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Nymphodora gen. nov., a new genus of Nannoniscidae Hansen, 1916 (Isopoda, Asellota, Janiroidea) from the high Arctic*

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Abstract

A new isopod genus is described from the Canada Basin, *Nymphodora* gen. nov. The type species of the genus, *Nymphodora fletcheri* (Paul & George, 1975) comb. nov., was first described as Desmosomatidae in the genus *Mirabilicoxa* and then later assigned to *Chelibranchus* by Kussakin (1999). However, the species bears characters with a greater affinity to Nannoniscidae, such as a bulbous terminal article of antenna 1 and fusions of the pereonites 6, 7 and pleotelson. Here, the species is redescribed and transferred to a new genus in Nannoniscidae.

Key words: Malacostraca, *Nymphodora fletcheri* (Paul & George, 1975) comb. nov., *Nannoniscus*, *Panetela*, Canada Basin, deep sea

Introduction

As with many taxa, Isopoda from the Northern seas are comparatively well studied, especially those from the shallows (Svavarsson *et al.* 1993). To a large extent this is due to identification of samples from more than a century of benthic surveys (see Sars 1899; Ohlin 1901; Hansen 1916; Svavarsson *et al.* 1990, 1993; Brandt 1995; Brandt *et al.* 1996). Sampling during these surveys is highly geographically and bathymetrically biased; whilst areas such as the Norwegian and Greenland seas have been fairly well studied, the sampling effort in other areas such as the deep Canada Basin (Bluhm *et al.* 2005) or the central Arctic basins has been negligible (Svavarsson *et al.* 1993; Malyutina & Kussakin 1996).

Generally (and arguably) the Arctic benthos is considered to be impoverished compared to similar size areas elsewhere due to its young age and isolation (e.g. see Svavarsson 1997; Piepenburg 2005). This at least seems to be true for the deep isopod fauna (e.g. Dahl *et al.* 1976; Svavarsson *et al.* 1990, 1993; Svavarsson 1997). At the species level, about 50% of the asellote species are endemic to the Northern seas, but to date just one isopod genus (*Cryodesma*) has been recorded as endemic to this area (Svavarsson *et al.* 1993).

In the current paper, a new genus in the family Nannoniscidae restricted to the Arctic is described. During a revision of the Nannoniscidae and the Desmosomatidae the type material of *Chelibranchus fletcheri* (Paul & George, 1975) was examined. This species was previously described in the desmosomatid genus *Mirabilicoxa* by Paul & George (1975) and later assigned to *Chelibranchus* by Kussakin (1999). However, due to the presence of a bulbous terminal article of antenna 1 and fused pereonites 6, 7 and pleotelson, this species is here transferred to a new genus in Nannoniscidae, *Nymphodora* gen. nov.

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Material and methods

Specimens of *Nymphodora fletcheri* (Paul & George, 1975) comb. nov. were taken between October 1969 and March 1972 using a Small Biological Trawl and a Mini-LUBS (i.e. a sphincter-type corer, cf. Paul & Menzies 1974). The collection was part of a U.S. progamme investigating high Arctic benthic communities and was carried out from Fletcher Ice Island T3, a drifting iceberg in the Beaufort Gyre (Paul & Menzies 1974). In total, samples yielded seven specimens of *N. fletcheri* (cf. Paul & Menzies 1974), of which just one (the holotype) is deposited in the Smithsonian United States National Museum of Natural History (USNM), Washington (USNM No. 143607).

The holotype of *N. fletcheri*, on loan from the USNM, was investigated microscopically. The specimen was transferred to glycerine. Illustrations were made using a *Zeiss* compound axioscope with a *camera lucida*. As the currently redescribed species is represented by just the sole (type) specimen, permission was not granted for dissection of appendages. Hence, antennae and pereopods were drawn *in situ*. Slight differences between the right and left part of the cephalothorax (Figs 1B, C) are due to dissection of the left mouthparts as well as tilting dorsally. For descriptions of the maxilliped compare Paul & George (1975).

For purposes of comparison, the following type material was examined from the Zoological Museum, University of Copenhagen (ZMUC):

Nannoniscus analis Hansen, 1916, syntypes, zmuc-cru 9345.

Nannoniscus arctoabyssalis Just, 1980, holotype (female), zmuc-cru 5591.

The terminology of the setation followed here was summarised by Brix (2007)

Abbreviations (used in the figures): A1—antenna 1; A2—antenna 2; P1–7—pereopods 1–7; Plt—pleotelson; Plp 2—pleopod 2 (operculum); Urp—uropods.

Taxonomy

Suborder Asellota Latreille, 1803
Suprafamily Janiroidea Sars, 1897
Family Nannoniscidae Hansen, 1916

Desmosomidae Sars, 1899: 118; Vanhoeffen, 1914: 549; Nannoniscini Hansen, 1916: 83; Nannoniscidae Siebenaller & Hessler, 1977: 17–43.

