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Eleven new spider species (Arachnida: Araneae) for Switzerland discovered in vineyards in Ticino – What are possible reasons?

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In the large project BioDiVine (**Bio**logical **Di**versity in **Vine**yards), aiming to investigate the determinants explaining the biodiversity and community assemblages of plants and invertebrates, spiders among other groups of organisms were determined. 278 species have been found, eleven of which are reported here for the first time in Switzerland: As possible reasons for the high amount of new records for Switzerland, factors such as higher temperatures, changes in land use, world-wide traffic of goods and people or simply the use of new methods or other habitats investigated are discussed.

Keywords: Faunistics, first records, climate change, ground cover vegetation, southern Switzerland

INTRODUCTION

With 1'065 ha of vineyards the canton of Ticino is the fifth most important wine-producing region of Switzerland. Vineyards are distributed across the entire canton and mainly located along south-facing slopes (200–600 m a.s.l.), but increasingly present also in the plain. Vineyards are often composed of small areas scattered at different suitable sites but grouped in geographical units (vineyard complexes), which are divided by geomorphological or anthropogenic structures and surrounded by settlements, gardens, semi-natural open habitats and forest edges.

Since the late 1800s the vineyard area has decreased due to both socio-economic changes and the grapevine pest Phylloxera (*Daktulosphaira vitifoliae* - first found in Europe in 1893) causing the rapid loss of many indigenous grapevine varieties and abandonment of the subsidiary type of viticulture. This has induced further changes in the viticulture practices that favour larger vine fields, more intensive management and mainly one single grapevine variety (Merlot) replacing approximately 80 % of the grapevine varieties cultivated in Ticino in the past.

Besides its economic importance within the agro-economy, viticulture still represents a valuable landscape element of the canton of Ticino with important environmental and socio-cultural services. Despite the lack of a comprehensive investigation on the biological diversity of vineyards in southern Switzerland, a few case studies showed the presence of rare and endangered species of both plants (Persico

2009; Bellosi *et al.* 2013) and animals (Patocchi & Moretti 1998). To fill this gap, a large research project code-named BioDiVine (**Bio**logical **Di**versity in **Vine**yards) aiming to investigate the determinants explaining the biodiversity and community assemblages of plants and invertebrates (including spiders) of vineyard ecosystems in southern Switzerland was launched in 2009 with a pilot phase in 8 vineyards, and expanded in 2011 to 48 vineyards. The study was part of a PhD thesis at the University of Neuchâtel by Valeria Trivellone and was conducted in collaboration between the Swiss Federal Research Institute WSL Bellinzona, the Museo cantonale di storia naturale (MCSN) Lugano, and Agroscope ACW Cadenazzo.

During the study 278 spider species were collected and identified (Trivelloni et al. 2013). In this paper we describe only the 11 species new for the Swiss spider fauna. The full species list and all ecological data of the project can be requested from one of the last three authors (Trivellone *et al.* 2012; Bellosi *et al.* 2013; Trivellone *et al.* 2013; 2014a, 2014b).

METHODS

Study area and trap sites

The study area comprises the whole wine-growing area of the canton of Ticino (southern Switzerland) which extends from the northernmost site Ludiano (46°25' N – 8°58' E) to the southernmost site Pedrinate (45°49' N – 9°00' E), ranging from 199 m to 589 m a.s.l. The area is characterized by a moist warm-temperate climate and mean annual precipitation ranging from 1 600 mm (south) to 1 700 mm (north), and mean monthly temperatures ranging from 0.5 °C (north) to 1.6 °C (south) in January and from 21.2 °C (north) to 23.5 °C (south) in July (Spinedi & Isotta, 2004).

The 48 study sites were selected using a design that accounted for the three main variables characterizing the vineyard agroecosystem in the study region, i.e. aspect (24 sites were exposed SE-SW; 24 sites NE-NW), slope (24 sites were on a plain: <5° of slope; 24 sites were terraced >10° of slope) and the dominant land use type (i.e. >50 % cover) surrounding the vineyard within a radius of 500 m (16 sites were dominated by forest, 16 sites by settlements, 16 sites by open areas). In this way, the selected 48 vineyards can be considered representative of the vineyard ecosystem and vineyard landscape of southern Switzerland.

The ground of the vineyards is fully covered by grass during the whole year, except along the vine rows (approx. 50 cm in width), which can be tilled or treated with herbicide.

