

## Databasing the stoneflies (Plecoptera) at the Natural History Museum in Oslo reveals new Norwegian province records

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In 2010 the metadata of the Plecoptera collection created by the late Albert Lillehammer at the Natural History Museum in Oslo (NHMO) were digitised and georeferenced. 4319 species records, mostly of common species collected in the 1960s and early 1970s, were delivered to the online databases of Artsdatabanken, the Norwegian Biodiversity Information Centre. The NHMO collection, and other collection-based records in Artsdatabanken are used to evaluate and update the stonefly checklists of the Norwegian provinces. The changes relative to previous checklists are documented and discussed. The riverine species *Xanthoperla apicalis* (Newman, 1836) and *Isogenus nubecula* Newman, 1833 are rare and vulnerable species whose occurrence in Norway merits monitoring.

Key words: Plecoptera, NHMO collection, Albert Lillehammer, checklist, Norwegian provinces.

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### Introduction

The Natural History Museum of Oslo (NHMO) houses a large collection of Norwegian stoneflies, most of which were collected by the late Albert Lillehammer (1930–1992). When this collection was digitised and databased in 2010, it turned out that some historical records have been overlooked in the provincial checklists of Norwegian stonefly species that have been published so far (Lillehammer 1988: 152–153; Solem 1996). In this paper, the checklists of the Norwegian provinces (fylker) are updated on the basis of the samples held at the NHMO and the additions of Olsen (2008). For each species, any changes relative to the previous checklists are documented. I also discuss new provincial records as published online in Artskart, the web service of the Norwegian Biodiversity Information Centre Artsdatabanken (ADB) (artskart.artsdatabanken.no).

### Stoneflies collected by Albert Lillehammer

From the 1960s to his death in 1992, Albert Lillehammer worked at the Zoological Museum of the University of Oslo, which later became part of the NHMO. He worked extensively on river ecology and on the biology and taxonomy of Norwegian stoneflies (Brittain 1993). Among his often cited publications are his article series on Norwegian stoneflies in *Norsk Entomologisk Tidsskrift* (Lillehammer 1974a, 1974b, 1975a, 1975b, 1976) and his handbook *Stoneflies of Fennoscandia and Denmark* (Lillehammer 1988).

Lillehammer built up a large collection of Norwegian stonefly samples at the NHMO. He collected most material, some 94% of the databased samples, himself in the period 1964–1971. However, this collection also contains samples collected by others between 1925 and 1981. Lillehammer's publications sometimes refer to specimens that have not been located at

the NHMO, so part of the material may have gone lost. Nonetheless, the remaining material is still of considerable size, and the collection Lillehammer created constitutes most of the stonefly material currently held at the museum. The collection created by Lillehammer consists of three parts: an inventoried ethanol collection (circa 5000 vials), a collection of slide-mounted wings and nymphal and imaginal body parts (circa 5000 slides), and a large volume of unsorted material.

In 2010 the organized part of the ethanol-preserved collection was georeferenced and databased, and in 2011, 4319 records were delivered to Artsdatabanken. With a few exceptions, each record refers to a vial containing one or more specimens of a species collected on a particular date at a particular locality. (Additional vials containing the same species taken at the same collecting event have not been inventoried.) A few records, 29, are based on slide-mounted body parts only. All records can be accessed through ADB's web service Artskart and the data portal of GBIF ([data.gbif.org](http://data.gbif.org)). A detailed description of the Plecoptera collection at the NHMO and the georeferencing procedure is published elsewhere (Boumans 2011).

The inventory of microscope slides is still ongoing. However, most slides bear wings of specimens that are also preserved in the ethanol collection. Databasing the slide collection will therefore yield only few additional distribution records.

### **Province records**

Presence/absence data for provinces is a very coarse-grained approach to species distribution, and maps produced with georeferenced data such as presented in Artskart replace such lists for most uses. However, province-based distribution tables still have applications when there is a need for a quick, text-based overview. For instance, if there is doubt about the correct identification of a specimen, it is useful to know if the species is known from the region in question.

Lillehammer (1988: 152–153) gives an overview table of the then known occurrence

of Scandinavian species for each Norwegian province, with some small provinces being merged and some large ones split. The system of geographic divisions is based on the revised Strand system (Økland 1981). A slightly simplified and possibly updated occurrence table is given by Solem (1996). Neither Lillehammer nor Solem states explicitly which collections or literature sources were consulted when creating the overview. Little has been published on Norwegian stoneflies since 1996, but some new province records are presented by Olsen (2008). Olsen's records are also included in the Artskart database.