Type genus: Nannoniscus Sars, 1870

Nymphodora gen. nov.

Type species: Mirabilicoxa fletcheri Paul & George, 1975

Species composition. *Nymphodora fletcheri* (Paul & George, 1975) comb. nov. (monotypic).

Diagnosis. Body 4.3 times longer than pereonite 2 width, tergits laterally expanding in marginal flanges. 5-segmented *antenna 1* with bulbous terminal article, article 4 with distolateral projection. *Pereopod 1* shorter, but more robust than pereopods 2–7. Pereopods 5–7 without natatory setae. *Pereonites* 6, 7 and pleotelson fused dorsally, pereonites 6, 7 or operculum without ventral spine or projection. Posterior margin of *operculum* strongly rounded. *Uropods* biramous, endopodite long, projecting posterior margin of pleotelson; exopodite minute.

***Nymphodora fletcheri* (Paul & George, 1975) comb. nov.**
(Figs 1–3)

Mirabilicoxa fletcheri Paul & George, 1975: 166–168; *Chelibranchus fletcheri* Kussakin, 1999: 314.

Holotype: 1 ♀ (preparatory, 2.8 mm), Canada Basin, 84°52.9'N, 110°27'W, 1740 m, USNM No. 143607.

Diagnosis. Cephalothorax frontally vaulted, antennae inserting frontolaterally in a deep fault next to strongly produced anterolateral triangular projections; pereonite 1 slightly longer than second, pereopod 1 more robust but shorter than pereopods 2–7. Pereonites 6, 7 and pleotelson fused dorsally; pleotelson without posterolateral spines. Uropods biramous, endopodite long, projecting posterior margin of pleotelson; exopodite minute (modified after Paul & George 1975).

Description. Habitus of holotype female (Figs 1A, B): body dorsoventrally slightly flattened, 4.3 times longer than pereonite 2 width (i.e. 0.7 mm incl. coxal plates), surface with several fine setule. Cephalothorax (Figs 1A, C) about 1.3 times wider than long, length 0.2 times body length. Antennae inserting in a deep fold next to anterolateral triangular projections. Anterior margin strongly vaulted medially. Coxae not visible in dorsal view. Tergits laterally expanding in marginal flanges. Body gradually flattening from pereonites 1–5. Pereonite 1 width 3.1 times length, pereonites 1–3 of similar width and length; pereonite 2 widest, pereonite 4 longest, 1.5 times pereonite 1 length, width 2 times length; pereonite 5 about 2.3 wider than long. Pereonites 6, 7 and pleotelson fused dorsomedially, anterior margin of pereonite 6 strongly concave. Pereonite 7 short, length 0.6 pereonite 6 length. Pleotelson (Fig. 3D) length 0.2 of body length, 1.2 times longer than wide, with few small setae. Lateral margins straight, posterior margin tapering distally. Uropods (Fig. 3E) inserting close to the anus valves.

Antenna 1 (Fig. 2A) length 0.1 times body length, with 5 articles. Article 1 widest, article 2 longest; article 3 minute; article 4 with a triangular lateral projection tipped with a long, simple seta, 1.4 times longer than wide, with 1 long broom seta laterally; article 5 bulbous, 2.1 times longer than wide, length 4.9 times article 3 length, with a small, robust sensory seta terminally.

Antenna 2 (Fig. 2B) 0.5 of body length, with 6 peduncular and 12 flagellar articles. Peduncular articles 1–4 short. Article 5 somewhat shorter and more robust than article 6. Article 6 long and slender, twice as long as flagellar article 1, with few small setae and 1 small broom seta laterally, with 1 simple, slender and 1 more robust seta and 2 long and 2 short broom setae distally. Flagellum length 0.8 peduncle length, articles with 1–4 simple setae of varying size distally; terminal article with 6 long, slender setae.

Pereopod 1 (Fig. 2C) more robust than pereopods 2–7. Basis length 4.4 times width; with 8 small, simple setae ventrally. Ischium length 0.4 times basis length, 2 times longer than wide. Merus length 0.6 times ischium length, 1.4 times longer than wide; with 1 unequally bifid seta distodorsally and with 1 long unequally bifid distally setulate seta and 1 small seta distoventrally. Carpus length 0.7 times merus length, 2.4 times longer than wide; with 2 short, simple setae dorsally, with 3 robust unequally bifid and 2 long unequally bifid distally setulate setae ventrally. Propodus nearly as long as carpus, 2.8 times longer than wide; with 1 long simple seta and 1 unequally bifid distally setulate seta dorsally, with 2 robust, unequally bifid setae, 2 simple setae of varying size and a fringe of short setae, membranously embedded, ventrally. Dactylus length 0.6 times propodus length, 3.3 times longer than wide; with 4 fine setae of varying size medially and a fringe of setae, membranously embedded, ventrally. Ungius length 0.3 times dactylus length; with 2 short, cuspidate setae and 2 slender setae of varying size in between.