Data sampling

The data have been sampled during two distinct phases: a) pilot phase in 2009, and b) main project BioDiVine 2011.

a) Pilot phase 2009 – The pilot phase took place in 8 of the 48 vineyards of the full project (see next section) between 04.05.2011 and 29.07.2009. The data sampling occurred along three distinct transects in each vineyard: in the upper, middle, and low sector, each of them including one vine row, vine canopy, interrow and adjacent slope if present. Arthropods were sampled using a D-Vac suction device (D-Vac Suction Sampler Stihl SH 86 modified by EcoTech©; http://www.ecotech-

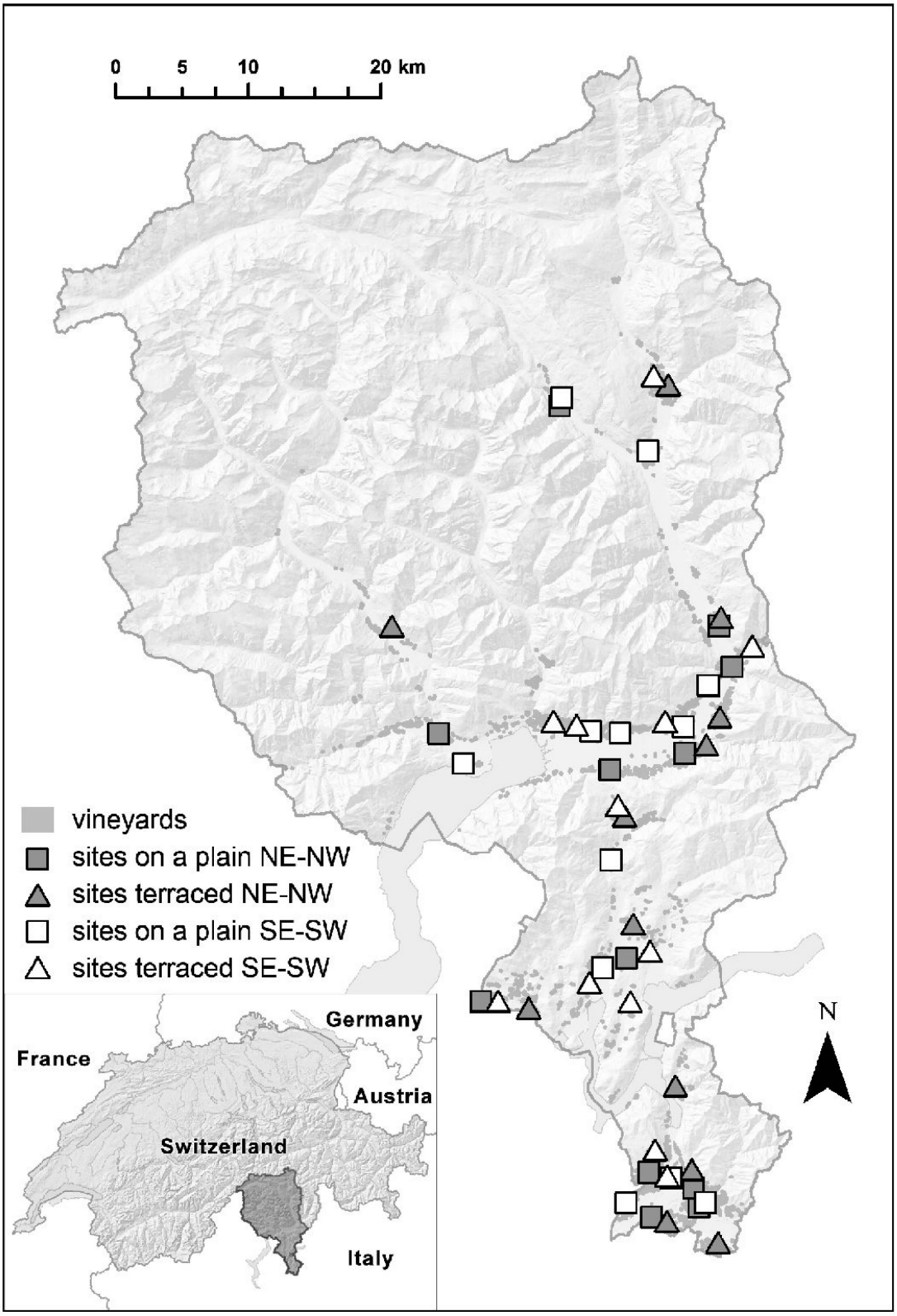

Fig. 1. Distribution of the 48 vineyards (symbols) investigated by the project BioDiVine selected within the vineyard area (bright grey patches) in the canton of Ticino. The vineyards were selected based on a balanced design according to the three main factors (dark symbols: 24 sites were NE-NW exposed; white symbols: 24 exposed SE-SW), slope (square symbols: 24 sites on the plain <5° of slope; triangle symbols: 24 sites on the slope >10° of slope) and proportion of dominant (>50 % cover) habitat (forest, urban, open land) within a radius of 500 m surrounding the sites (thus 16 sites were surrounded by forest; 16 sites by urban; 16 by open land).

bonn.de/), six pitfall trap sites each consisting of three 200 ml cups (7 cm in diameter and half-filled with saline solution with some drops of detergent and covered by a transparent plastic roof), one yellow pan trap (a plastic bowl 25 cm in diameter) and a standard sweep net (35 cm in diameter). Pitfall traps and yellow pan trap were open during four periods of 7 days each (i.e. once every 3–4 weeks) during the sampling period, while D-Vac suction and sweep net were used on one day of suitable weather for each period. For a detailed description of the methods used see Trivellone *et al.* (2012).

b) Main project BioDiVine 2011 – The main project, which was extended over 48 vineyards, took place from 28.03.2011 to 11.10.2011. Data sampling occurred at two distinct sites within each vineyard (minimum distance between sites 20 m and 30 m from vineyard margin). At each sampling site, we used pitfall traps and D-Vac suction for capturing the dwellers of the ground and herb layers, while the beating tray technique was used for the species living on the vine canopy. Pitfall traps were placed along both vine rows and on the slopes (4 traps each); if the slope was absent, traps were placed along a second vine