First records of the species *Tinodes pallidulus* (McLachlan, 1878) in Norway (Trichoptera, Hydropsychoidea, Psychomyiidae)

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Persson, J. & Wiberg-Larsen, P. 2020. First records of the species *Tinodes pallidulus* (McLachlan, 1878) in Norway (Trichoptera, Hydropsychoidea, Psychomyiidae). *Norwegian Journal of Entomology* 67, 97–100.

In this note, the first record of *Tinodes pallidulus* (McLachlan, 1878) in Norway is reported.

Key words: Trichoptera, Psychomyiidae, *Tinodes pallidulus*, larval stage, new records.

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Introduction

The Trichoptera (caddis flies) are a relatively small sister group of the much larger order Lepidoptera (butterflies). Globally, the number of known species is about 14,500 and in Europe at least 1582. In Norway, 202 species are recorded so far (Artsdatabanken).

In this note, we report the first record of *Tinodes pallidulus* (McLachlan, 1878) in Norway. According to Neu *et al.* (2018), *T. pallidulus* is widely distributed in Europe, although concentrated in its central part. It is found from Denmark/South Sweden in the north to northern Italy and the Balkans in the south (even with one record from western Turkey), and from southern England in the west to western Turkey in the east. The closest records to the new sites in Norway are in Denmark (see "Comments").

The species belongs to the family Psychomyiidae that in Europe includes 115 species, about 90% of which belong to the genus *Tinodes* (Neu *et al*. 2018). Species richness increases markedly going from north to south, and richness is especially high in mountainous areas, where they have a high degree of endemism, as demonstrated for other running water Trichoptera (Wiberg-Larsen 2008). The majority of the species inhabit different kinds of running waters, including hygropetric habitats where water is seeping as a thin film over rock surfaces. Larvae of Psychomyiidae are characterized as gallery-builders, constructing fixed, tunnel-shaped, structures on solid substrates like dead wood or stones (e.g. Edington & Hildrew 1995). These tubes are made of fine wooden or mineral particles glued together with silk, each housing a single larva, feeding (*i.e.* grazing) on detritus or periphytic algae at the area just in front of the anterior tunnel-opening. Larvae continuously enlarge their galleries to access new food resources.

Material and methods

The larval specimens of *T. pallidulus* were collected from streams using semi-quantitative kick sampling at stations surveyed as part of regional monitoring programs. The samples were preserved with EtOH alcohol in the field and the material was later sorted and animals identified in the laboratory. Identification was made according

to Edington & Hildrew (1995) and Rinne & Wiberg-Larsen (2017). The identifications were further verified by the co-author of the present note.

We also attempted to carry out DNA barcoding on legs and subsequently most of the abdomen from the first found specimen. This was done in cooperation with The Natural History Museum at the University of Oslo. However, despite several attempts, the results from the analyses were not sufficient for species identification.

Details about the sampling method and localities for records one and two, including photos from the stations, can be found in Persson (2019) [in Norwegian, abstract in English]. Information about record three is found in Hobæk *et al.* (2019) [in Norwegian, abstract in English]. Material is kept in the collection of the "Macroinvertebrate Working Group" at the Norwegian Institute of Water Research (NIVA) in Oslo.

Localities are listed according to counties as defined after the 2020 Norwegian municipal and regional reform. EIS-locations are given according to Endrestøl (2005).

Records

Tinodes pallidulus McLachlan, 1878

First records from Norway, see also Figure 2. All first identified by J. Persson.

Material: Vestfold og Telemark: Larvik, Tjodalyng, small unnamed side stream to Istreelva (EIS 19, WGS84 59.076297 N, 10.177493 E) 29 November 2018, 1 larvae, leg. J. Persson (kick-net), coll. NIVA Oslo. Vestfold og Telemark: Larvik, Tjodalyng, Haslebekken (EIS 19, WGS84 59.06431 N, 10.18065 E) 11 November 2019, 1 larvae, leg. J. Persson (kick-net), coll. NIVA Oslo. Agder: Åmli, Raudfet, Stigvasselva (EIS 10, WGS84 58.74752 N, 8.51043 E) 21 November 2018, 1 larvae, leg. J. Håvardstun (kick-net), coll. NIVA Oslo.

Comments. There is no doubt about the identity of the new species for Norway. Morphology of the larvae are so unique (see Figure 1) that other potential *Tinodes*-species can be excluded, e.g. *T. maclachlani* (Kimmins, 1966) with nearest presence on the Faroe Islands. When using the key by Edington & Hildrew (1995), it must be mentioned that its illustration of the head of *T. pallidulus* shows a very large light patch on frontoclypeus. In the Norwegian specimens, this patch is smaller, but still larger than the two lateral ones. Danish specimens all share this characteristic.

The three Norwegian sites for *T. pallidulus* were all located near the southeast coast (Figure 2). Sites one and two, both located in agricultural areas, were 0.5–1 m wide brooks edged by reeds and a few scattered bushes. The current was slow to moderate and the substrate dominated by silt and sand, but also included small to medium sized rocks. Site three was in a 3–4 m wide stream in a