Pereopods 2–4 (Figs 2D–F). Basis of pereopod 2 length 4.5 times width, in pereopods 3–4 basis length 5.7 times width; pereopods 3–4 with 7 small, simple setae ventrally. Ischium length 0.4 times basis length. Ischium of pereopods 2–3 with 2 simple setae dorsally and 3 simple setae ventrally. Ischium of pereopod 4 more slender than of pereopods 2–3, length 3 times width; with 1 simple setae dorsally. Merus of pereopods 2–4 length 0.7 times width. Merus of pereopod 2 length 1.5 times width; with 4 simple setae of varying size dorsally and 2 simple setae ventrally. Merus of pereopods 3–4 length 2.1 times width; pereopod 3 with 3 simple setae dorsally and 2 small simple setae ventrally. Merus of pereopod 4 with each 1 simple seta dorsally

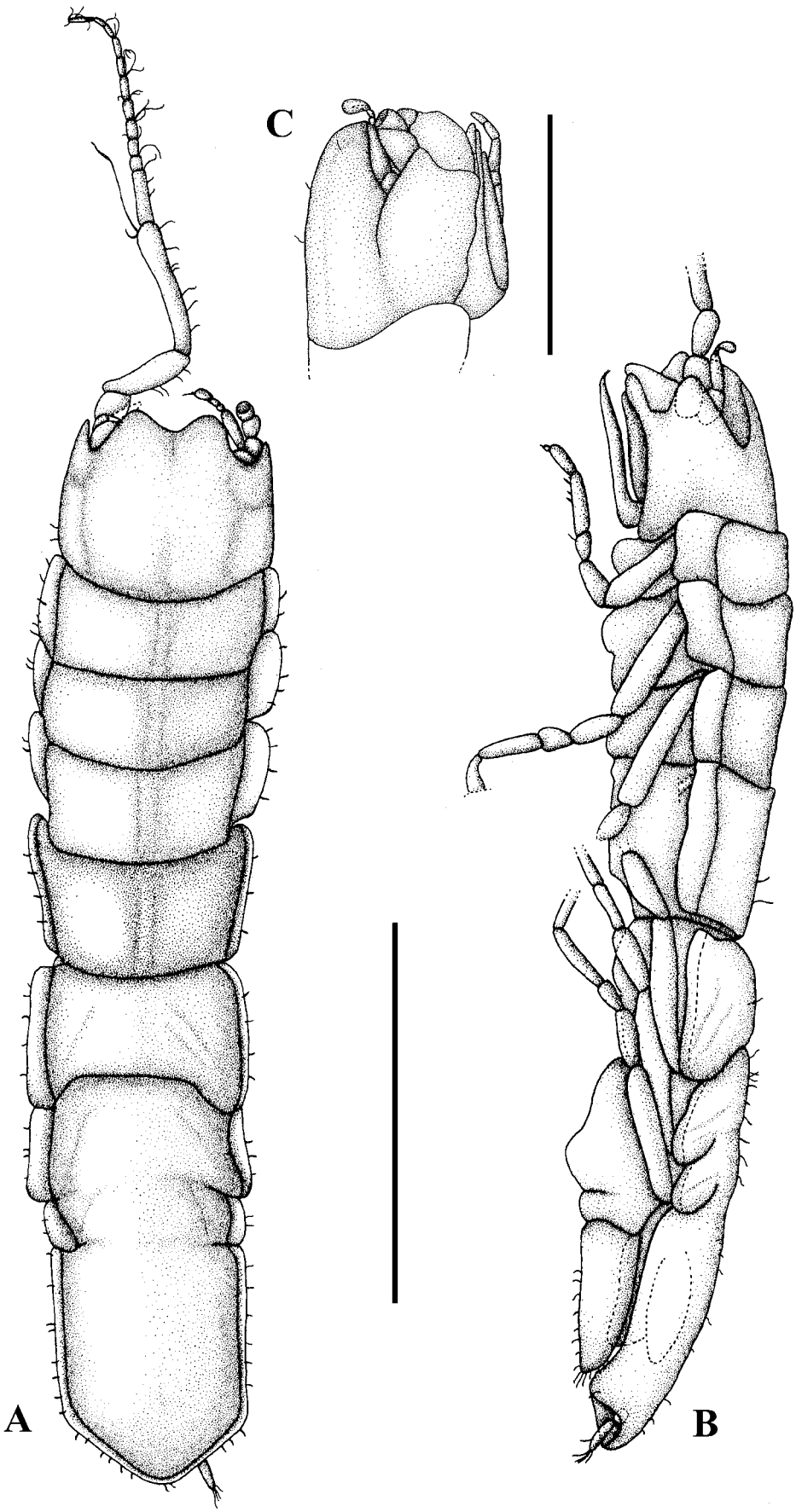

FIGURE 1. *Nymphodora fletcheri* (Paul & George, 1975) comb. nov., holotype female (USNM No. 143607); A, habitus, dorsal view; B, habitus, lateral view; C, cephalothorax, lateral view. Scale bar: A, B = 1000 µm, C = 500 µm.

