°11’44.05”N, 13°04’35.66”E	162
33	Marano Lagunare (UD)	Le Favole	45°46’32.31”N, 13°08’59.15”E	1
34	Marano Lagunare (UD)	Isola di Sant’Andrea	45°42’51.63”N, 13°12’59.57”E	0
35	Moruzzo (UD)	Torbiera Borgo Pegoraro	46°07’31.53”N, 13°06’53.32”E	186
36	Muzzana del Turgnano (UD)	Bosco Baredi - Selva di Arvonchi	45°47’22.34”N, 13°07’00.34”E	10
37	Muzzana del Turgnano (UD)	Bosco Coda di Manin	45°47’59.59”N, 13°08’41.21”E	10
38	Osoppo (UD)	Risorgive dei Bars	46°13’37.62”N, 13°02’47.37”E	150
39	Pagnacco (UD)	Torbiera di Lazzacco	46°07’56.38”N, 13°09’35.77”E	189
40	Palazzo Stella (UD)	Casali Marianis	45°46’14.43”N, 13°05’34.73”E	0
41	Paluzza (UD)	Pal Piccolo	46°36’02.00”N, 12°57’00.00”E	1613
42	Paluzza (UD)	Torbiera Val Pudia	46°32’12.36”N, 13°01’32.34”E	760
43	Paluzza (UD)	Torre Moscarda	46°33’17.30”N, 13°00’57.07”E	815
44	Paularo (UD)	Torbiera Zuc Guardia, Cason Lanza	46°33’43.28”N, 13°10’18.24”E	1570
45	Pontebba (UD)	Urban area	46°30’20.34”N, 13°18’07.34”E	589
46	Precenicco (UD)	Bosco Bando	45°46’45.05”N, 13°03’46.40”E	15
47	Precenicco (UD)	Titiano	45°44’41.71”N, 13°04’18.71”E	1
48	San Daniele del Friuli (UD)	Bosco di Soprapaludo	46°09’53.70”N, 13°01’49.30”E	151
49	San Daniele del Friuli (UD)	Urban area	46°09’27.17”N, 13°00’36.25”E	235
50	San Giorgio di Nogaro (UD)	Porto Nogaro	45°45’32.20”N, 13°14’24.54”E	1

(continued)