Even though most samples collected by Lillehammer are from the 1960s and early 1970s, the digitised collecting event data now show that some province records were omitted from the earlier overviews. I checked all specimens at the NHMO that revealed a new species for a particular province, and corrected any labelling or identification errors. (It was not feasible to check all 4319 records.) Here I present an updated overview of the provincial checklists (Table 1) based on the following sources: the checklists of Lillehammer (1988: 152–153) and Solem (1996), Olsen's (2008) additions, the Plecoptera collection at the NHMO, including the more recent samples deposited by K.M. Olsen or collected by myself, and finally province records from Artskart (consulted 29 September 2011). I also refer to Sivertsen, Mossestad and Stokke's extensive inventory of benthic fauna in Sogn og Fjordane province, which is published in a report (Sivertsen et al. 2009). The sample specimens from the latter inventory have been deposited at the Natural History Collections of Bergen Museum (ZMB), and subsamples from all stonefly species from Sivertsen et al.'s inventory have been donated to the NHMO for the purpose of DNA barcoding.

Table 1 shows the occurrence of each species in the Norwegian provinces, where the large provinces Nordland and Finnmark are divided into two parts as in Lillehammer (1988: 153). I distinguish three categories of reference data. The table cells marked '1' refers to presence of a species in a province (or region) based on either the collections at NHMO or a convergence of at

**Table 1.** Documented occurrence of stonefly species in eighteen Norwegian provinces, with Oslo merged with Akershus and the provinces Norland and Finnmark divided into two regions each. Abbreviations: 1 = NHMO collection, or convergence of at least two other sources: Solem (1996), Lillehammer (1988 : 152-153) or collection-based Artskart records; \* = only collection-based artskart records; ? = uncertain, see main text for details.

	Ø	AK	HE	O	B	VE	TE	AA	VA	R	HO	SF	MR	ST	NT	NS	NN	TR	FV+FI	FN+FO	sum cat 1	sum (all 3 cats)	
<i>Arcynopteryx compacta</i> (MacLachlan, 1872)	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	14	(14)
<i>Diura bicaudata</i> (Linnaeus, 1758)	1	1	1	1	1	1	1	1	?	1	1	1	1	1	1	1	1	1	1	1	1	15	(16)
<i>Diura naniseni</i> (Kempony, 1900)	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	20	(20)
<i>Isoagenus nubecula</i> Newman, 1833	?	1	1	1	1													*			3	(4)	
<i>Perlodes dispar</i> (Rambur, 1842)	1	1	1	1	1	1	1	1	1	1	1	?	*	1	1	1	1	*	1	1	11	(14)	
<i>Isoperla difformis</i> (Klapálek, 1909)	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	20	(20)	
<i>Isoperla grammatica</i> (Poda, 1761)	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	19	(19)	
<i>Isoperla obscura</i> (Zetterstedt, 1840)	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	10	(14)	
<i>Dinocras cephalotes</i> (Curtis, 1827)	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	19	(19)	
<i>Siphonoperla burmeisteri</i> (Pictet, 1841)	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	5	(6)	
<i>Xanthoperla apicalis</i> Newman, 1836	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	20	(20)	
<i>Taeniopteryx nebulosa</i> (Linnaeus, 1758)	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	20	(20)	
<i>Brachyptera risi</i> (Morton, 1896)	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	19	(19)	
<i>Amphinemura borealis</i> (Morton, 1894)	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	3	(3)	
<i>Amphinemura palmeni</i> Koponen, 1916	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	19	(19)	
<i>Amphinemura standfussi</i> (Ris, 1902)	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	20	(20)	
<i>Amphinemura sulcicollis</i> (Stephens, 1836)	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	3	(3)	
<i>Nemoura arctica</i> Esben-Petersen, 1910	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	19	(19)	
<i>Nemoura avicularis</i> Morton, 1894	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	20	(20)	
<i>Nemoura cinerea</i> (Retzius, 1783)	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	12	(16)	
<i>Nemoura flexuosa</i> Aubert, 1949	1	1	1	1	1	1	1	1	?	1	1	1	1	1	1	1	1	1	1	1	4	(5)	
<i>Nemoura sahlbergi</i> Morton, 1896	?																						

