

Selysiothermis nigra* new for continental France (Odonata: Libellulidae)

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Abstract

On 24-vii-2020 one adult male and two exuviae of *Selysiothermis nigra* were found in the middle Durance Valley, southern France, in the North of the Var department, not far from the village of Vinon-sur-Verdon. These observations are the first records of the species in continental France. The exuviae were found on the shore of a former gravel pit, while the imago was photographed perching on a stem at a river bank near the Durance. The findings are discussed regarding the hitherto known range of the species, and possible immigration routes are described. The nearest sites where the species occurs are situated in northwestern Italy, northeastern Corsica and northeastern Spain, between 250 and 330 km from the Durance Valley. Most probably there is a migration of *S. nigra* along the shore of the Mediterranean Sea, either from the Southwest (Spain) or the Southeast (Corsica and Italy), before entering continental France and following the Durance Valley. The causes of an increase of records of *S. nigra* in an almost constant range, as well as the obvious spreading of other species like *Trithemis annulata* and *T. kirbyi*, are discussed. Climate change has clearly favoured the expansion of at least *T. annulata* and *T. kirbyi* during the last decades and years, respectively, and these species entered continental France coming from Spain. However, the increase of anthropogenic water bodies like man-made dams, irrigation basins, impoundments or gravel pits have also favoured this trend as recently stated for the highly ubiquitous *T. kirbyi*, for which both climate and habitat changes act in synergy. In the case of *S. nigra*, the increasing availability of such artificial, suitable habitats might be the main reason for the expansion as the species has been demonstrated to have recently established in areas where temperatures have decreased and rainfall increased since the turn of the millenium. Whether climatic factors also have a significant influence on the increase of observations and the small range expansions of this species might be made clearer by future research.

Résumé

***Selysiothermis nigra* nouvelle espèce pour la France continentale (Odonata: Libellulidae)**
– Le 24 juillet 2020, un mâle et deux exuvies de *Selysiothermis nigra* ont été trouvés dans

* dem Baron der Schweizer Libellenkunde zum 80. Geburtstag gewidmet

la vallée de la Moyenne Durance, dans le sud-est de la France, au nord du département du Var, non loin du village de Vinon-sur-Verdon. Ces observations sont les premières données de l'espèce en France continentale. Les exuvies ont été trouvés sur les rives d'une ancienne gravière, tandis que l'imago a été photographié assis sur une tige au bord d'un gravier près de la Durance. Ces observations sont discutées dans le contexte de l'aire de distribution connue de *S. nigra*, ainsi que ses voies d'immigration possibles vers la France continentale. Les sites les plus proches, où l'espèce a été trouvée, sont situés dans le nord-ouest de l'Italie, le nord-est de la Corse et le nord-est de l'Espagne, à 250 à 330 km de la vallée de la Moyenne Durance. Les voies d'immigration les plus probables du *S. nigra* sont celles qui longeraient les côtes méditerranéennes, soit en provenance du sud-ouest (Espagne), soit du sud-est (Corse et Italie), avant que l'espèce puisse emprunter la basse vallée du Rhône et la vallée de la Durance sur le continent. Les raisons de l'augmentation des observations concernant *S. nigra* dans une région méditerranéenne élargie mais à peu près constante depuis plusieurs décennies puis de sa faible expansion qui ne semble que débiter dans certaines parties de son aire de répartition, ainsi que celles d'autres espèces, telles que *Trithemis annulata* et *T. kirbyi*, sont discutées. *T. annulata* et *T. kirbyi* sont arrivées en France continentale au cours des dernières décennies et années en provenance de l'Espagne, poussés en cela dans une large mesure par le réchauffement climatique. La multiplication des barrages, bassins de rétention et gravières a cependant favorisé cette tendance et il est particulièrement clair pour *T. kirbyi* que les paramètres climatiques et les modifications d'habitat ont tous deux agi en synergie pour favoriser une expansion rapide de l'espèce du sud au nord de l'Espagne puis son apparition en France. Pour *S. nigra*, la multiplication des retenues d'eau artificielles appropriées à l'espèce est probablement la principale cause de la multiplication des sites reproducteurs de l'espèce car elle s'est récemment implantée dans des régions où la température avait diminué et la pluviométrie augmentée. L'influence éventuelle des facteurs climatiques sur la répartition et le détail de la distribution de cette espèce devra être clarifiée par des enquêtes ultérieures.