Continued Table 1

51	Talmassons - Bertiolo (UD)	Risorgive F. Stella, Flambro	45°55'48.53"N, 13°04'30.26"E	10
52	Tarvisio (UD)	Torbiera Scicchizza, Fusine in Valromana	46°29'28.67"N, 13°40'32.89"E	845
53	Timau (UD)	Bosco ripario torrente But, Muse	46°34'56.98"N, 13°00'03.31"E	840
54	Tolmezzo (UD)	Torbiera Curiedi, Fusea	46°25'33.47"N, 12°58'49.85"E	849
55	Torreano di Cividale (UD)	Cava di Togliano	46°07'25.21"N, 13°22'43.61"E	125
56	Torviscosa (UD)	Bosco Ronchi di Sass	45°48'23.39"N, 13°14'22.99"E	10
57	Varmo (UD)	Grave fiume Tagliamento, Madrisio	45°51'59.45"N, 12°58'27.12"E	11
58	Grado (GO)	Boscat	45°43'49.97"N, 13°25'25.07"E	1
59	Grado (GO)	Bosco "la Rotta"	45°41'26.25"N, 13°26'49.64"E	1
60	Grado (GO)	Fossalon di Grado	45°43'44.63"N, 13°29'37.15"E	1
61	Grado (GO)	Punta Sdobba	45°43'31.60"N, 13°32'32.81"E	0
62	Grado (GO)	Valle Cavarera	45°41'21.83"N, 13°25'20.07"E	1
63	Monfalcone (GO)	Marina Julia	45°46'47.37"N, 13°31'59.34"E	0
64	Monfalcone (GO)	Palude Sablici	45°48'30.20"N, 13°33'59.05"E	15
65	Pieris (GO)	Grave fiume Isonzo	45°48'47.99"N, 13°25'46.04"E	5
66	Ronchi dei Legionari (GO)	Stagni di Selz, Mucille	45°49'18.67"N, 13°31'30.43"E	13
67	San Floriano del Collio (GO)	Palude di Preval	45°57'42.66"N, 13°31'39.51"E	59
68	San Floriano del Collio (GO)	Urban area	45°58'56.64"N, 13°35'14.82"E	262
69	Staranzano (GO)	Isola della Cona	45°43'48.56"N, 13°33'14.60"E	0
70	Versa (GO)	Grave fiume Judrio	45°53'54.98"N, 13°25'24.33"E	25
71	Duino Aurisina (TS)	Stagno di Slivia N. 34	45°46'20.01"N, 13°39'39.09"E	125
72	Duino Aurisina (TS)	Villaggio del Pescatore	45°46'41.90"N, 13°34'38.55"E	1
73	Monrupino (TS)	Campi solcati Colognatti	45°42'10.66"N, 13°48'34.18"E	308
74	Monrupino (TS)	Stagno Zolla di Monrupino, N. 50	45°43'01.10"N, 13°48'03.00"E	367
75	Monrupino (TS)	Stagno di Rupingrande N. 7	45°43'14.40"N, 13°47'03.60"E	292
76	Opicina (TS)	Cisterna romana, Ovcjak, N. 44	45°42'05.92"N, 13°47'38.11"E	271
77	Opicina (TS)	Stagno di Percedol, N. 103	45°42'19.71"N, 13°48'12.26"E	270
78	Sgonico (TS)	Campi solcati Borgo Grotta Gigante	45°42'26.35"N, 13°45'29.79"E	256
79	Sgonico (TS)	Stagno di Sagrado, N. 46	45°43'34.10"N, 13°46'20.00"E	343
80	Sgonico (TS)	Urban area	45°44'12.39"N, 13°44'56.43"E	275
81	Trieste	Urban area (Querceto di Bovedo)	45°40'39.92"N, 13°45'45.62"E	99
82	Trieste	Stagno di Conconello, N. 26	45°40'23.10"N, 13°47'51.19"E	412
83	Bibione (VE)	Risaie IV Bacino	45°39'37.46"N, 13°01'55.70"E	1
84	**Aquileia (UD)**	**Not reported**	**Not reported**	**2**
85	**Marano Lagunare (UD), Grado (GO)**	**Laguna di Grado e Marano, Riserva Caneo**	**Not reported**	**0-1**
86	**Grado (GO)**	**Grado Pineta**	**Not reported**	**1**
87	**Duino Aurisina (TS)**	**Foci del Timavo**	**Not reported**	**2**
88	**Coastal municipalities (UD, GO, TS)**	**Coast and plains**	**Not reported**	**0-2**

Cx. martinii (Toma *et al*., 2013), *Ae. dorsalis* (Stammer, 1932), *Cs. subochrea* (Dechigi *et al*., 1967) and *An. sacharovi* (Sepulcri, 1963), were all reported from coastal and plain sites as well.

In the Carnic and Julian Pre-Alps and Alps (sites between 760-1613 m a.s.l.) seven species were recorded and three of them, the more microterm *Ae. communis*, *Ae. pullatus* and *Ae. punctor*, only in mountain areas (Table 3 and Table 4 in Supplementary material).

In the Karst plateau (sites between 125-412 m a.s.l.) a total of 10 species were sampled (Table 3).

In urban areas of all the region (sites between 0-900 m a.s.l.), a total of 12 species were found, but only four taxa, *Ae. koreicus, Ae. japonicus, An. maculipennis* s.l. and *Cx. pipiens,* were collected over 330 m a.s.l. (Table 3). The exotic *Ae. albopictus* and the native *Cx. pipiens* constantly occurred but the establishment of *Ae. albopictus* was restricted to plain and hilly areas up to an altitude of 350 m a.s.l., as no larvae and eggs were found in breeding sites of Pre-Alps and Alps. The presence of *Ae. koreicus* and *Ae. japonicus,* more resistant to cold temperatures than *Ae. albopictus* (Tanaka *et al*., 1979), resulted still restricted to the hilly and mountain areas where they were firstly detected (Montarsi *et al*., 2015; Zamburlini & Cargnus, 2015; Seidel *et al*., 2016).

Ecosystems and habitats of pre-imaginal stages

Immature stages of 29 taxa (28 species plus the larvae of *An. maculipennis* s.l.) have been collected in a rich variety of stagnant water habitats included in the six major ecosystems identified on the regional territory (Table 2 and Table 4 in Supplementary material).

Table 2 – Habitats of pre-imaginal stages of Culicidae collected in Friuli Venezia Giulia (north-eastern Italy).