Table 1. continued

	Ø	AK	HE	O	B	VE	TE	AA	VA	R	HO	SF	MR	ST	NT	NS	NN	TR	FV+FI	FN+FØ	sum cat 1	sum (all 3 cats)
<i>Nemoura viki</i> Lillehammer, 1972	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	*	1	1	2	(3)
<i>Nemurella pictetii</i> Klapálek, 1900																					20	(20)
<i>Protonemura intricata</i> (Ris, 1902)																					2	(2)
<i>Protonemura meyeri</i> (Pictet, 1841)	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	20	(20)
<i>Capnia atra</i> Morton, 1896	1	1	1	1	1	?	1	?	1	1	1	1	1	1	1	1	1	1	1	1	18	(20)
<i>Capnia bifrons</i> (Newman, 1839)	1	1	1	1	1	1	1				*										11	(13)
<i>Capnia pygmaea</i> (Zetterstedt, 1840)									?	1	1	1	1	1	1	1	1	1	1	1	16	(17)
<i>Capnia vidua</i> Klapálek, 1904																					4	(4)
<i>Capnopsis schilleri</i> (Rostock, 1892)	1	1	1	1	1	1	1							1	1	1	1	1	1	1	14	(14)
<i>Leuctra digitata</i> Kempny, 1899	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	20	(20)
<i>Leuctra fusca</i> (Linnaeus, 1758)	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	20	(20)
<i>Leuctra hippopus</i> Kempny, 1899	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	20	(20)
<i>Leuctra nigra</i> (Olivier, 1811)	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	20	(20)
sum category 1	22	23	28	26	25	19	26	18	18	22	22	21	21	27	27	26	24	27	31	30		
sum (all three categories)	(23)	(26)	(28)	(26)	(26)	(20)	(26)	(20)	(21)	(22)	(22)	(23)	(23)	(23)	(27)	(27)	(25)	(31)	(32)	(31)		

least two of three other sources: the two previous published checklists (Lillehammer 1988; Solem 1996) and collection-based records in the Artskart database. Solem only refers to provinces, and therefore merges Lillehammer's regions NN and NS, as well as (FV+FI) and (FN+FØ), whereas Lillehammer merges the provinces Ø and AK. Table 1 follows the most conservative approach, such that for example presence in FV+FI in Lillehammer and F in Solem is interpreted as recorded for FV+FI but not for FN+FØ.

Presence marked by an asterisk in Table 1 is based solely on records in the Artskart database supported by specimens deposited at other institutions, which I have not checked myself. Presence marked by a question mark signals the need for verification. This holds for presence based exclusively on either Lillehammer's or Solem's checklist, and in the cases of *Nemoura flexuosa* in Vest Agder and *N.sahlbergi* in Buskerud, as explained below. Finally, Artskart records that I consider unlikely or that are based on observations only are ignored in the table, but are mentioned below in the paragraphs discussing individual species.

All species that are added to one or more provincial checklists are commented on below. Unless stated otherwise, all stonefly specimens mentioned are from the collection at NHMO (conventionally referred to as ZMUN); unless stated otherwise, these are adult specimens, and initial identifications were done by A. Lillehammer (though this is not documented on the labels). I have verified the initial identifications.

### *Arcynopteryx compacta* (McLachlan, 1872)

**Records.** **B** Nore og Uvdal, Tinnhølen Langesjøen, 10 July 1965, 1♂, leg. Magne Grande; **HE** Folldal, Haldogsenøyi, Atnaelva, 18 June 1967, 1♂1♀ adult, leg. R. Mehl; idem 1♂9♀♀, leg. A. Lillehammer; **NS** Rana, Mo i Rana, Snefjeldå, 25 June 1971, 3 nymphs, leg. Lillehammer.

**Remarks.** HE and NS are missing from Lillehammer (1988) but HE is included in Solem (1996); Solem shows only the presence for the whole of N province. More observations from NS are present in the Artskart database, namely from

Gildeskål in 1905.

### *Diura bicaudata* (Linnaeus, 1758)

**Records.** **R** Sauda, Røldalsveien Botnavatnet, bekk nordenden, 10 June 1965, 2♀♀, leg. A. Lillehammer [subgenital plates removed; label mentions finds of males together with the females]; Odda, Halvfjerdingsv. 29 July 1971, 2♀♀, leg. A. Lillehammer.

