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First record of the migrant dragonfly *Pantala flavescens* for mainland Italy (Insecta: Odonata)

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Abstract
In this contribution we report the observation of an individual of the migrant dragonfly *Pantala flavescens* (Fabricius, 1798) found at Montanaro (Piemonte, Italy) on 14 Aug 2019. This represents the first record of the species for mainland Italy and one of the very few available for Western and Central Europe before 2019. We discuss two hypotheses on the origin of this individual integrating available literature with very recent records retrieved from citizen science faunistic platforms.

Keywords*:* climate warming, dragonfly distribution, insect migration, migration pathway, Piemonte.

Introduction

Pantala flavescens has a circumtropical range including both the Old and the New World between 40°S and 40°N (Boudot & Kalkman 2015; Buczyński et al. 2014). The species is a very long-distance migrant within most of its range and, thanks to its capacity to fly several thousand kilometers over open waters and to cross high mountain passes, it performs the furthest known migration of any insect, estimated in up to 18,000 km between East Africa and the Indian subcontinent, although probably divided upon four generations (Anderson 2009; Hobson et al. 2012; Troast et al. 2016). This involves that the species can appear outside its intertropical range; records from Central Asia and the North-Eastern U.S.A. are not uncommon (Boudot & Kalkman 2015; Donnelly 2004; Malikova & Kosterin 2019), but it was recorded as far north as Kamchatka (Russia) and, notably, in several of the Earth most remote places, such as Easter Island and Amsterdam Island in the Southern Hemisphere (Devaud & Lebouvier 2019; Dumont & Verschuren 1991). Deposition could take place in any kind of standing water, but reproduction was proven to be particularly successful in small temporary ones (e.g. rain pools and small artificial ponds). Thanks to its rapid larval development (in some cases less than 40 days; Suhling et al. 2003), the species can breed *en route* during the migration (Boudot & Kalkman 2015; Corbet & Brooks 2008).

In the Western Paleartic region, *Pantala flavescens* is rare and regularly observed only in the Middle East, Anatolia, and Egypt. Several records are also available for Caucasus, Macaronesia, and Maghreb (Boudot & Kalkman, 2015; De Knijf 2015; Durand & Rigaux, 2015; Seehausen et al., 2016; Vieira & Cordero-Rivera 2015; Weihrauch et al. 2016). Presence data of the species in Europe are occasional and were recently reviewed by Boudot & Kalkman (2015) and Buczyński et al. (2014). They reported that few (1-3) individuals of the species were reliably recorded in Cyprus [4 records; although recently it was considered as a "very rare migrant" by De Knijf (2015)], Greece (2), European Turkey (4), Montenegro (1), Croatia (1), Bulgaria (1), Malta (3). An observation from Kaliningrad Oblast (Russia) was considered the northernmost record for Europe (Buczyński et al. 2014). Other recent records referred to an individual observed in Malta in 2014 (Gauci 2018), and to two individuals recorded at two sites in Poland in 2016 (Buczyński et al. 2019). Notably, apart from several claims from Germany, France, and Spain, which are considered as unreliable (Laister 2005; Ober 2008), the species has never been observed in Western and Central Europe, nor in the Iberian Peninsula, before 2019.

In Italy the species was first recorded in Pelagie islands (Linosa and Lampedusa, central Mediterranean), in October-November 2012 (Corso et al. 2012). Subsequently it has been regularly recorded (every year) in Linosa in October-November (Corso et al., 2017, 2012; A. Corso & O. Janni, pers. com.). In December 2012 the species was found for the first time in Sicily (Corso et al. 2017; Galasso et al. 2017), where it is now regularly observed from June to December, although no reproductive evidences have been claimed (A. Corso, pers. com.). No records of the species are available for mainland Italy.

In this contribution we report the first record of *Pan-*

tala flavescens for mainland Italy and one of the very few available for Western and Central Europe. Additionally, we discuss two hypotheses on the origin of this individual. To do this, we integrated available literature with several very recent records retrieved from citizen science faunistic platforms and commented local weather conditions during the days before the observation.

Results and discussion

On 14 Aug 2019 (9.35 a.m., local hour) one of us (LP) observed and photographed a female *Pantala flavescens* in Montanaro (Piemonte, NW Italy; WGS84: 45.247° N, 7.871° E; EPSG: 4326; 225 m). The dragonfly was found perching on the low (about 1.30 m) ruderal vegetation between a walnut orchard and a dirt road (Figure 1). No permanent standing water occurs within the observation site; however, several temporary ditches and some small rain pools are found nearby. The site is part of a cropland-dominated floodplain with few remnant patches of native woodland and it is very similar to many other places in the upper Po river Plain. After about 10 minutes, the individual fled and disappeared without being relocated subsequently. During the observation the weather was partly cloudy, with weak wind from north-west.