Geographic distribution	Ecosystem	Habitat of pre-imaginal stages
Northern Adriatic Sea coast	**1.** Coastal brackish marshes	**1a.** Temporary pools in halophytic marshes
		1b. Permanent brackish ponds and swamps
Friulian plains and Morainic hills 0–280 m a.s.l.	**2.** Wet woodlands and flooded shaded meadows	**2a.** Semi-permanent ponds and marshes
		2b. Permanent shaded ponds
		2c. Temporary freshwater pools
		2d. Tree-holes water-filled
	3. Crops	**3a.** Rice flooded parcels
		3b. Crop drains
Carnic and Julian Pre-Alps and Alps (mountains) 760–1620 m a.s.l.	**4.** Wet forests and marshes	**4a.** Pools in mixed deciduous woodlands
		4b. Flooded meadows and marshes. Snow melt pools
Karst plateau 120–420 m a.s.l.	**5.** Karst woods and marshes	**5a**. Shaded semi-permanent and permanent ponds and artificial containers
		5b. Tree-holes and rock-holes water-filled
Whole region 0–910 m a.s.l.	**6.** Urban areas	**6a.** Natural and artificial small containers of eutrophic water
		6b. Shaded containers filled with clear rainwater
		6c. Polluted water ditches

Northern Adriatic Sea coast

1. Coastal brackish marshes

1a. Temporary pools located within halophytic marshes, characterized mainly by *Salicornia* sp. and *Juncus* sp. (8 sites), were the main habitat of the constantly sampled *Ae. caspius* (8 sites) associated with the rare *Ae. detritus* (2 sites) (Table 4 in Supplementary material). Based on literature data, *Ae. dorsalis* shared this habitat with *Ae. caspius* (Stammer, 1932).

1b. Permanent brackish ponds and swamps (salinity below 2%) in the past were the main pre-imaginal habitat of *An. sacharovi* (De Faveri, 1939) (Table 4 in Supplementary material). This type of habitat has been greatly reduced by land reclamations and this species is currently absent (Zamburlini & Cargnus, 1998c).

Friulian plains and Morainic hills

2. Wet woodlands and flooded shaded meadows

2a. Semi-permanent ponds and marshes, placed along springs, river meanders or dismissed quarries, often characterized by the occurrence of *Populo-salicetum* and *Magnocariceton* vegetation; immature stages of a total of 9 species were collected (29 sites) (Table 4 in Supplementary material). *An. claviger* (27 sites), *Cs. morsitans* (21 sites), *Ae. annulipes* (21 sites), *Ae. cantans* (9 sites) and *Ae. cinereus* (9 sites), were the most frequent species, whereas *Ae. geminus*, *Ae. sticticus* and *Ae. vexans* were less common (4, 1 and 2 sites, respectively). Larvae of *An. hyrcanus* were collected in a semi-permanent pond at the edge of a grove; this record dates back to 1994 and, therefore, this species has to be considered as very rare so that its presence needs to be confirmed.

2b. In permanent shaded ponds, often covered by floating vegetation and by filamentous algae and surrounded by *Phragmites australis* and *Typha latifolia*, immature stages of seven mosquito species were found (13 sites) (Table 4 in Supplementary material). *An. maculipennis* s.l. (6 sites), *Cx. pipiens* and *Cx. territans* (4 sites, both) were the most frequent species, whereas *Cs. annulata* (2 sites) and *Cx. theileri* (1 site) were less frequent. *Cx. territans* was often found in pools rich in green algae situated along river streams. *U. unguiculata* was sampled in a freshwater pond within a *Phragmitetum* together with *An. maculipennis* s.l.. This record dates back to 1994 (Zamburlini, 1995) so the current presence of this species in FVG needs to be confirmed. Adults of *Cq. richiardii* were sampled near ponds (2 sites). Furthermore, *Cx. impudicus* and *Cx. martinii* (1 adult) (Toma *et al*., 2013), and *Cs. subochrea* (1 adult) (Dechigi *et al*., 1967) are reported from this type of habitat as well (Table 4 in Supplementary material).

2c. In temporary freshwater pools within *Querco-Carpinetum* woodlands situated in alluvial low plains, four mosquito species were collected in 10 sites (Table 4 in Supplementary material). Large numbers of larvae of *Ae. vexans* (10 sites) and *Ae. sticticus* (9 sites), more often in mixed populations, were found to exploit the springtime rainwater pools on thick leaf litter. Subsequent high densities of biting adults were observed in late springtime, causing strong annoyance to human activities in the woods and nearby areas. *Ae. annulipes* and *Ae. cinereus* were collected as well (1 and 2 sites respectively).