**Remarks.** R is missing from Lillehammer (1988) but included in Solem (1996). Artskart mentions no other finds from this province. Solem (1996) marked the occurrence in VA with a question mark; I have found no confirmation of *D. bicaudata* in that province.

### *Isogenus nubecula* Newman, 1833

**Records.** **B** Sigdal, Tempelbekken, Norefjell, 1 October 1966, 1 nymph [slide marked P258, bearing nymphal pronotum, leg, cercus and maxilla]

**Remarks.** *Isogenus nubecula* is an inhabitant of large lowland rivers that was once rather common in central and northern Europe. It suffered a dramatic decline in most of its range due to pollution and habitat fragmentation (Zwick 1992, 2004; Fochetti & Tierno de Figueroa 2006; Davy-Bowker et al. 2007; Koese 2008: 91). In Scandinavia it is restricted to rivers with relatively high water temperatures, which may explain its rarity in the peninsula (Hoffsten & Malmqvist 2003). The material in the NHMO contains no complete specimen. I list the above collection details because very few records of *I. nubecula* from Norway are documented. Artskart includes two collection-based records from TR, possibly referring to a single sample. As these collection sites are outside of the species' known distribution (Lillehammer 1985, 1988; Zwick 1992), the identification of these specimens needs verification.

### *Perlodes dispar* (Rambur, 1842)

**Records.** **AK** Oslo, Sørkedalselva, Langlielva, 25 February 1969, 1 nymph, leg. Smestad [slide marked P1669 with nymphal cercus, leg and maxilla]; Søndre Høland, 1♂ [slide with no further labelling, bearing male subanal lobe and

cerci; the municipality Søndre Høland existed between 1924 and 1966].

**Remarks.** The above collection details are given here because very few records of *P. dispar* from Norway are documented. Artskart includes two collection-based records from TR, possibly referring to a single sample. As these collection sites are far from its hitherto known distribution (Lillehammer 1985, 1988), I assume that *P. dispar* does not occur in TR. Solem (1996) lists *P. dispar* for both AK and Ø, while Lillehammer (1988: 152) merges these provinces in one column in his overview table. In view of its distribution in AK and southern Sweden, its occurrence in Ø is likely.

### *Isoperla difformis* (Klapálek, 1909)

**Records.** **VE** Re, Verpelva 1 UTM 32VNL746851, 16 October 2003, 1 exuvium; Verpelva 2 UTM 32VNL 750822, 16 October 2003, 1 nymph; Re, Verpelva 3 UTM 32VNL757780, 16 October 2003, 2 nymphs, all leg. and det. K.M. Olsen; **TE** Siljan, Siljanelva, 21 June 1968, 3 nymphs, leg. Th. Dalene

**Remarks.** The record from Verpelva 1 was previously reported in Olsen (2008). The occurrence in VE and TE is known only from nymphs, which are difficult to identify. Artskart contains records of the nymphs Olsen collected in VE, as well as collection-based records from MR and TR. Only Solem (1996) lists *I. difformis* for SF; Sivertsen et al. (2009) do not report it for that province.

### *Isoperla obscura* (Zetterstedt, 1840)

**Records.** **VE** Tjøme, Rød, 22 April 1968, 1♀, 3 nymphs, leg. A. Lillehammer; **AA** Bykle, Bykle (ved brua), 10 July 1969, 1♀, leg. K. Myhr.

**Remarks.** Artskart contains no further records from AA and VE. The only province for which this species has not been reported is VA.

### *Dinocras cephalotes* (Curtis, 1827)

**Records.** **B** Drammen, Valsbekk, 3 July 1925, 1 nymph, 26 July [no year], 9 nymphs, both leg. Sig. Thor; Hol Hovet Hallingdalselva, 11 May 1970, 1 nymph, leg. K. Myhr; **SF** Sogndal, Røysi UTM 32V 397.59 6789.89, 14 August 2008, 3 nymphs, leg. & det. Sivertsen, Mossestad &

Stokke, col. ZMB and ZMUN.