row. Additional pitfall trap sites were placed at the forest margin of 16 vineyards. The traps were open for 7 days per month during the sampling period, for a total of eight sampling periods. Depending on the weather conditions suction and beating occurred only seven and five times respectively, once a month, from March to October. D-Vac sampling was applied along the slopes and interrows, during 120 seconds each obtaining two distinct samples per vineyard. The beating tray technique was performed by shaking thirty vine branches per plant over an entomological umbrella (1 m x 1 m) collecting all the arthropods which fell down.

Species identification and collection of voucher specimens

All specimens were labelled and conserved in 70 % alcohol and sent to the specialists for identification. Spiders were identified by Xaver Heer and Anna Stäubli. Most species were double checked by Ambros Hänggi. The nomenclature follows Platnick (2014). The collection is deposited at the Museo cantonale di storia naturale in Lugano (MCSN), while vouchers of all species new to Switzerland are deposited at the Natural History Museum of Basel (NMB).

Large scale distribution data are mainly taken from Blick *et al.* (2004), Helsdingen (2012) and Platnick (2014). The detailed information for France is taken from Le Peru (2007) and for Northern Italy from Isaia *et al.* (2007).

RESULTS

Here we present only the eleven spider species new for Switzerland plus one additional species (*Heriaeus oblongus* Simon, 1918) because of its problematic taxonomic and faunistic situation. The full list with all 278 species will be available at the CSCF Neuchâtel from 31.12.2016; meanwhile data can be required from one of the last three authors.

AGELENIDAE

Tegenaria hasperi Chyzer, 1897

CH: TI: Gordola: S. Antonio, CH-coord. 710.145 / 115.588 (WGS84 8° 51' 54.69" N / 46° 10' 57.89" E), alt. 319 m, pitfall traps: 17.–24.06.2011, 2 ♂♂.
CH: TI: Cugnasco-Gerra: Gerra Piano, CH-coord. 712.968 / 114.832 (WGS84 46° 10' 31.74" N / 8° 54' 05.64" E), alt. 199m, pitfall traps: 17.–24.06.2011, 2 ♂♂.
CH: TI: Camorino; Montagna, CH-coord. 721.686 / 113.825 (WGS84 46° 09' 53.68" N / 8° 00' 51.02" E), alt. 407m, pitfall traps: 07.–14.07.2011, 1 ♂.
CH: TI: Sementina: Mondò, CH-coord. 718.586 / 115.583 (WGS84 46° 10' 52.58" N / 8° 58' 28.17" E), alt. 372 m, pitfall traps: 06.–13.07.2011, 1 ♂.
CH: TI: Lavertezzo: Montedato, CH-coord. 711.913 / 115.291 (WGS84 46° 10' 47.25" N / 8° 53' 16.87" E), alt. 336m, pitfall traps: 05.–12.08.2011, 1 ♀.