2d. In tree holes filled with rainwater, frequently in *Carpinus* sp. and *Fraxinus* sp. trees, larvae of *Ae. geniculatus* (all 12 sites) and *An. plumbeus* (8 sites) were collected (Table 4 in Supplementary material).

3. Crops

3a. In a single site with rice fields, five mosquito species were detected (Table 4 in Supplementary material). Intermittent cycles of flooding and drying up favoured the development, especially at the margins of the rice parcels, of *Ae. caspius* and of the less abundant *Ae. vexans*. Where the water persisted for a longer period, immatures of *An. maculipennis* s.l., *Cx. modestus* and *Cx. pipiens* were found well hidden within the superficial layer of filamentous algae.

3b. In field drains, where stagnant water is more persistent, *An. maculipennis* s.l. (2 sites) and *Cx. modestus* (1 site) were collected, whereas *Ae. caspius* developed in a temporary drain pools subjected to water level excursions (2 sites) (Table 4 in Supplementary material).

Table 3 – Checklist of 37 Culicidae species of Friuli Venezia Giulia (north-eastern Italy). Thirty-two species were recorded by the Authors of this paper from 1983 to 2017 (not in bold); five species were reported in literature from 1932 to 2017 (in bold). The asterisk (*) in the first column indicates a taxon not identified to species level. Two asterisks (**) in the second column indicate the 10 species recorded only by the Authors of this paper. Development stages are indicated as E = egg; L = larva; P = pupa; A = adult. Description of the types of habitat (1a- 6c) is reported in Table 2. – : no pre-imaginal stages collected.

N.	Species/taxon	Stage coll.	Year of collection	Habitat of pre-imaginal stages	References
1	*Anopheles* (*Anopheles*) *atroparvus* van Thiel, 1927	A	1994-1997	–	De Faveri, 1939; Sepulcri, 1963; Zamburlini & Cargnus, 1998b, 2009
2	*Anopheles* (*Anopheles*) *claviger* (Meigen, 1804)	LPA	1994-2015	2a, 6b	De Faveri, 1939; Sepulcri, 1963; Zamburlini, 1995; Zamburlini & Cargnus, 1998c, 2009; Mancini *et al*., 2017; this paper
3	*Anopheles* (*Anopheles*) *hyrcanus* (Pallas, 1771) (**)	L	1994	2a	Zamburlini, 1995 (current presence to be confirmed)
4	*Anopheles* (*Anopheles*) *maculipennis* s.s. Meigen, 1818	A	1994-1997	–	De Faveri, 1939; Sepulcri, 1963; Zamburlini, 1995; Zamburlini & Cargnus, 1998b, 2009
(*)	*Anopheles* (*Anopheles*) *maculipennis* s.l. Meigen	LP	1994-2015	2b, 3a, 3b, 5a, 6b	Stammer, 1932; Zamburlini & Cargnus, 1998b, Mancini *et al*., 2017; this paper
5	*Anopheles* (*Anopheles*) *messeae* Falleroni, 1926	A	1994-1997	–	De Faveri, 1939; Sepulcri, 1963; Zamburlini, 1995; Zamburlini & Cargnus, 1998b, 2009
6	*Anopheles* (*Anopheles*) *plumbeus* Stephens, 1828	LPA	1994-2015	2d, 6a	Zamburlini, 1995; Zamburlini & Cargnus, 2009; Mancini *et al*., 2017; this paper
7	***Anopheles sacharovi* Favr, 1903**	**ELPA**	**1920-1940s**	**1b**	De Faveri, 1939; Sepulcri, 1963 (to be considered extinct)
8	*Aedes* (*Stegomyia*) *albopictus* (Skuse, 1894)	ELPA	1995-2017	6a	Zamburlini, 1995; Zamburlini & Frilli, 2006; Zamburlini & Cargnus, 2009, 2015; Mancini *et al*., 2017; this paper
9	*Aedes* (*Ochlerotatus*) *annulipes* (Meigen, 1830) (**)	LPA	1994-2017	2a, 2c	Zamburlini, 1995, 1996a; Zamburlini & Cargnus, 2009; this paper
10	*Aedes* (*Ochlerotatus*) *cantans* (Meigen, 1818)	LPA	1994-2017	2a, 4a, 4b, 5a	Zamburlini, 1995; Zamburlini & Cargnus, 2009; Mancini *et al*., 2017; this paper
11	*Aedes* (*Ochlerotatus*) *caspius* (Pallas, 1771)	LPA	1983-2017	1a, 2a, 3a, 3b	Stammer, 1932; Dechigi *et al*., 1967; Zamburlini, 1995; Zamburlini & Cargnus, 2009; Mancini *et al*., 2017; this paper
12	*Aedes* (*Ochlerotatus*) *cataphylla* (Dyar, 1916) (**)	LPA	1996-2014	4b, 5a	Cargnus & Zamburlini, 1999; Zamburlini & Cargnus, 2009; this paper
13	*Aedes* (*Aedes*) *cinereus* Meigen, 1818	LPA	1994-2017	2a, 2c	Dechigi *et al*., 1967; Zamburlini, 1995; Zamburlini & Cargnus, 1998a; this paper
14	*Aedes* (*Ochlerotatus*) *communis* (De Geer, 1776) (**)	LPA	1994-2014	4a, 4b	Cargnus & Zamburlini, 1999; Zamburlini & Cargnus, 2009; this paper
15	*Aedes* (*Ochlerotatus*) *detritus* (Haliday, 1833)	L	1983-2001	1a	Dechigi *et al*., 1967; Zamburlini, 1995; Mancini *et al*., 2017
16	***Aedes* (*Ochlerotatus*) *dorsalis* (Meigen, 1830)**	**L**	**1932**	**1a**	Stammer, 1932 (reported as doubtful; current presence to be confirmed)
17	*Aedes* (*Aedes*) *geminus* Peus, 1970 (**)	LPA	1994-2015	2a, 4a, 4b, 5a	Zamburlini & Cargnus, 1998a; 2009; this paper
18	*Aedes* (*Dahliana*) *geniculatus* (Olivier, 1791)	ELPA	1994-2017	2d, 5b, 6a	Zamburlini, 1995; Zamburlini & Cargnus, 2009, 2015; Mancini *et al*., 2017; this paper
19	*Aedes* (*Hulecoeteomyia*) *japonicus* (Theobald, 1901)	LPA	2016	6a	Seidel *et al*., 2016; this paper
20	*Aedes* (*Hulecoeteomyia*) *koreicus* (Edwards, 1917)	LPA	2015-2017	6a	Montarsi *et al*., 2015 Zamburlini & Cargnus, 2015
21	*Aedes* (*Ochlerotatus*) *pullatus* (Coquillett, 1904) (**)	LPA	1994-2015	4a, 4b	Zamburlini, 1995; Cargnus & Zamburlini, 1999, 2009; this paper