Zusammenfassung

***Selysiothemis nigra* neu für das kontinentale Frankreich (Odonata: Libellulidae)** – Am 24. Juli 2020 wurden im mittleren Durancetal, Südfrankreich, im Norden des Departements Var, unweit des Dorfes Vinon-sur-Verdon, ein adultes Männchen und zwei Exuvien von *Selysiothemis nigra* gefunden. Diese Beobachtungen sind die ersten Nachweise der Art für das kontinentale Frankreich. Die Exuvien wurden am Ufer einer ehemaligen Kiesgrube gefunden, während die Imago auf einem Halm am Rande einer Kiesbank in der Nähe der Durance sitzend fotografiert wurde. Die Funde werden im Hinblick auf das bisher bekannte Verbreitungsgebiet der Art und mögliche Einwanderungswege diskutiert. Die nächsten Fundorte mit Nachweisen der Art liegen in Nordwestitalien, im Nordosten Korsikas und in Nordostspanien, 250 bis 330 km vom Durancetal entfernt. Am wahrscheinlichsten ist die Migration von *S. nigra* entlang der Mittelmeerküste, entweder aus dem Südwesten (Spanien) oder dem Südosten (Korsika und Italien), bevor sie dem Durancetal folgend ins französische Festland gelangte. Die Ursachen für die Zunahme der Nachweise von *S. nigra* in einem nahezu konstanten Verbreitungsgebiet, sowie für die offensichtliche Ausbreitung anderer Arten, wie *Trithemis annulata* und *T. kirbyi*, werden diskutiert. Der Klimawandel

hat die Ausbreitung zumindest von *T. annulata* und *T. kirbyi* in den letzten Jahrzehnten bzw. Jahren gefördert. Diese Arten wanderten auf dem französischen Festland von Spanien her ein. Die Zunahme anthropogener Gewässer wie Stauseen, Bewässerungs- und Rückhaltebecken sowie Kiesgruben hat diesen Trend begünstigt. Dies wurde kürzlich für die weit verbreitete *T. kirbyi* festgestellt, die sowohl von Klima- als auch von Habitatveränderungen profitiert. Für *S. nigra* dürfte die zunehmende Verfügbarkeit solcher künstlichen, für sie geeigneten Gewässer der Hauptgrund für die Ausbreitung sein. Dies lässt sich auch daraus ableiten, dass die Art sich kürzlich in Regionen angesiedelt hat, in denen Temperaturrückgänge und eine Niederschlagszunahme seit Beginn dieses Jahrtausends beobachtet wurden. Ob auch klimatische Faktoren einen wesentlichen Einfluss auf die Häufigkeitszunahme und leichte Ausbreitung dieser Art haben, kann nur durch zukünftige Untersuchungen geklärt werden.

Introduction

Selysiotthemis nigra has a huge range which covers the whole Mediterranean Basin, the Black Sea and the Middle East (including Iran and the whole Arabian Peninsula) as well as parts of the Sahara. In Asia it is known from all Central Asian countries and reaches Pakistan, NW India, the southern Ural in Russia and the westernmost part of China in Xinjiang (KALKMAN & BOGDANOVIC 2015: 291–292; WILDERMUTH & MARTENS 2019: 732–733; ZHANG 2019). More to the East, some regional records refer to northeastern China in Inner Mongolia, Liaoning, Hebei and Beijing. The species is known as a highly mobile, migratory species, and its swarming behaviour has been documented several times (e.g. SCHNEIDER 1981; see also WILDERMUTH & MARTENS 2019: 733). That allowed the species to establish in many Mediterranean islands (KALKMAN & BOGDANOVIC 2015: 291–293) if favourable habitats are present. In France *S. nigra* had been observed for the first time in Corsica in 2015 (SANNIER 2015), but until now no record from continental France has been documented or published.