**Remarks.** Further details on the collecting event in SF can be obtained from Sivertsen et al. (2009: 56). The Artskart database includes collection-based records from SF, TR and FN. Nordland is listed only by Solem (1996). Since both nymphs and adults of *D. cephalotes* are easy to recognise, it is likely that this species does occur in these regions. Artskart also includes an observation record from Lørenskog, AK, that would need confirmation.

### *Xanthoperla apicalis* (Newman, 1836)

**Records.** **B** 'Buskerud' [Ringerike], August [18]45, 2♀♀, leg. J.H. Siebke, det. R. Brekke [two specimens on two pins, additional labels 'Siebke', '33', 'Gf2276 ZM Oslo', respectively '34' and 'Gf 2277 ZM Oslo']; **HE** Elverum, [no date], 2 ♀, leg. J.H. Siebke, det. R. Brekke [two specimens on a single pin, additional labels 'Siebke', '35-36' and 'Gf 2278 ZM Oslo']; **NT** Steinkjer, Ognå, 1 adult of unknown sex, 22 July 1967, leg. ? [ethanol specimen, genitalia removed and missing]; Grong, Fjerdingelven, 1♂, 2 July 1970, leg. A. Lillehammer [ethanol specimen, genitalia slide-mounted, labelled P2137].

**Remarks.** NT is included in Solem's (1996) table, but was missing from Lillehammer (1988). In addition to the above-cited specimens, Brittain (1983; Brittain et al. 1984) discusses finds from the Namsen and Sanddøla rivers in NT, as well as the river Glomma in Hedmark. Neither Lillehammer nor Solem lists Buskerud, even though the nineteenth century specimens in the ZMUN are listed by Brekke (1941) under the name *Chloroperla borealis* Bengtsson, 1933. According to Brekke, these are the specimens Schøyen (1887) refers to as *Isopteryx apicalis* Newm. Schøyen does not mention specimens explicitly, but lists the localities Christiania (= Oslo), Ringerike and Elverum. The specimens from 1845 could have been collected from one of the rivers Ådalselva, Randselva or Storelva in Ringerike. Artskart lists collected specimens from F (FV, FI, FN), NT and ST, as well as observations from AK.

Like *I. nubecula*, *X. apicalis* is a species of larger rivers in Europe (Lillehammer 1988:

80). It was historically widespread in Europe but suffered from habitat fragmentation and has become very rare in central Europe (Zwick 1992, 2004; Koese 2008: 105). It is also rare in Norway, with a scattered and little known distribution.

The slide collection at NHMO also includes three slides marked 'X. *apicalis* P39', bearing nymphal hind leg, cerci, two heads, one pronotum and a complete small nymph. P39 is a collecting event number referring to 'Storelva [presumably Sauda in Rogaland], 26.iv.1966'. The pronota suggest that these preparations are in fact *Siphonoperla* (Peter Zwick, personal communication September 2011). Moreover, Zwick (2004) remarks that figure 114 in Lillehammer (1988: 76) does not show the pronotum of *X. apicalis*.

#### ***Amphinemura palmeni* Koponen, 1917**

**Remarks.** The NHMO holds no ethanol-preserved or slide-mounted specimens labelled as such, nor do Lillehammer's publications bear evidence that he studied specimens of *A. palmeni*. The online data portals do not contain any observations either. The fact that very few findings of this species have ever been reported is at least partly due to its unclear taxonomic status, and the difficulty of finding unambiguous and consistent morphological characters that distinguish it from *A. standfussi*.

I am currently re-examining the taxonomic status of this species. Preliminary analyses of mitochondrial sequences from *P. cf. palmeni* from Finnmark and Troms provinces show that two distinct clades of *standfussi*-like stoneflies occur in northern Scandinavia. Further research should establish whether one or both northern clades can be considered as an easterly form of *A. standfussi*, and whether these two clades and the typical (southern) *A. standfussi* interbreed.

#### ***Amphinemura standfussi* Ris, 1902**

**Remarks.** Lillehammer (1988) reports this rather common species for all provinces except VE, VA and AA; Solem (1996) for all except VE. Specimens registered in Artskart support the occurrence in AA and VA, while the species still has not been reported from VE.