(continued)

Continued Table 3

22	*Aedes* (*Ochlerotatus*) *punctor* (Kirby, 1837) (**)	LPA	1994-2015	4b	Zamburlini & Cargnus, 2009; this paper
23	*Aedes* (*Ochlerotatus*) *sticticus* (Meigen, 1838)	LPA	1994-2017	2a, 2c, 5a	Zamburlini, 1995, 1996b; Mancini *et al*., 2017; this paper
24	*Aedes* (*Aedimorphus*) *vexans* (Meigen, 1830)	LPA	1994-2017	2a, 2c, 3a, 5a	Stammer, 1932; Dechigi *et al*., 1967; Zamburlini, 1995; Zamburlini & Cargnus, 2009; Mancini *et al*., 2017; this paper
25	*Coquillettidia* (*Coquillettidia*) *richiardii* (Ficalbi, 1889)	A	1998-2014	–	Stammer, 1932; Zamburlini, 1995; Zamburlini & Cargnus, 2009; Toma *et al*., 2013; Mancini *et al*., 2017; this paper
26	*Culex* (*Maillotia*) *hortensis* Ficalbi, 1889 (**)	LPA	1994-2015	2b, 5a, 6b	Zamburlini, 1995; this paper
27	***Culex (Neoculex) impudicus* Ficalbi, 1890**	**LPA**	**2013**	**2b**	Toma *et al*., 2013
28	***Culex (Neoculex) martinii* Medschid, 1930**	**A**	**2013**	–	Toma *et al*., 2013 (presence to be confirmed)
29	*Culex* (*Barraudius*) *modestus* Ficalbi, 1889	LPA	1994-2013	3a, 3b	Stammer, 1932; Dechigi *et al*., 1967; Zamburlini, 1995; this paper
30	*Culex* (*Culex*) *pipiens* Linnaeus, 1758	LPA	1994-2017	2b, 3a, 5a, 6a, 6b, 6c	Stammer, 1932; Dechigi *et al*., 1967; Zamburlini, 1995; Zamburlini & Cargnus 2009; Mancini *et al*., 2017; this paper
31	*Culex* (*Neoculex*) *territans* Walker, 1856	LPA	1994-2011	2b	Stammer, 1932; Dechigi *et al*., 1967; Zamburlini, 1995; Zamburlini & Cargnus, 2009; Mancini *et al*., 2017; this paper
32	*Culex* (*Culex*) *theileri* Theobald, 1903	L	1994-2013	2b, 6b	Dechigi *et al*., 1967; Zamburlini, 1995; Toma *et al*., 2013
33	*Culiseta* (*Culiseta*) *annulata* (Schrank, 1776)	LPA	1994-2017	2b, 6c	Dechigi *et al*., 1967; Zamburlini, 1995; Mancini *et al*., 2017; this paper
34	*Culiseta* (*Allotheobaldia*) *longiareolata* (Macquart, 1838) (**)	LPA	1994-2015	5b, 6a	Zamburlini & Cargnus, 2015; this paper
35	*Culiseta* (*Culicella*) *morsitans* (Theobald, 1901)	LPA	1994-2017	2a	Dechigi *et al*., 1967; Zamburlini, 1995, 1996a; Zamburlini & Cargnus, 2009; this paper
36	***Culiseta (Culiseta) subochrea* (Edwards, 1921)**	**A**	**1967**	–	Dechigi *et al*., 1967 (current presence to be confirmed)
37	*Uranotaenia* (*Pseudoficalbia*) *unguiculata* Edwards, 1913 (**)	L	1994	2b	Zamburlini, 1995 (current presence to be confirmed)

