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Successful breeding by *Pantala flavescens* in Germany (Odonata: Libellulidae)

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Abstract. On 06-vii-2019 a single male of *Pantala flavescens* was recorded in the early post-mining landscape of Lower Lusatia, south-eastern Brandenburg, Germany. This was the first record of this migratory species in Germany not attributable to human transportation. On 17-viii-2019 an exuviae and a single adult in late teneral condition were found at the same site. According to current knowledge this is the first confirmed record of a successful breeding of *P. flavescens* in Europe.

Further key words. Dragonfly, Anisoptera, Wandering glider, Europe, dragonfly migration

Introduction

Despite its worldwide distribution and its highly migratory biology (*e.g.*, Troast et al. 2016) records of *Pantala flavescens* (Fabricius, 1798) from continental Europe are hitherto surprisingly rare (Kalkman & Monnerat 2015). Both authors list and discuss in detail all records of species known up to 2014. This review has been updated by Corso et al. (2017) and Buczyński et al. (2019).

In Europe and nearby relatively regular sightings of *P. flavescens* have only been recorded in the Marmara Region of Turkey (Buczyński et al. 2019; Jean-Pierre Boudot pers. comm.), in the Sicilian Channel islands, especially on the Pelagie islands and, more rarely, on the Sicilian mainland (Corso et al. 2017). Degabriele (2014) provided recent records from the Maltese Archipelago. Despite the numerous current records in the eastern and central Mediterranean, so far no evidence for a successful breeding of the species in continental Europe has been published. With regard to Italy and the central Mediterranean basin, Corso et al. (2017) wrote: »Although the species is a regular migrant also in Sicily mainland, where no doubt a number of suit-

able biotopes exists, there is at present no evidence of breeding in Italy«. All other European records seem to be more or less single events. Probable cause of the rarity is the infrequent occurrence of humid air currents from the tropics (Wildermuth & Martens 2019), so that migratory swarms only occasionally reach Europe.

From Central Europe *sensu lato* records so far have only been published from the Croatian island of Krk (Finkenzeller 2010), Kaliningrad Oblast (Buczyński et al. 2014), and Poland (Buczyński et al. 2019). During an Odonata survey of the early post-mining landscape of Lower Lusatia (south-eastern Brandenburg, Germany) on 06-vii-2019 the first record of *P. flavescens* for Germany had been made (Günther 2019). A male of the species patrolled persistently over a small pond. Surprisingly, 42 days after the first record at the same site, there was a second record of an imago and also the discovery of an exuvia. According to current knowledge this is this is the first confirmed record for successful breeding of *P. flavescens* in Europe and therefore details of the discovery are given and the record is discussed.

Study site and methods

Lignite mining has influenced and disturbed large swathes of Lower Lusatia in south-eastern Brandenburg (NE-Germany). The mining companies are obliged to restore the landscape after mining activities have been completed. As a part of this restoration, artificial catchment areas are often established to supply habitats for aquatic species. The study site (51.612500°N, 14.181389°E; 115 m a.s.l.) is part of one of these newly built artificial water bodies in the early post-mining landscape (Fig. 1). A multi-layered body of quaternary sand has been dumped on a north-south inclined base layer of tertiary clay. This has facilitated the accumulation of a local body of groundwater. Stored rainwater should feed a shallow 1 ha pond in the future. Due to drought, the surface area of water in July/August 2019 was only 300 m², with a maximum water depth of 10 cm. A single measurement on 23-viii--2019 gave a pH of 3.9 and an electrical conductivity of 1 400 µS/cm. Almost all other ponds in the near vicinity were dried up. The vegetation of the pond was still in an early successional phase and dominated by common reed *Phragmites australis*, bushgrass *Calamagrostis epigejos* and common barnyard grass *Echinochloa crus-galli*. To the west of the area an approxi-

mately 7 m high slope and a pine forest provide protection from westerly winds and hence favourable climatic conditions.

The study site experiences the Central European temperate transitional climate, characterised by low rainfall, hot summers, and cold winters. The long-term (1961–1990) average annual air temperature for the DWD weather station Cottbus (20 km NNE) is 9.6°C. The lowest average monthly temperature of 0.3°C was in January, the highest of 19.4°C was in July. For the period of observations, between 6-vii-2019 and 17-viii-2019, the average air temperature at 2 m above ground was 20.2°C (all climate data from DWD CDC 2019).

From May to August 2019 the site was visited nine times to monitor the odonate fauna (23-v-, 13-vi-, 06-vii-, 07-vii-, 17-vii-, 25-vii- [M. Olias], 16--viii- [M. Olias], 17-viii-, and 23-viii-2019). Both imagines and exuviae were recorded. On 23-viii-2019 an additional intensive search for larvae took place.

Results

On 06-vii-2019 a male of *Pantala flavescens* was observed and photographed at the pond (Günther 2019). The visits to the site on the following days as well as the search in nearby habitat were at first unsuccessful. I was therefore the more surprised by the observation of a second individual of *P. flavescens* on 17-viii-2019 at the same locality. The imago clung to a tussock of *Calamagrostis epigejos* and flew off as I approached. Later, it flew several times on the slope. It was in an early post teneral condition and most probably had not emerged that day. The search for exuviae led to the discovery of a single specimen (Figs 2, 3).