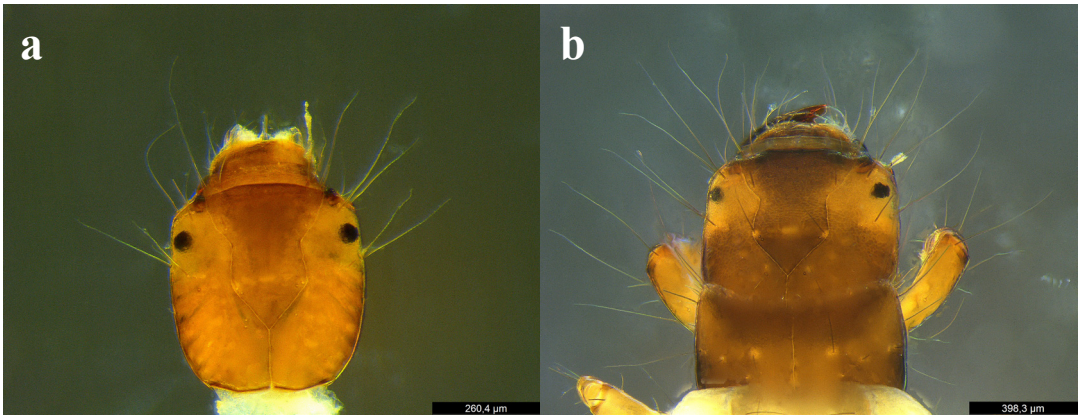

FIGURE 1. *Tinodes pallidulus* (McLachlan, 1878) from locations one (**a**) and two (**b**). The animal from location three unfortunately lost its structure and pigmentation due to a cracked vial and desiccation. Photo: Johnny Håll, NIVA.

FIGURE 2. Map of southern Norway showing the locations where *T. pallidulus* (McLachlan, 1878) were found.

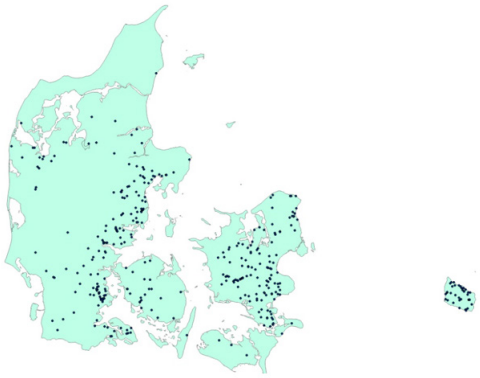

FIGURE 3. Distribution of *Tinodes pallidulus* (McLachlan, 1878) in Denmark based on data from the National Program for Nature and Aquatic Environment (NOVANA) and regional county monitoring during the period 1990–2015. Data are extracted by the co-author from the WinBio database and validated.

small open area mainly surrounded by forest. The current was moderate to fast and the substrate was stony.

Very little is published on the ecology of *T. pallidulus*, as previously noted by Higler (2005). However, Gullefors (2015) reports it from smaller streams (brooks) in southernmost Sweden (including the islands of Öland and Gotland), Speth *et al.* (2006) also primarily found it in brooks in Schleswig-Holstein, feeding on periphyton and fine detritus, and Higler (2005) recorded it from small Dutch streams. According to the co-author (unpublished data), the species in Denmark is primarily found in small streams (unpublished). The median width of 372 unique and widely distributed Danish sites (see Figure 3) was found to be 1.5 m, 90% of these sites being less than 3.6 m wide. Sites generally had fast to moderate current and partly stony substrate. Here larvae build tubes (in galleries) on stones in fairly moderate current, primarily near the streambank. Here they primarily graze on periphyton. Sites are found in both forested areas and open land.

Although it is of course difficult to prove, we find it likely that *T. pallidulus* has colonized Norway recently. If so, colonizers have most likely come from the nearest sites, 180 km away in Denmark (see Figure 3). Populations in other "nearby" countries are situated more than 400 km away in Sweden, northern Germany and southern England (Speth *et al*. 2005, Gullefors 2015, Wallace 2016). The "new" Norwegian populations extend the northern boundary of the global distribution considerably. Furthermore, although reference data are limited, the species seems to have expanded further north in Denmark during the last few decades. This is probably due to global warming, combined with a general improvement of the ecological quality of Danish streams, which has taken place over the last thirty years (mainly because of better treatment of wastewater and the elimination of illegal discharges of liquid manure and silage from agriculture). It appears that 50–70 years ago, the northern boundary was more than 100 km south of the present Danish one (Wiberg-Larsen, unpublished). Long-distance dispersal, also over open water, is well documented for other orders of insects, in particular for butterflies and dragonflies (Baguette 2003, May 2013, Kuussaari *et al*. 2016). Examples of this occurring in caddisflies are limited, however. Nevertheless, a recent record of a *Hydropsyche bulgaromanorum* (Malicky, 1977) in a light trap located at the South coast of Lolland, a species that definitely does not

have populations in Denmark, indicates that over-water dispersal in the range of 200 km or more may have taken place, from the closest population found in North Germany and North Poland,. Such a long-distance dispersal depends, however, on favorable winds during flight periods, as adult Trichoptera are generally regarded as relatively weak flyers. *T. pallidulus* is no doubt a weak flyer, day-active, having a flight period in Denmark from late June to early August (Wiberg-Larsen 2004). The climate in Denmark is dominated by westerly winds, although southern winds have become more common in recent years. Strong winds from south may therefore occur occasionally during the flight period of *T. pallidulus*.

Acknowledgement. Eivind Ekholt Andersen (NIVA) brought individual three to our attention. Tor Erik Eriksen (NIVA) provided the contact with The Natural History Museum at the University of Oslo for the DNA barcoding. Audun Schrøder-Nielsen (The Natural History Museum at the University of Oslo) performed the DNA barcoding. Johnny Håll (NIVA) provided the photos in figure 1. Henrik Tornbjerg (Bioscience, Aarhus University) provided Figure 3. Joanna Lynn Kemp (NIVA) improved our English. The regional monitoring at sites one and two was funded by Lundhs AS and Larvik Granite AS, and the regional monitoring at site three was funded by Agder fylkeskommune.

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Received: 25 May 2020
Accepted: 15 June 2020