Carnic and Julian Pre-Alps and Alps

4. Wet forests and marshes

4a. In semi-permanent rainwater pools within deciduous forest of sub-mountain and mountain areas (2 sites), immature stages of *Ae. pullatus* (2 sites), *Ae. cantans, Ae. communis* and *Ae. geminus* (1 site each) were collected. Additionally, some biting adults of *Ae. pullatus* were found (1 site) (Table 4 in Supplementary material).

4b. In flooded meadows and marshes of mountain areas, larvae of six species were detected (5 sites) (Table 4 in Supplementary material). Only *Ae. pullatus* was found in all sites, whereas *Ae. communis*, *Ae. geminus*, *Ae. punctor*, *Ae. cantans* and *Ae. cataphylla* were less frequent. *Ae. pullatus* was found in marshes flooded by snow melting water at higher altitudes (1570 m a.s.l.). Biting females of *Ae. geniculatus* were also captured (Table 4 in Supplementary material).

Karst plateau

5. Karst woods and marshes

5a. In shaded semi-permanent and permanent ponds and artificial containers, immatures stages of eight mosquito species were collected (7 sites) (Table 4 in Supplementary material). *An. maculipennis* s.l. (2 sites), *Cx. hortensis* (1 site) and *Cx. pipiens* (1 site) were detected in natural or artificial (cisterns and animal troughs) permanent water bodies, while *Ae. cantans* (2 sites), *Ae. sticticus* (3 sites), *Ae. vexans* (2 sites), *Ae. cataphylla* (1 site) and *Ae. geminus* (1 site) were found in temporary or semi-permanent water bodies subjected to level excursions at the margins of ponds, pools and swamps.

5b. In tree-holes and karst rock-holes filled with rainwater (3 sites), rich in decaying leaves and superficial microalgae, larvae of *Ae. geniculatus* and *Cs. longiareolata* (Macquart) (3 and 1 site, respectively) were collected (Table 4 in Supplementary material).

Whole region

6. Urban areas

6a. In natural and artificial small containers of eutrophic water (11 sites), larvae of eight species were collected (Table 4 in Supplementary material). *Ae. albopictus* (9 sites) was almost always detected, together with *Cx. pipiens* (8 sites) and with *Cs. longiareolata* (2 sites). The exotic *Ae.*

koreicus and *Ae. japonicus* (2 and 1 site, respectively) were also sampled. *An. plumbeus* (3 sites) and *Ae. geniculatus* (1 site) were collected in tree holes. Moreover, some adults of *Ae. albopictus* were sampled in one touristic site situated at 907 m a.s.l. (site N. 26) but no larvae were found in the surroundings.