Within the last three decades, several species with African or south Mediterranean distribution have been discovered as new in continental France, including *Trithemis annulata*, *T. kirbyi* and *Pantala flavescens* (GRAND 1994; POLETTE et al. 2017; SOUSTELLE et al. 2019). This paper deals with the observation of *S. nigra* in summer 2020 in the Var department, being the first record for continental France.

Observations

On 24 July 2020 I visited a water body in the middle Durance Valley, three kilometers northwest of Vinon-sur-Verdon (43.74418° N, 5.77926° E; 260 m a.s.l.). The site called “les Iscles de Notre Dame” is located in the northwestern part of the French Var departement (region Provence-Alpes-Côte d’Azur), but is only a few hundred meters distant from the border to the Alpes-de-Haute-Provence de-

partement. The site is a former gravel pit now used as a fish pond with a water surface of 3.8 ha.

The weather was sunny and hot, the maximum temperature reached 32°C. A moderate but gusty wind was blowing southwestward down the valley (3–5 on the Beaufort scale). The observations were made between 15:00 h and 17:00 h CEST.

At the shore of the gravel pit, exuviae were collected. Two of them were identified only a few days later as *S. nigra* (Fig. 1). The determination of the exuviae was conducted by using CONESA GARCIA (1985), HAGEN (1996), GERKEN & STERNBERG (1999) and CARCHINI (2016). The exuviae weren't fresh, emergence probably having taken place several weeks earlier.

Besides *S. nigra*, the following species were observed at the former gravel pit (im = imagines; ex = exuviae):

Erythromma lindenii (im/ex), *E. viridulum* (im), *Enallagma cyathigerum* (im/ex), *Ischnura elegans* (im/ex), *Anax parthenope* (im), *Onychogomphus forcipatus* (ex), *Crocothemis erythraea* (im/ex), *Orthetrum cancellatum* (im/ex), *Orthetrum coerulescens* (im), *Sympetrum fonscolombii* (ex), *S. striolatum* (ex) and *Trithemis annulata* (im).

At the gravel pit a little black anisopteran male belonging to Libellulidae was observed only a few meters away onshore, but could not be caught for further



Figure 1. Exuvia of *Selysiothemis nigra*, lateral view, gravel pit near Vinon-sur-Verdon, Var department, southern France, 24-vii-2020. – **Abbildung 1:** Exuvie von *S. nigra*, Seitenansicht, Abgrabungsgewässer bei Vinon-sur-Verdon, Departement Var, Südfrankreich, 24.07.2020. Photo: ML

identification. It was probably a male of *S. nigra*. A little bit later, at the banks of the Durance river 500 m west of the gravel pit another black libellulid was observed, perching on a stem of the sparse vegetation of the river bank, oriented against the wind, not far from the shore of another former gravel pit. It was observed for more than 20 minutes, and several photographs were taken despite the gusty wind (Figs 2, 3). The individual was identified without any doubt as a male of *S. nigra*.

Discussion

Range and possible immigration routes

In the Mediterranean Basin, most records of *S. nigra* are from coastal areas, whereas the species occurs in inland desert regions, mainly in oases in North Africa and West Asia (Fig. 4; KALKMAN & BOGDANOVIC 2015: 291–293).

From the Mediterranean area the species has been known for a very long time. Pierre Léonard Vander Linden described the species in 1825 based on a single individual from Terracina in the Lazio region in Central Italy (COMPTE SART 1960).