All specimens mixed in one vial in NMB-ARAN-25742.

Determination: Deltshev (1993: sub *Malthonica nemorosa* Simon, 1926), Bolzern *et al.* (2013)

Distribution: France (Alpes-Maritimes, Corse, Hérault, Var, Vaucluse), Italy (including Piemonte, Lombardia), Hungary, Balkans, Turkey

Ecology: This funnel web spider places its web near the ground in xerothermic woods between roots and according to Kovács & Szinetár (2012) in Hungary mainly «on the outside of buildings, at places getting direct sunshine». Adult males are found in May and July, females from April to September.

Comments: Considering that this species was caught in five different localities during this project, it is quite surprising that it has never been found in Ticino before. It could be useful to review older records of the genus *Tegenaria*.

CORINNIDAE

Trachelas minor O. P.-Cambridge, 1872

CH: TI: Gordola: S. Antonio, CH-coord. 710.145 / 115.588 (WGS84 46° 10' 57.89" N / 8° 51' 54.69" E), alt. 274 m, pitfall traps: 06.–13.5.2009, 1 ♀; 22.–28.07.2009 1 ♂; 31.03–06.04.2011, 1 ♂; 29.04.–06.05.2011, 2 ♂♂; D-Vac: 06.05.2009, 1 ♂ (NMB-ARAN-25747); 20.05.2009, 5 ♀♀; 22.07.2009, 4 ♂♂, 3 ♀♀ (NMB-ARAN-25745 and NMB-ARAN-25746); 06.05.2011, 3 ♂♂, 4 ♀♀; 24.06.2011, 3 ♀♀; 20.07.2011, 50 juveniles; 10.08.2011, 1 ♂, 3 ♀♀; 08.09.2011, 5 ♂♂, 1 ♀. yellow pan trap: 22.–28.07.2009, 1 ♂.
CH: TI: Lavertezzo: Montedato, CH-coord. 711.913 / 115.291 (WGS84 46° 10' 47.25" N / 8° 53' 16.87" E), alt. 336 m, D-Vac: 06.05.2011, 1 ♂.
CH: TI: Bioggio, CH-coord. 713.879 / 97.033 (WGS84 46° 00' 54.89" N / 8° 54' 32.58" E), alt. 310 m, D-Vac: 19.07.2011, 5 juveniles.
CH: TI: Mendrisio: Rancate, CH-coord. 719.041 / 81.188 (WGS84 45° 52' 18.70" N / 8° 58' 18.04" E), alt. 378 m, D-Vac: 19.07.2011, 3 juveniles

Determination: Bosselars *et al.* (2009), Marusik & Kovblyuk (2010)

Distribution: southern Europe, in the east to Uzbekistan (Bosselars *et al.* 2009, Marusik & Kovblyuk 2010). Till now not known from Piemonte and Lombardia (Isaia et al. 2007) which is rather surprising because the species is well known from south-eastern France (Le Peru 2007) and was mentioned for Northern Italy by Pesarini (1995).

Ecology: According to Bosselars *et al.* (2009) and Le Peru (2007) the species may be found in the higher vegetation, on tall grass, bushes and trees near rivers or in bogs. But Bosselars *et al.* (2009) also mention captures by suction traps on citrus trees which corresponds very well with our captures mostly made by D-vac sampling.

Comments: Because of the very typical colouration and habitus of this species localities that are represented only by juveniles are also included.

GNAPHOSIDAE

Micaria dives (Lucas, 1846)

CH: TI: Sementina: Mondò, CH-coord. 718.586 / 115.583 (WGS84 46° 10' 52.58" N / 8° 58' 28.17" E), alt. 317 m, pitfall traps: 06.–13.05.2009, 3 ♂♂, 1 ♀ (NMB-ARAN-25750 – 25752); 20.–27.05.2009, 1 ♂; 31.03.–06.04.2011, 2 ♂♂; 17.–24.06.2011, 1 ♂♂; 06.–13.07.2011, 1 ♂; 05.–12.08.2011, 2 ♂♂; D-vac: 06.05.2009, 1 ♂.