Clear evidences exist on the influence of weather conditions on the migration and stop-over of *Pantala flavescens* (Anderson 2009; Devaud & Lebouvier 2019); however, very little knowledge is available on how climate and

Fig. 1 – Female *Pantala flavescens* (dorsal and lateral view). 14 Aug 2019. Montanaro (TO), Piemonte, Italy. First record for mainland Italy. Photos: Lorenza Piretta.

local weather conditions influence dragonfly migration in Europe (Chapman et al. 2015). This considered, and given the scarcity of European records of this species, we can only speculate on the origin of this individual and about the causes of its occurrence in the study area. A first hypothesis is a southern origin. This hypothesis could be supported by the fact that, the days before the observation (between the end of the 11-12 Aug 2019), an Atlantic south-western front brought strong thunderstorms with heavy rains in the region. Since the night of 13th August, the prevailing winds had turned into north-north west and blew weakly to moderately with extensive *foehn* conditions (data derived from http://www.arpa.piemonte.it and www.ventusky.com).This could suggest that the observed individual could have been pushed to the study area by these wet southern winds and then it was obliged to stop, interrupting his migration due to the rains.

The Sahara desert has been suggested to act as a barrier for the movements of this species, because it cut off the Maghreb from the continent's interior, and because dry winds, which are particularly unfavourable for dragonfly migration, prevails there (Buczyński et al. 2014, 2019; De Knijf 2015). This was suggested as a possible explanation for the rarity of occurrence of *Pantala flavescens* in Europe, and in particular in the western part of the continent; however, this cannot be a rule considering the increasing number of Sicilian records and the fact that in the summer 2019 there was an unprecedently reported influx of this species in Europe, including its western part. Although most of the 2019 records are still unpublished and even more will probably come to light in the future, an opportunistic (and thus surely not exhaustive) survey on several recognised citizen science platforms allows to find several records with photographic evidence (thus certain), which are summarized as follow:

- Belarus. 1, 15 Jul 2019, Klyaschchy, source: https://observation.org/waarneming/view/178642613
- France. 1, 12 Aug 2019, Saint-Paul-la-Coste (Gard), source: http://www.naturedugard.org/atlas.php?id_groupe=5&id_sp=65369#65369
- Malta. 1, 08 Aug 2019, Imselliet Valley (Gauci 2019); 1, 27 Oct 2019, Imselliet Valley and 1, 30 Oct 2019, Chadwick Lakes, C. Gauci (pers. comm.)
- Cyprus. 1, 11 Sept 2019, Konia, source: https://www.inaturalist.org/observations/32517275

In addition to the above data, millions of individuals were reported on the southern coast of Turkey (Göksu Delta) on 20 Aug 2019 (source: https://observation.org/waarneming/view/178702606), suggesting a massive influx of the species in the Eastern Mediterranean basin during the days of the Italian observation. Although this last record might support the hypothesis of a southern provenance of the Italian individual, it appears to be in contrast with a western trajectory of origin. Unfortunately, based on our current poor comprehension on the movements of this species in Europe, it is impossible to favour one or another option.

Even though the reproduction of the species in Europe was supposed only once (in Rhodes, Greece; Laister 2005), and records from Europe and Anatolia mostly span from June to November (Boudot & Kalkman 2015), the few spring observations available for Europe could suggest a second, probably less supported, though fascinating, hypothesis on the origin of the Italian *Pantala flavescens* and possibly of other summer/autumn records. In fact, given the adaptability and reproductive plasticity of this species, it is not impossible to imagine that some individuals arrived in Europe in spring were able to complete their very quick reproductive cycle here; therefore, at least some of the individuals reported in summer-autumn, might be the offspring of these early migrants. The very scant body of evidence available in this sense could be due to the rarity of this phenomenon and to the fact that *Pantala flavescens* exploits very temporary and artificial waters for reproduction, which are difficult to find and substantially neglected by odonatologists. The (still doubtful) reproduction of the species in Europe could be facilitated by the pattern of climate warming affecting Europe, which was proven or supposed to foster the northward expansion of several warm-climate adapted dragonfly species (Hassall & Thompson 2008; Ott 2010; Polette et al. 2017; Rattu et al. 2014).

Considering that the interest for dragonflies in Europe has rapidly increased from the late 1990s onwards, also among amateur naturalists (Kalkman et al. 2018), it is still to clarify whether the observed rise of European records of *Pantala flavescens* since 2010 (De Knijf 2015) is due to an effective increase of individuals which are able to reach (and possibly reproduce in) Europe, or to a boom in the number of people which are able to detect this species. Only the accurate archiving of these out-of-range occurrence records and future synthesis will hopefully answer this question.

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