6b. In shaded containers filled with clear rainwater (3 sites) larvae of *Cx. hortensis* (3 sites), *Cx. pipiens* (2 sites), *An. claviger*, *An. maculipennis* s.l. and *Cx. theileri* (1 site) were collected (Table 4 in Supplementary material).

6c. In large and permanent polluted water basins such as ditches rich in organic matter (3 sites), *Cx. pipiens* constantly occurred, sometimes found together with *Cs. annulata* (2 sites) (Table 4 in Supplementary material).

CONCLUSIONS

From a zoo-geographic point of view, all the native mosquito species recorded in FVG have a wide distribution in Europe (Becker *et al*., 2010) and are already reported for other Italian regions (Severini *et al*., 2009), except *Ae. geminus,* which is mainly distributed in central and western Europe and currently recorded only in FVG (Zamburlini & Cargnus, 1998a).

Many species recorded in FVG have a prevailing central-northern distribution in Europe. Among these, *Ae. annulipes*, *Ae. cantans* and *Ae. sticticus* are reported from Veneto (Mancini *et al*., 2017), and the latter two species also from Piedmont (Sabatini *et al*., 1981) and Tuscany (Baldaccini & Gianchecchi, 1989), respectively. *Ae. cataphylla, Ae. communis* and *Ae. pullatus* were found first in the Apennines at high altitudes (Coluzzi & Coluzzi, 1967). More recently, *Ae. cataphylla* and *Ae. pullatus* were found also in Piedmont (Toma *et al*., 2013), and *Ae. communis* in Lazio (De Liberato *et al*., 2015). On the contrary, *Cx. impudicus* and *Cx. theileri* have a prevailing Mediterranean gravitation and reach in FVG the northern limit of their European distribution.

After the spread of the Asian tiger mosquito, in the last years two new exotic species were introduced in FVG: *Ae. japonicus*, which is establish in the nearby Carinthia region (Austria) (Seidel *et al*., 2016), and *Ae. koreicus* which is spreading in the Italian regions adjacent to FVG (Montarsi *et al*., 2015) and in north-eastern Slovenia (Kalan *et al*., 2017).

Further research, especially conducted in the mountain areas less investigated until now, will probably and hopefully enrich the mosquito inventory of FVG, in particular with species documented in the nearby Veneto region, such as in the far past *Ae. zammitii* (Theobald, 1903) [(sub *Ae. mariae* (Sergent & Sergent, 1903)] and *Cs. litorea* (Shute, 1928) (Dechigi *et al*., 1967), and more recently *Ae. berlandi* (Seguy) (Mancini *et al*., 2017), or detected in other Italian regions (Severini *et al*., 2009), in the nearby Slovenia (Snow & Ramsdale, 1999), in Croatian Istria (Merdić *et al*., 2008) and in Austria (Zittra *et al*., 2017).

Many of the mosquitoes present in FVG, both native or exotic species, have a great health concern as potential vectors of pathogens for humans and animals and they are object of an intensive surveillance (Zamburlini & Frilli, 2006; Mancini *et al*., 2017). The study of the density and distribution of potential malaria vectors is still an important medical issue which needs to be updated, as the data here presented date back to the end of 1990s (Zamburlini & Cargnus, 1998b).

From a conservation perspective, the mosquito fauna represents in many natural ecosystems a precious resource of biodiversity, not always to be hasty eliminated but attentively controlled. Furthermore, the natural breeding sites of mosquitoes, and annexed fauna, need a particular protection since they have been greatly reduced in the last decades and are often at risk of disappearance, especially in the Friulian plains because of agriculture and urbanization expansion.

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Table 4 – Geographic distribution, type of ecosystem, site of collection and types of habitat (1a-6c) of pre-imaginal stages of mosquitoes of Friuli Venezia Giulia (site N. 83 from the nearby Veneto region) (north-eastern Italy). The five species indicated in bold are not collected by the present Authors; (*) taxon not identified to species level. In the third column, "Site N." refers to sites of collection as listed in Table 1. Description of the types of habitat (1a- 6c) reported in Table 2; A: only adults collected.