Determination: Thaler (1981), Wunderlich (1979), Bosmans & Blick (2000), Kovblyuk & Nadolny (2008)

Distribution: According to the above cited authors, *Micaria dives* is a Palaearctic species, inhabiting the more southern parts, even if in Europe it is found as far north as Denmark.

Ecology: Known from different types of xerothermic habitats as steppes, dunes, more or less open forests, maquis shrubland and parks.

Comments: All 11 males and the single female were caught in the same locality. Males from April to August, the female in May. It is quite surprising that this species was recorded for the first time for Switzerland as it was already recorded all around this country (Le Peru 2007, Staudt 2013, Thaler 1981, Isaia *et al.* 2007).

Scotophaeus nanus Wunderlich, 1995

CH: TI: Lamone, CH-coord. 716.170 / 100.344 (WGS84 46° 02' 40.70" N / 8° 56' 21.96" E), alt. 428 m, pitfall traps: 08.–15.07.2011, 1 ♂ (NMB-ARAN-25743).
CH: TI: Rovio, Basso, CH-coord. 719.358 / 88.126 (WGS84 45° 56' 03.10" N / 8° 58' 39.04" E), alt. 424 m, pitfall traps, 05.–12.05.2009, 1 ♂ (NMB-ARAN-25744).

Determination: Wunderlich (1995a), Grimm (1985) (♀ sub *S.* cf. *quadripunctatus*)

Distribution: Only known from Austria.

Ecology: Wunderlich (1995a) supposed that it could be an arboricolous species living mainly under the bark of trees.

LINYPHIIDAE

Trichoncus hackmani Millidge, 1955

CH: TI: Chiasso, Pedrinate, CH-coord. 722.600 / 76.303 (WGS84 45° 49' 38.25" N / 9° 00' 58.46" E), alt. 451 m, pitfall traps: 26.04.–03.05.2011, 1 ♂, 03.–10.08.2011, 1 ♀; D-vac: 26.04.2011, 1 ♂.
CH: TI: Claro: Al Razzei, CH-coord. 722.806 / 123.453 (WGS84 46° 15' 04.67" N / 8° 01' 52.34" E), alt. 412 m, pitfall traps: 16.–23.06.2011, 1 ♀; D-vac: 27.04.2011, 1 ♂, 2 ♀♀.
CH: TI: Lamone, CH-coord. 716.170 / 100.344 (WGS84 46° 02' 40.70" N / 8° 56' 21.96" E), alt. 428 m, pitfall traps: 08.–15.07.2011, 1 ♀.
CH: TI: Lavertezzo: Montedato, CH-coord. 711.913 / 115.291 (WGS84 46° 10' 47.25" N / 8° 53' 16.87" E), alt. 336 m, pitfall traps: 06.–13.07.2011, 1 ♂, 1 ♀; 13.–20.07.2011, 1 ♂; 08.–15.09.2011, 1 ♂; D-vac: 06.05.2009, 1 ♂; 22.07.2009, 1 ♂; 31.03.2011, 1 ♂; 10.08.2011, 1 ♂.
CH: Ti: Sementina: Mondò, CH-coord. 718.586 / 115.583 (WGS84 46° 10' 52.58" N / 8° 58' 28.17" E), alt. 372 m, pitfall traps: 06.–13.05.2009, 2 ♂♂, 08.–15.09.2011, 1 ♂; D-vac: 08.09.2011, 1 ♂, 06.05.2009, 1 ♂ (NMB-ARAN-25756), 22.07.2009, 1 ♂ (NMB-ARAN-25757).

Determination: Roberts (1987), Wunderlich (2011)

There were rather big problems in determination and a lot of synonyms within the genus *Trichoncus* and it is quite possible that in older material some *Trichoncus hackmani* could be hidden.

Distribution: Known from most countries of Europe excluding the Iberian Peninsula and the eastern part. It is quite surprising that this species is mentioned here for the first time for Switzerland because it was found in all surrounding countries.

Ecology: Because of the difficulties in determination there are some doubts about older records. In England the species was found near the southern coast among stones and stranded goods. Similar habitats are listed for some material in the collection of the NMB but there are other records from dry open habitats too.

PHILODROMIDAE

Philodromus buchari Kubcová, 2004

CH: TI: Bellinzona, Ravecchia, CH-coord. 722.710 / 115.911 (WGS84 46° 11' 00.56" N / 8° 01' 40.72" E), alt. 336 m, beating tray: 20.07.2011, 1 ♀ (NMB-ARAN 25773).