Figure 2. Male of *Selysiotthemis nigra*, dorsal view, gravel pit near Vinon-sur-Verdon, Var department, southern France, 24-vii-2020. – **Abbildung 2:** Männchen von *S. nigra*, Rückenansicht, Abgrabungsgewässer bei Vinon-sur-Verdon, Departement Var, Südfrankreich, 24.07.2020. Photo: ML

It was found in the end of the 19th century in Spain, but until the 1960s there had been few records of the species (COMPTE SART 1960). In the following decades, the knowledge about the species' distribution grew significantly. Its hitherto known range in the European part of the Mediterranean area extends from Portugal in the west to Greece and the European Turkey and most of the Black Sea coast in the east, including most countries and large islands within the Mediterranean Basin (Fig. 4; KALKMAN & BOGDANOVIC 2015: 291–292). The most northern records in the Mediterranean area originate from northeastern Italy and Slovenia (ZANDIGIACOMO & BUIAN 2010; UBONI et al. 2015), those in Friuli Venezia Giulia (North Italy) being the most northern observation worldwide with evidence of autochthony (UBONI et al. 2015).

The observation of *S. nigra* in the Middle Durance Valley is, as far as is known, the first documented record of this species in continental France. The first observation for France was made in 2015 in the northeastern part of the island of Corsica, where a single immature male was observed (SANNIER 2015). Several observations of imagines, as well as records of exuviae at two sites in the surroundings in 2016 and 2017 (BERQUIER et al. 2017) documented the establishment of the species in Corsica, with at least one autochthonous population. The



Figure 3. Male of *Selysiotthemis nigra*, lateral view, river bank of the Durance near Vinon-sur-Verdon, Var department, southern France, 24-vii-2020. – **Abbildung 3:** Männchen von *S. nigra*, Seitenansicht, Kiesbank der Durance bei Vinon-sur-Verdon, Département Var, Südfrankreich, 24.07.2020. Photo: ML

distance from the Corsican sites to continental France is about 200 km, that to the location in the Durance Valley amounts to 330 km in northwestern direction.

The next known sites of the species to the Durance Valley are situated in north-western Italy in the Piedmont region, where *S. nigra* was found at two artificial water bodies with proof of reproduction (SUBRERO 2014). These sites are located 250 km northeast of the Durance Valley locality. In northeast Spain the species was found only 25 km south of the border with France in Catalonia (FERNÁNDEZ & ÁLVAREZ 2017), approximately 300 km southwest of the location in the Durance Valley.

Selysiotthemis nigra is an excellent flier – supported by its great wing surface in relation to the body size (Fig. 2) – and is a very mobile species. Its migratory capabilities are well known by many observations of swarms (e.g. SCHNEIDER 1981; HOLUŠA 2011) and are accounted for by its establishment on many remote islands in the Mediterranean when favourable habitats for reproduction occurred. The observed individual in the Durance Valley didn't show swarming behaviour, as described in HOLUŠA (2011), who observed a group of individuals restlessly flying over two hours 0.5 to 2.5 m above the ground. The behaviour of the male photographed in the Durance Valley can be best characterized as described in