#### ***Nemoura avicularis* Morton, 1894**

**Records.** AA Bygland, Moi, 24 April 1970, 4♂♂3♀♀, leg. Al. Lillehammer; R Klepp, 1929, 1♂, leg. Fr. Jensen.

**Remarks.** Lillehammer (1988) does not list this widespread species for R, SF and MR; Solem (1996) lists it for all provinces except SF, AA and VA, without commenting on this incongruence. Artskart lists collection-based records from eleven communities in AA, seven communities in VA, and one record from MR (from Rauma community in 1991). One record from Kristiansand, VA was published by Olsen (2008). SF is the only province for which the occurrence of *N. avicularis* is not documented. Sivertsen et al. (2009) did not find it in their extensive faunistic inventory, which suggests that it is really lacking from this province.

#### ***Nemoura flexuosa* Aubert, 1949**

**Records.** VA Søgne, Try, 5 September 1967, 1 small nymph, leg. A. Lillehammer

**Remarks.** The identification of this specimen is doubtful. It has long bristles on the distal part of the front femur, as in *N. flexuosa*, but unlike this species, the bristles on the cercal segments are long, reminiscent of *N. avicularis*. Artskart yields no further records from VA, but includes four collection-based records from AA (Gjerstad) and one from HO, two other new province records. MR is only listed by Solem (1996).

Nymphs of *N. flexuosa* and *N. dubitans* are distinguished from the other Fennoscandian and Danish *Nemoura* nymphs by the presence of long bristles on the front femur. Lillehammer's identification key (1988: 108) erroneously suggests the difference is in the hind femur, but his illustrations (1988: 106-107) show this feature correctly.

#### ***Nemoura sahlbergi* Morton, 1896**

**Remarks.** This arctic species is with certainty known from the northern provinces N, TR and F. Olsen (2008) reports the find of a single female adult from B (Lier municipality, 1993). As this is far from the species' known distribution, and female *Nemoura* specimens are difficult to identify, the occurrence of *N. sahlbergi* in B is in

need of confirmation.

### *Nemoura viki* Lillehammer, 1972

**Records.** FI Kautokeino, Emmatjernbekken, 29 June 1972, 55 imagos, leg. A. Lillehammer [labelled P2694: ethanol, specimens stored individually in numbered vials, together with their detached right forewing; slide-mounted epiprocts specimens nr. 49–52]; slide-mounted epiproct of additional, unlabelled specimen.

**Remarks.** By all likelihood all specimens at the ZMUN have been identified by Lillehammer, but this is not documented. The type specimens of *N. viki* appear to be lost (Boumans 2011). The specimens used for the description of the nymphs (Lillehammer 1986) have not been located either. Only records from northernmost parts of Finland and Norway were known to Lillehammer (1988: 118). Johansson and Nilsson (1989, 1994) reported isolated finds of *N. viki* from the Swedish province of Västerbotten, 500 km south of the previously reported distribution. The Artskart database includes two collection-based records from TR, Harstad, Sæterelva 2004. In all, there are very few published records of this taxon, despite the fact that Arctic fauna elements typically have a wide distribution (Downes 1962). *Nemoura viki* is very similar to *N. arctica* Esben-Petersen 1910, notably in the shape of the epiproct (cf. photos in Boumans 2011). For these reasons, its taxonomic status needs verification.

### *Protonemura intricata* (Ris, 1902)

**Records.** FØ Sør-Varanger, veget. Oterbekk under tregren [vegetation Oterbekk stream, under tree branch], 17 July 1966, 1♂, leg. A. Lillehammer[ethanol]; FV Alta: Gargia, Gargiaelva, N 69°48.30 E 23°29.30, 23 July 2010, 1♀; FN Nesseby, Nyborg, stream, N 70°10.65 E 28°36.60, 28 July 2010, 2♀; Lebesby, Kunes: Austerelva, N 70°20.60 E 26°31.15, 28 July 2010, 1♂; FØ Sør-Varanger, Nordvest-bukta, Emanuelbekken, N 69°18.20 E 29°15.75, 30 July 2010, 1♀; all 2010 specimens leg. L. Boumans, T. Ekrem & S. Roth, det. L. Boumans.

**Remarks.** This species is widespread in Europe (Illies 1978), but in Scandinavia it is restricted to the northernmost parts as it reached the peninsula

only from the northeast (Lillehammer 1988: 125). The older material at the NHMO contains only a single specimen collected during the Pasvik expedition in 1966. New samples collected in 2010 indicate that the species is currently not rare in Finnmark, though it may be absent from FI.