Determination: Kubcová (2004), Muster & Thaler (2004)

Distribution: Up to now known from several countries in central Europe and Turkey, but there will certainly be more records as soon as further material has been checked (see below).

Ecology: As most *Philodromus*-species *P. buchari* seems to live on trees and normally is captured by sweep nets or beating trays.

Comments: In the past this species has been confused with *Philodromus aureolus* and *P. longipalpis* (Muster & Thaler, 2004). Furthermore, as suggested by Kubcová (2004), the males of the subspecies *P. aureolus variegatus* Kulczyński, 1891 as figured in Braun (1965: fig. 17a, b) may belong to this species too (see below).

While checking the *Philodromus* material in the collection of the NMB, special emphasis was given to the *P. aureolus variegatus* samples. As suspected, one sample was found to contain a female of *P. buchari* (details see below). This specimen was published by Schenkel (1926) as *P. aureolus variegatus*. A further sample of two females under the same name belongs to *Philodromus praedatus* O. P.-Cambridge, 1871. All determinations were verified by Ch. Muster.

Old material of *P. buchari* in the collection of NMB: CH: Wallis: Fiesch, along the Furka road, alt. 1100 m, 18.07.1925, 1 ♀, legit E. Schenkel. The second sample under the same name belongs to *P. praedatus* and was collected nearby at CH: Wallis: Fiesch, Altbachgraben, alt. 1200 m, 15.07.1925, 2 ♀♀, legit E. Schenkel.

SALTICIDAE

Icius hamatus (C. L. Koch, 1846)

CH: Ti: Mendrisio, Rancate, CH-coord. 719.041 / 81.188 (WGS84 45° 52' 18.70" N / 8° 58' 18.04" E), alt. 378, beating tray: 1 ♂ (NMB-ARAN-25774).

Determination: Metzner (1999), Alicata & Cantarella (1994), Tomasiewicz & Wesołowska (2006)

Distribution: southern part of Europe. A record from Poland in Tomasiewicz & Wesołowska (2006) concerns a single female that was collected on imported

pomegranates. This single male recorded from Germany (Schäfer & Deepen-Wieczorek 2014) it is also supposed to be imported even if caught outdoors in a garden.

Ecology: According to Hansen (1982) and Nentwig *et al.* (2014) the species is regularly found in the shrub layer even in agricultural plantations (citrus groves). Thus the record in a vineyard is not surprising.

Neaetha membrosa (Simon, 1868)

CH: Ti: Sementina: Mondò, CH-coord. 718.586 / 115.583 (WGS84 46° 10' 52.58" N / 8° 58' 28.17" E), alt. 317 m, pitfall traps: 06.–13.05.2009, 1 ♂ (NMB-ARAN-25753).

Determination: Metzner (1999), Logunov (1996), Noflatscher (1993)

Distribution: southern part of Europe. In Germany the species is only known from the Kaiserstuhl, a small mountain in the Rhine valley that is known for its very warm climate (Staudt 2013, Wunderlich 1995b). While there is no record in Isaia *et al.* (2007) for Piemonte and Lombardia there is one record for Vinschgau in South-Tyrol (Noflatscher 1993).

Ecology: known from stony, xerothermic sites (Nentwig *et al* 201a).

THERIDIIDAE

Phoroncidia paradoxa (Lucas, 1846)

CH: TI: Claro: Al Razzei, CH-coord. 722.806 / 123.453 (WGS84 46° 15' 04.67" N / 8° 01' 52.34" E), alt. 412 m, D-vac: 06.09.2011, 1 ♂ (NMB-ARAN-25761).

Determination: Thaler & Noflatscher (1990), Le Peru (2011), Wunderlich (2008).

Distribution: Very scattered in the more southern parts of Europe and North Africa. Recently recorded from the Asian part of Turkey (Kunt *et al.* 2012).

Ecology: According to Thaler & Noflatscher (1990) the species mainly lives in the bush layer.