The search for larvae on 23-viii-2019 resulted in records of *Libellula depressa* Linnaeus, 1758, *Orthetrum brunneum* (Fonscolombe, 1837), and *O. coerulescens* (Fabricius, 1798). *Ischnura elegans* (Vander Linden, 1820), *I. pumilio* (Charpentier, 1825), and *Sympetrum striolatum* (Charpentier, 1840) were recorded as exuviae or freshly emerged individuals. A further search for *P. flavescens* at the site and in adjacent areas was unsuccessful.

Discussion

On 06-vii-2019 I had observed a single male at the same site in south-eastern Brandenburg (Günther 2019). Therefore, at least a second individual – a female – must have arrived at the site. The exact date of oviposition is

unknown. It was probably on the same day or just before. From 07-vii-2019, a period with air temperatures below 20°C began during which activity by *P. flavescens* would have been unlikely. The interval between the first observation and the discovery of the exuviae was 42 days. This corresponds very well to the known minimum development time of less than 40 days (Suhling et al. 2004). According to current knowledge this is the first confirmed record for successful breeding of *P. flavescens* in Europe.

Despite its primarily circumtropical distribution, *P. flavescens* is also found in many temperate areas including the large parts of the United States and southern Canada (Needham et al. 2000), Central Asia (Borisov 2015), Transbaikalia and the Far East of Russia (Borisov & Malikova 2019). The more surprising is the lack of evidence of breeding in Europe. Only in the extreme east of the Black Sea does *P. flavescens* seem to have established. Seehausen et al. (2016) note: »Further records of *Pantala flavescens* sug-

Figure 1. Habitat of *Pantala flavescens* in the early post-mining landscape near Neupetershain, south-eastern Brandenburg, Germany. Photo: AG (17-xiii-2019)

Figure 2. Exuviae of *Pantala flavescens* at the locality in the early post-mining landscape near Neupetershain, south-eastern Brandenburg, Germany. Photo: AG (17-xiii-2019)

Figure 3. Exuviae of *Pantala flavescens* from Figure 2 still clinging to emerging substrate but for the photo taken from the emergence place in south-eastern Brandenburg, Germany. Photo: AG (17-xiii-2019)

gested rather regular occurrence in Georgia, being an integral part of the Georgian dragonfly fauna« and A. Schröter (pers. comm.) added »that several records of evidenced reproduction are known from the Georgian Black Sea coast«. It is still unknown where the individuals that emerge near the Black Sea coast go to. For Central Asia and the Russian Far East it was attributed to an annual immigration from the South in the spring. The incoming adults breed and contribute to a much larger summer population. At least some of the emerging individuals of these summer generations seem to migrate south in late summer and early autumn (Borisov 2012, 2015; Kalkman & Monnerat 2015; Borisov & Malikova 2019).

From Italy, including the adjacent islands, there is still no evidence for breeding by *P. flavescens* (Corso et al. 2017). The situation is slightly different in the eastern Mediterranean. Arlt (1999) reported the first breeding record in Turkey (23-vi-1998, Göksu Delta), and Laister (2005) caught a female of the species in a late teneral condition near Apolakkia on Rhodes on 29-viii-2001. The Cyprus Dragonfly Study Group has found the species every year since 2012 but the number of records has varied considerably from year to year. Peak season in these years was August until November. Many of the observed individuals arrived on Cyprus from the south or departed to the North. But there were observations of reproductive behaviour including pairs in copula and ovipositing females. In 2018 they obtained a larva and a specimen in a late teneral stage. *Pantala flavescens* has not yet been recorded on Cyprus between February and June. In 2019 the earliest sighting was on 24th July (D. Sparrow pers. comm.). So it is very unlikely that the individual reported here originated from Cyprus.

In the Nile valley, North Africa, and the Levant *P. flavescens* is found throughout the year, although migrating swarms in the Nile valley are mainly observed between May and January (Kalkman & Monnerat 2015). This tends to suggest an African origin for the observed vagrants in northern Germany.

It can be safely assumed that neither eggs or larvae, nor imagines of *P. flavescens* can successfully overwinter in Central Europe. However, permanent establishment is not always expected in nomadic species, the occurrence of which often depends on constant or sporadic immigration and emigration throughout much its vast range. The current wind and weather

conditions in Central Europe very seldom favour such migratory behaviour. This means the described observation may very likely be a singular event. This record of *P. flavescens* north of the Alps does not correspond to any known pattern of range expansion to the North, as has been observed in species such as *Anax imperator* Leach, 1815, *Crocothemis erythraea* (Brullé, 1832) or *Orthetrum albistylum* (Selys, 1848) in recent decades in Europe. Although a summer generation of *P. flavescens* could undoubtedly develop under present climatic conditions in Central Europe, the occurrence of the species in the near future will remain dependent on suitable air currents and weather conditions, favourable contingencies and presumably precipitation the eastern Mediterranean and northern Africa.

It would be interesting to correlate the known data of influxes of *P. flavescens* with weather phenomena that occur in Europe like the North Atlantic Oscillation. However, the results of Haest et al. (2017) suggest any such analysis should proceed with caution.

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