### *Capnia atra* Morton, 1896

**Remarks.** Solem (1996) lists *C. atra* for all provinces. The occurrence in VE and AA is not listed by Lillehammer (1988), nor supported by records in Artskart.

### *Capnia bifrons* (Newman, 1838)

**Remarks.** In addition to the provinces listed in Lillehammer (1988) and Solem (1996), Artskart shows findings in HO and SF. These records are based on nymphs, which are rather difficult to distinguish from other *Capnia* species. Sivertsen et al. (2009) report *C. atra* and *C. pygmaea* from many localities in SF, but not *C. bifrons*.

### *Capnia pygmaea* (Zetterstedt, 1840)

**Records.** B Gol, Svenkerud Hallingdalselva, 26 April 1968, 1♂1♀, leg. A. Lillehammer; Hol, Hovet Hallingdalselva, 11 May 1970, 1♂1♀, leg. K. Myhr; idem 1♂2♀, leg. R. Borgstrøm; AA Bykle, Berdals bru, 23 April 1970, 5♂♂10♀♀, leg. Smedstad; Bykle, Byklestøylande, 23 April 1970, 1♂1♀, leg. A. Lillehammer.

**Remarks.** Artskart contains another record from B, Hol from 1905. VA is listed in Lillehammer (1988), but no specimens have been found in NHMO's collection (though may be present in the unorganized part of the collection). Solem (1996) does not list VA, nor does Artskart contain records from this province.

### *Capniopsis schilleri* (Rostock 1892)

**Remarks.** The collection at NHMO provides no addition to the known distribution. It is noteworthy that this species had no previous collection-based records in Artskart, even though it is common in south-eastern and northern Norway. This may result from a databasing error. The genus name has been misspelled as '*Capniopsis*' in ADB's databases (now corrected in the online checklist Artsnavnebasen).

### *Leuctra digitata* Kempny, 1899

**Remarks.** Lillehammer (1988) lists *L. digitata* for all provinces except VE, AA, VA and MR; according to Solem (1996) it occurs in all provinces. The occurrence of this species in the afore-mentioned provinces is supported by collection-based records in Artskart.

### Discussion

The growing digital databases allow us to map the distribution of species in a much more precise way than has been possible in the past. Eventually we will also have better estimates of rarity and distributional changes. Of the 35 stonefly species recorded from Norway, three figure on the most recent Norwegian Red List (Kjørstad et al. 2010): *Perlodes dispar* is categorised as near threatened (NT), *Amphinemura palmeni* as vulnerable (VU) and *Protonemura intricata* as near threatened (NT). Even if this list follows from a proper application of the red list criteria (Kålås et al. 2010: 19-48), it seems that at least two other species, *Isogenus nubecula* and *Xanthoperla apicalis*, deserve particular attention in nature management. Based on samples collected in Finnmark in 2010, my impression is that *P. intricata* is rather common in that province. *Perlodes dispar* is truly rare in Norway, but widely distributed and common in Europe (Zwick 2004). It reaches the north-western border of its distribution in south-eastern Norway, where it occurs in shallow streams with a high summer temperature (Lillehammer 1988: 67). There are relatively many observations of this species in south-western Sweden (Swedish biodiversity information portal artportalen.se, last accessed 25 August 2011). On the other hand, there are very few documented observations of *I. nubecula* and *X. apicalis*, even though these species are historically more widespread in Norway. Their dependence on large clean rivers makes these species particularly vulnerable, and populations have declined all over Europe. In Norway, the chemical treatment of rivers in order to eradicate the salmon parasite *Gyrodactylus* constitutes an obvious threat (cf. Eriksen et al. 2009). For this reason it will be worthwhile to monitor these rare

riverine stoneflies in Norway, and investigate whether they still occur in their historical sites, for instance *X. apicalis* in Ringerike.

The large numbers of specimens of the commoner stonefly species held by the NHMO, as well as other Norwegian museums, cover all of Norway and more than a century of collecting activity. These collections offer excellent opportunities for detailed studies of phenology and morphological variation within species (cf. Boumans 2011). Such studies can build on an important volume of previous knowledge, including notably Albert Lillehammer's research, while applying present-day techniques and statistics.

Finally, more natural history museums will digitize, georeference and publish their Plecoptera collections over the coming years. This will, in addition to new observations, lead to a more complete overview of the past and present distribution of stonefly species in Norway.

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