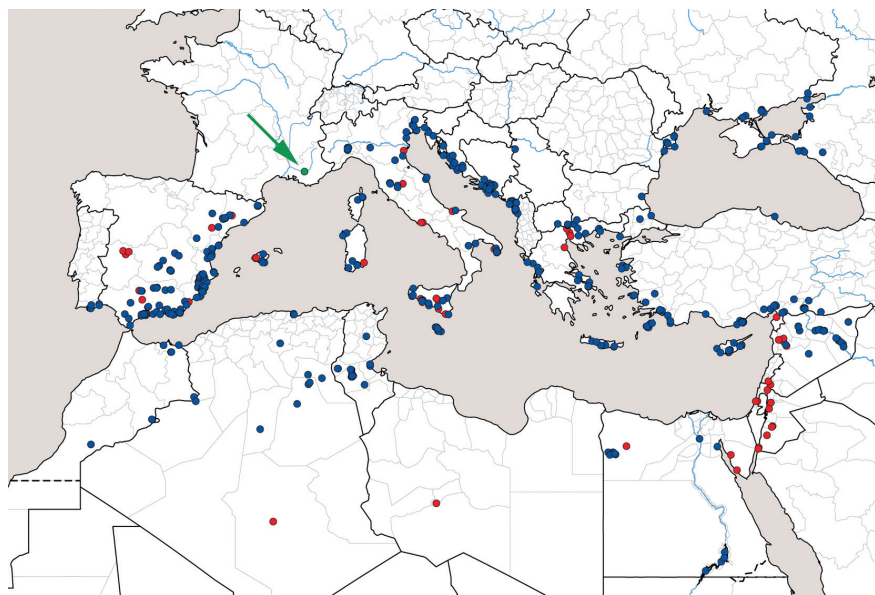


Figure 4. Hitherto known distribution of *Selysiotthemis nigra* in the southwestern Palearctic. – **Abbildung 4:** Bislang bekannte Verbreitung von *S. nigra* in der südwestlichen Paläarkt. ● records/Nachweise < 1990; ● records/Nachweise ≥ 1990; ● record in continental France (this paper)/Nachweis im kontinentalen Frankreich (in dieser Publikation); Map by/Karte von Jean-Pierre Boudot

KALKMAN (2020: 313): perching »on prominent stakes, often with the abdomen and wings slightly raised, ruffling in the breeze like a pennant« (Fig. 3). Perhaps the male perched some metres distant from a water body suitable for reproduction. Nevertheless, migratory behaviour could be another possible explanation, with the male roosting due to the gusty wind, while migrating along the Durance Valley.

SCHNEIDER (1981) supposed linear structures in the landscape are possible parameters helping migratory routes for *S. nigra*. The most probable migration axis for the species in southern France might be coastal lines as well as valleys, like the Côte d'Azur, the shore of the Languedoc region and the Rhône and Durance Valleys. It cannot be excluded that the species had been overlooked in recent years, but the Durance Valley is well prospected by odonatologists, and the Odonata fauna is well documented (e.g. PAPAIZIAN et al. 2017). It seems more probable that the species immigrated from the Mediterranean shore to inland France following the Rhône and the Durance Valley from southwest to northeast. Whether the species reached continental France from the east (northwest Italy), the southeast (Corsica) or the southwest (northeast Spain), remains unclear. The site in the Piedmont region is the nearest, but the Alpes-Maritimes range, which approaches 3,000 m a.s.l. between the Italian and the French sites, would be too strong an obstacle. Perhaps the species took the same immigration route to continental France and to northern Italy by migrating northwards along the shore of the Tyrrhenian Sea from coastal areas of Tuscany, where the species occurs on several sites (cf. Fig. 4; RISERVATO et al. 2014).

Breeding and Odonata assemblage

The finding of two exuviae, as well as the observation of one or two adults, suggests the presence of a population since at least 2019. The species is bivoltine in one of the warmest regions of Central Asia (BORISOV 2005), but no data for voltinism are available for Europe (BOUDOT et al. 2017). However, there is no evidence for bivoltinism in the prospected site in southern France, at the northern limit of its European distribution. Finding of exuviae at least a few weeks old suggests an emergence period from the end of June to July. This is in accordance with observations in Corsica, Sardinia and northern Italy, where exuviae of *S. nigra* were found from June to the beginning of July (SUBRERO 2014; BERQUIER et al. 2017; R. Jödicke pers. comm.).

The assemblage of Odonata occurring syntopically with *S. nigra* in the gravel pit in the Durance Valley is similar to those found in the Piedmont in northern Italy (SUBRERO 2014). Many species of sunny, shallow standing waters were present besides *S. nigra* in both sites: e.g. *A. parthenope*, *S. fonscolombii* and *C. erythraea*. Noteworthy is the presence of *O. forcipatus* exuviae in both gravel pits in the Piedmont as well as in the Durance Valley. In southern France the species is well known to be typical for running waters as brooks, streams and rivers. In the region of Provence-Alpes-Côte d'Azur it also rarely inhabits standing water bodies like gravel pits and ponds (PAPAIZIAN et al. 2017).