Geographic distribution	Type of ecosystem	Site N.	Species/taxon																																					
			1. *Anopheles atroparvus*	2. *Anopheles claviger*	3. *Anopheles hyrcanus*	4. *Anopheles maculipennis* s.s.	(*) *Anopheles maculipennis* s.l.	5. *Anopheles messeae*	6. *Anopheles plumbeus*	**7. *Anopheles sacharovi***	8. *Aedes albopictus*	9. *Aedes annulipes*	10. *Aedes cantans*	11. *Aedes caspius*	12. *Aedes cataphylla*	13. *Aedes cinereus*	14. *Aedes communis*	15. *Aedes detritus*	**16. *Aedes dorsalis***	17. *Aedes geminus*	18. *Aedes geniculatus*	19. *Aedes japonicus*	20. *Aedes koreicus*	21. *Aedes pullatus*	22. *Aedes punctor*	23. *Aedes sticticus*	24. *Aedes vexans*	25. *Coquillettidia richiardii*	26. *Culex hortensis*	**27. *Culex impudicus***	**28. *Culex martinii***	29. *Culex modestus*	30. *Culex pipiens*	31. *Culex territans*	32. *Culex theileri*	33. *Culiseta annulata*	34. *Culiseta longiareolata*	35. *Culiseta morsitans*	**36. *Culiseta subochrea***	37. *Uranotaenia unguiculata*
Northern Adriatic Sea coast	Coastal brackish marshes	28												1a				1a																						
		29												1a																										
		34												1a																										
		61												1a																										
		62												1a				1a																						
		63												1a																										
		69												1a																										
		72												1a																										
		87																	**1a**																					
		88								**1b**																														
Friulian plains and Morainic hills	Wet woodlands and flooded shaded meadows	**86**																																					**A**	
		84																														**A**									
		85																													**2b**										
		2																			2d						2c	2c													
		3		2a								2a																											2a		
		5		2a																	2d																		2a		
		6		2a								2a																											2a		
		7		2a																																			2a		
		8																																	2b						
		10		2a																																			2a		
		11					2b																												2b						
		14	A	A		A		A																																	
		15		2a								2a																											2a		
		16		2a					2d			2a									2d																				
		17		2a					2d			2a									2d							2c													
		18										2a		2a		2a																									
		19		2a								2a																											2a		
		20							2d			2a	2a			2a					2d						2c	2c		2b									2a		
		21		2a								2a																											2a		
		22		2a																								2a											2a		
		23																		2a									A												
		24							2d			2a	2a			2a					2d						2c	2c													
		25		2a								2a																											2a		
		29					2b																																		2b
		32		2a								2a																													
		33				A																																			
		35		2a								2a	2a							2a																			2a		
		36			2a				2d			2a	2a			2a					2d						2c	2c		2b				2b					2a		
		37		2a					2d			2a	2a			2a					2d						2c	2c		2b				2b					2a		
		38		2a								2a																											2a		
		39		2a																																			2a		
		40		A		A																																			
		46							2d							2c					2d						2c	2c													
		47		A		A																																			
		48		2a			2b					2a	2a			2ac				2a	2d						2c	2c									2b		2a		
		50	A	A		A																																			
		51		2a								2a																											2a		
		55		2a								2a				2a																							2a		
		56							2d			2c									2d						2c	2c													
		57					2b																											2b	2b						
		58				A		A																																	
		59											2a	2a		2a																									
		60		A		A		A																																	
		64		2a								2a	2a			2a				2a							2a	2a									2b		2a		
		65					2b																											2b	2b						
		66										2a	2a								2d						2c	2c	A							2b					
		67		2a																																			2a		
		70					2b																																		
	Crops	31					3b							3b																			3b								
		62					3b							3b																											
		83					3a							3a														3a					3a	3a							
Carnic and Julian Pre-Alps and Alps	Wet forests and marshes	13											4b		4b		4b			4b	A			4b	4b																
		41																						A																	
		42																						4b																	
		43											4a				4a							4a																	
		44																						4b																	
		52																						4b																	
		53																		4a				4a																	
		54															4b			4b				4b	4b																
Karst plateau	Woods and marshes	71					5a																																		
		73																			5b																				
		74																								5a															
		75																								5a															
		76																									5a														
		77											5a		5a						5b																				
		78																			5b																5b				
		79					5a						5a							5a						5a	5a		5a												
		82																															5a								
Whole region	Urban areas	1									6a												6a															6a			
		4									6a										6a		6a																		
		9							6a		6a																		6b				6abc		6b	6c	6a				
		12					6a				6a																						6a								
		26									A																														
		27																															6a								
		30					6b		6a		6a																		6b				6abc			6c					
		45																				6a											6a								
		49		6b					6a		6a																		6b				6ac								
		68									6a																						6a								
		80									6a																						6a								
		81									6a										A																				