Theridula gonygaster (Simon, 1873)

CH: TI: Monteggio: Persico, CH-coord. 705.988 / 94.505 (WGS84 45° 59' 37.67" N / 8° 48' 23.78" E), alt. 377 m, D-vac: 19.05.2009, 1 ♂ (NMB-ARAN-25748), 21.07.2009, 1 ♂, 22.07.2011, 1 ♂ (NMB-ARAN-25749).
CH: TI: Monteggio: Fornasette, Fornaci, CH-coord. 704.679 / 94.490 (WGS84 45° 59' 37.93" N / 8° 47' 22.97" E), alt. 303 m, D-vac: 04.08.2011, 1 ♀, 06.09.2011, 1 ♀.

Determination: Le Peru (2011), Saaristo (2006), Wunderlich (2008)

Distribution: According to the older literature with a pantropical distribution, newer European records from Italy and the Iberian Peninsula and considered as a cosmopolitan species (Platnick 2014).

Ecology: According to Le Peru (2011) collected in cereal fields. It may be suggested that the newer cosmopolitan distribution could be a result of the world-wide trade of cereal seeds.

THOMISIDAE

Heriaeus hirtus (Latreille, 1819)

CH: TI: Gordola: S. Antonio, CH-coord. 710.145 / 115.588 (WGS84 46° 10' 57.89" N / 8° 51' 54.69" E), alt. 274 m, pitfall traps: 06.–13.5.2009, 1 ♂ (NMB-ARAN-25755); D-Vac: 20.05.2009, 1 ♂; sweep net: 20.05.2009, 1 ♂, 24.06.2009, 1 ♂ (NMB-ARAN-25754).

Determination: Loerbroks (1983)

Distribution: Mediterranean species, in the east also known from Georgia. Isaia *et al.* (2007) reported the species for both Piemonte and Lombardia.

Ecology: In Mediterranean dry garrigue and maquis shrubland typically on hairy leaves (Loerbroks 1983).

Comments: The morphological differences between *H. hirtus* and *H. graminicola* (Doleschall, 1852) are very subtle. Comparing our material with the figures 5 and 23 in Loerbroks (1983) we would like to suggest that the palpal tibia of the males are more densely covered with stout hairs in *H. hirtus* compared to *H. graminicola*. Loerbroks did not mention this difference in the text but showed it in the figures.

In contrast to the small differences in morphology, there are clear differences in ecology (*H. graminicola* in dense vegetation of wetlands) and geographic distribution (*H. graminicola* in more Northern Europe). Nevertheless, because of the very small morphological differences it is always possible that mismatching may have occurred.

A single male of a further *Heriaeus* species was found in Mendrisio, Somazzo. Because of the special nomenclatural situation it is mentioned below.

Heriaeus oblongus Simon, 1918

CH: TI: Mendrisio: Somazzo, CH-coord. 720.588 / 81.801 (WGS84 45° 52' 37.53" N / 8° 59' 30.34" E), alt. 537 m, D-Vac: 15.06.2011, 1 ♂ (NMB-ARAN-25776)

Determination: Loerbroks (1983: sub *H. mellottei*), Roberts (1998: sub *H. mellottei*)

Distribution: In Switzerland already known from several localities sub *H. hirsutus* (sensu Lessert 1910) und *H. mellottei* (sensu Maurer & Hänggi 1990). Otherwise with a Palaearctic distribution.

Ecology: on high grass and bushes in xerothermic sites (Loerbroks 1983).

Comments: According to Ono 1988 the true *H. mellottei* Simon, 1886 is restricted to south-eastern Asia (correct spelling after Platnick 2014 is *mellotteei*).

DISCUSSION

To get eleven first records of spider species for Switzerland in one single project, even if during a large investigation, is a great success. This is especially true for a country like Switzerland with quite a good arachnological tradition (Lessert 1910, Maurer & Hänggi 1990). At present 983 species are known in Switzerland (972 in Hänggi & Stäubli 2012, plus the 11 species presented here). Compared to the 991 species established in Germany (Blick *et al.* in press) or the 984 in Austria (Blick *et al.* 2004), two considerably bigger countries, this number is even more astonishing at first glance.