Possible causes for the increase of records of *S. nigra* and other species

Several species with African or subtropical distribution have been recorded for the first time in continental France since the 1990s. *Trithemis annulata* appeared in 1994 in continental France (GRAND 1994), after it had been found in 1988 in Corsica (ROCHÉ 1989). *Trithemis kirbyi* was observed in 2017 at five different sites in several departments for the first time in southern France (POLETTE et al. 2017). The latest new member of the Odonata fauna of continental France is *Pantala flavescens* (SOUSTELLE et al. 2019) found in the Gard department in 2019. Both *T. annulata* and *T. kirbyi* immigrated from Africa to the Iberian Peninsula, 16 and 10 years before their first occurrence in southern France, respectively. *Trithemis annulata* has extended its range in continental France since the 1990s, when the species was found for the first time, and is now widespread and locally abundant in many southern departments (BOUDOT et al. 2017). Records of exuviae of *T. kirbyi* in the region Nouvelle-Aquitaine, southwestern France, in 2020 give evidence of reproduction (OPIE ODONATES 2020). It is to be expected that the species has already become permanently established in the country, or will in the next few years. Whether *S. nigra* will also become a permanent member of the Odonata fauna of continental France remains to be seen, but records of exuviae in the Durance Valley suggest that the species has already successfully reproduced. Discovery of more populations may occur, especially along the expected species immigration route.

With regards to *T. annulata* and *T. kirbyi*, two factors have been discussed as causes for the northward expansion of their range. They obviously benefited by the large number of artificial habitats in many regions, such as irrigation reservoirs and impoundments that have been constructed. For *T. annulata* the warmer climate is suggested as the main driver of the range extension (KALKMAN et al. 2015: 313–315). The immigration waves of *T. kirbyi* are particularly related to heatwaves coming from the Sahara to Europe and it is obvious that both changes in climate and habitats acted synergistically on the northern expansion of e.g. *T. kirbyi* (e.g. POLETTE et al. 2017).

Some authors consider climate change as a cause of a range extension of *S. nigra* as doubtful. MARTYNOV et al. (2015) didn't ascribe the expansion of this species at the northern shore of the Azov Sea (Ukraine) to climate warming, because the climate in the region showed a decrease in temperatures and an increase of precipitation over the last 75 years.

In coastal areas of the Mediterranean Basin *S. nigra* inhabits shallow, often brackish and temporary water bodies. In contrast, most of the observed individuals and populations of *S. nigra* in inland regions of mainland and islands of the Mediterranean area are found in artificial habitats (KALKMAN 2020: 313). Aside from coastal areas the species seems to prefer those water bodies like currently used or former gravel pits, shallow lakes, impoundments, reservoirs or park lakes. It was found autochthonous in such habitats e.g. in Corsica and in northern Italy (SUBRERO 2014; UBONI et al. 2015; BERQUIER et al. 2017) as well as in the Durance Valley. *Selysiotthemis nigra* has obviously benefited from the increase of

man-made dams, reservoirs and lakes in many parts of the Mediterranean Basin (e.g. KALKMAN & BOGDANOVIC 2015: 292–293; UBONI et al. 2015). Thus, the main driver of expansion might be the increasing availability of such anthropogenic, suitable habitats.

Nevertheless, COMPTE SART (1960) linked the northern limit of the range of *S. nigra* with the 25°C isotherm of July suggesting a climatically induced dependency of the species' distribution. To what extent climatic factors and climate change are related to the increasing number of records of *S. nigra* remains unclear but for this species too it is likely that climate and habitat changes are both synergistically responsible for increasing records, and future northern expansion if any.

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