Given the small dimension of Switzerland compared to Germany and Austria, the reason for this high number of spider species in Switzerland has nothing to do with a higher investigation effort but rather with its high structural and environmental diversity, as well as with its geographical position with influences from north and south of the Alps. Moreover, the canton of Ticino, situated entirely south of the Alps, is well known to harbour a great amount of Mediterranean species. Seven of the 11 species (*Tegenaria hasperi*, *Trachelas minor*, *Icius hamatus*, *Neaetha mem-*

brosa, *Phornoncidia paradoxa*, *Theridula gonygaster*, *Heriaeus hirtus*) show a Mediterranean or otherwise southern distribution. Only one species (*Micaria dives*) is evenly distributed in Central Europe. The remaining three species (*Scotophaeus nanus*, *Trichoncus hackmani* and *Philodromus buchari*) have been described for the first time only some years or a few decades ago. For this reason, these species represent rather taxonomical problems and their discovery in the canton of Ticino cannot be attributed to a biogeographical reason either because the finding locations are in the mid and upper part of the canton (e.g. Lavertezzo, Claro, and Lamone).

Overall, the spider fauna of the canton of Ticino can be considered as quite well known (Hänggi 1988, Lessert 1910, Maurer & Hänggi 1990). In 1993, 519 species of spiders were already recorded for the canton of Ticino (Hänggi 1993), representing about 60 % of the 875 spider species then known for Switzerland. From this and further not yet published projects, some 60 more species are known for Ticino, still representing about 60 % of the actually known 983 spider species of Switzerland. Thus, the canton of Ticino is a region with a very high spider biodiversity. This is also true compared to the Italian regions of Lombardia and Piemonte with 679 and 546 spider species respectively (Isaia *et al.* 2007). These two regions, having similar environmental and topographical gradients as the canton of Ticino, are in direct contact with it, but are eight to nine times larger.

Despite the fact that most of the new species have been described a long time ago, we wonder why they have not been discovered earlier in the canton of Ticino, since this part of Switzerland has been regularly investigated in the past 30 years. One reason could be the use of sampling methods other than the pitfall traps used most commonly in the canton of Ticino in the last decades. D-Vac suction, beating tray, and sweep net in the shrub layer often catch other species than pitfalls on the ground. By differentiating the sampling methods, there is a higher probability to sample species that have been overlooked so far. Nevertheless, only 4 new species out of 11 have been exclusively captured using one of the unconventional methods mentioned: *Philodromus buchari* and *Icius hamatus* were sampled with beating tray, while *Phoroncidia paradoxa* and *Theridula gonygaster* were caught with D-Vac. Overall in this study the role of new sampling techniques can only partially explain the great amount of new species sampled.

Another reason could be linked to the drift of species from south to north as a consequence of combined factors such as higher temperatures, changes in land use and world-wide traffic of goods and people. Of course, it is not possible to give an answer only based on our data, but there seems to be some evidence from other species that show an expansion of their distribution from the Mediterranean region northwards to Central Europe. One example is *Zoropsis spinimana* (Dufour, 1820), not known in Switzerland in 1990 (Maurer & Hänggi 1990). Today the species is widespread north of the Alps (Hänggi 2003: Switzerland, Thaler & Knoflach 1998: Austria, Hänggi & Bolzern 2006: Germany, Bosmans 2009: Belgium, Harvey 2012: Great Britain). At present the species is reported from all larger cities of Switzerland (Hänggi & Zürcher 2013). A similar situation can be observed in *Cheiracanthium mildei* L. Koch, 1864 (Muster *et al.* 2008, Thaler 2005) and *Dictyna civica* (Lucas, 1850) (Thaler 2005). In all probability these species are victims of human dispersal, but compared to earlier times, when there was traffic from south to north too, these species seem to be able to build up durable populations today. Likewise

it may be supposed that the above mentioned species new for Switzerland might have expanded their original Mediterranean range of distribution.

A possible additional reason for such great success in finding new species for Switzerland might be the fact that the vineyard ecosystem, compared to other ecosystems in the canton of Ticino, has been investigated only modestly so far. Vineyards on slopes, in particular, are often located in warm and dry places between urbanized areas and seminatural environments such as forests and grasslands, and provide a mosaic of valuable structures, such as embankments, often not so intensively managed as rows and interrows, dry walls, shrubs and hedges, and areas with bare soil (paths and tracks). Such locations are likely to provide suitable conditions for species that might be under pressure in a surrounding landscape of intensive agriculture, urban sprawl or denser forest stands. In this context, vineyards might play an important role in maintaining biodiversity and species community assemblages including rare species and species of conservation concern, thus increasing the overall stability of agro-ecosystems, while also maintaining the benefit drawn by farmers. Of course, attaining these multi-services will only be possible if farming practices and management regimes of vineyard grasslands, including broad spectrum insecticide application, are not intensified.

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