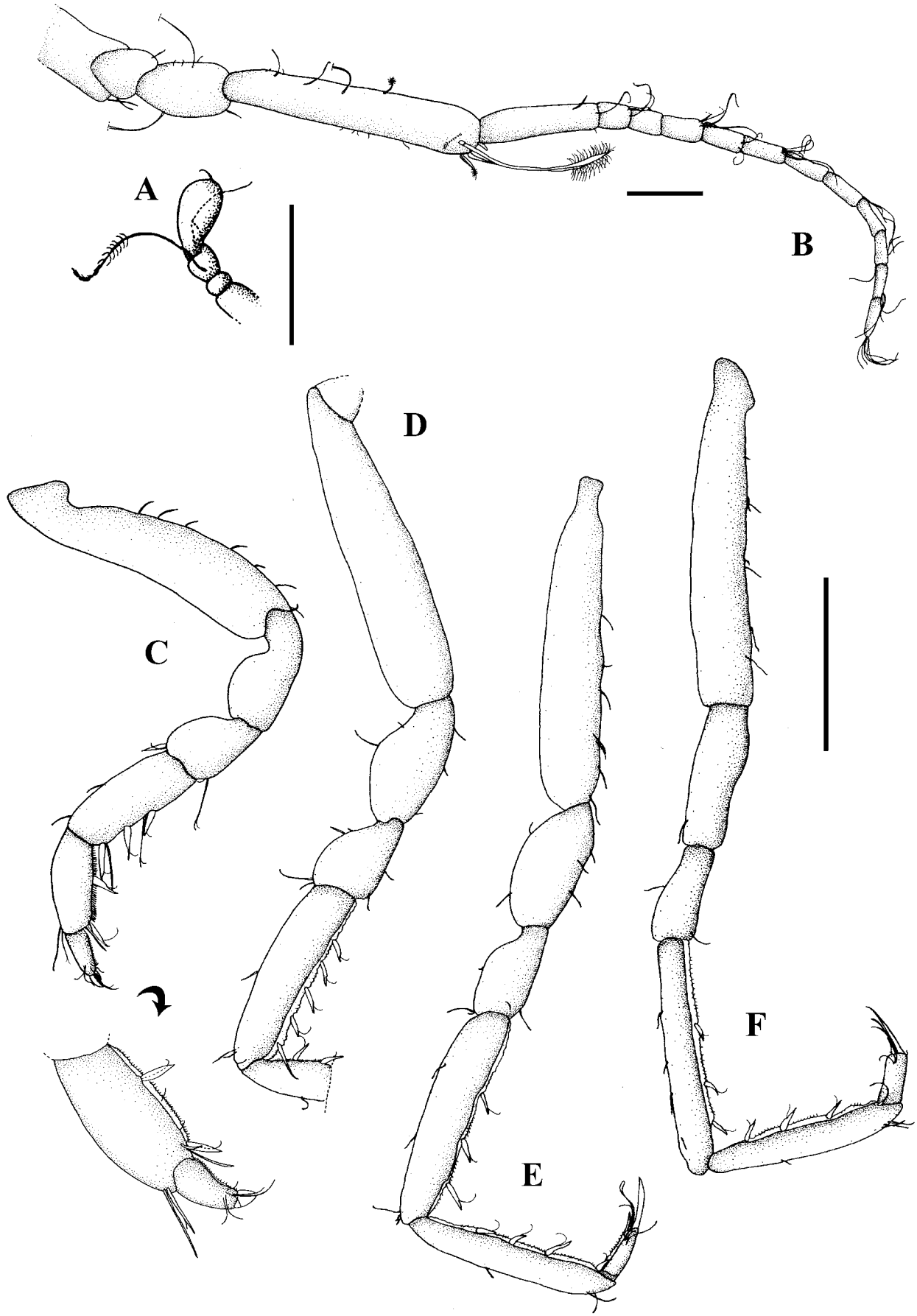

FIGURE 2. *Nymphodora fletcheri* (Paul & George, 1975) comb. nov., holotype female (USNM No. 143607); A, A1; B, A2; C–F, P1–4. Scale bar: A, B = 100 µm, C–F = 200 µm.

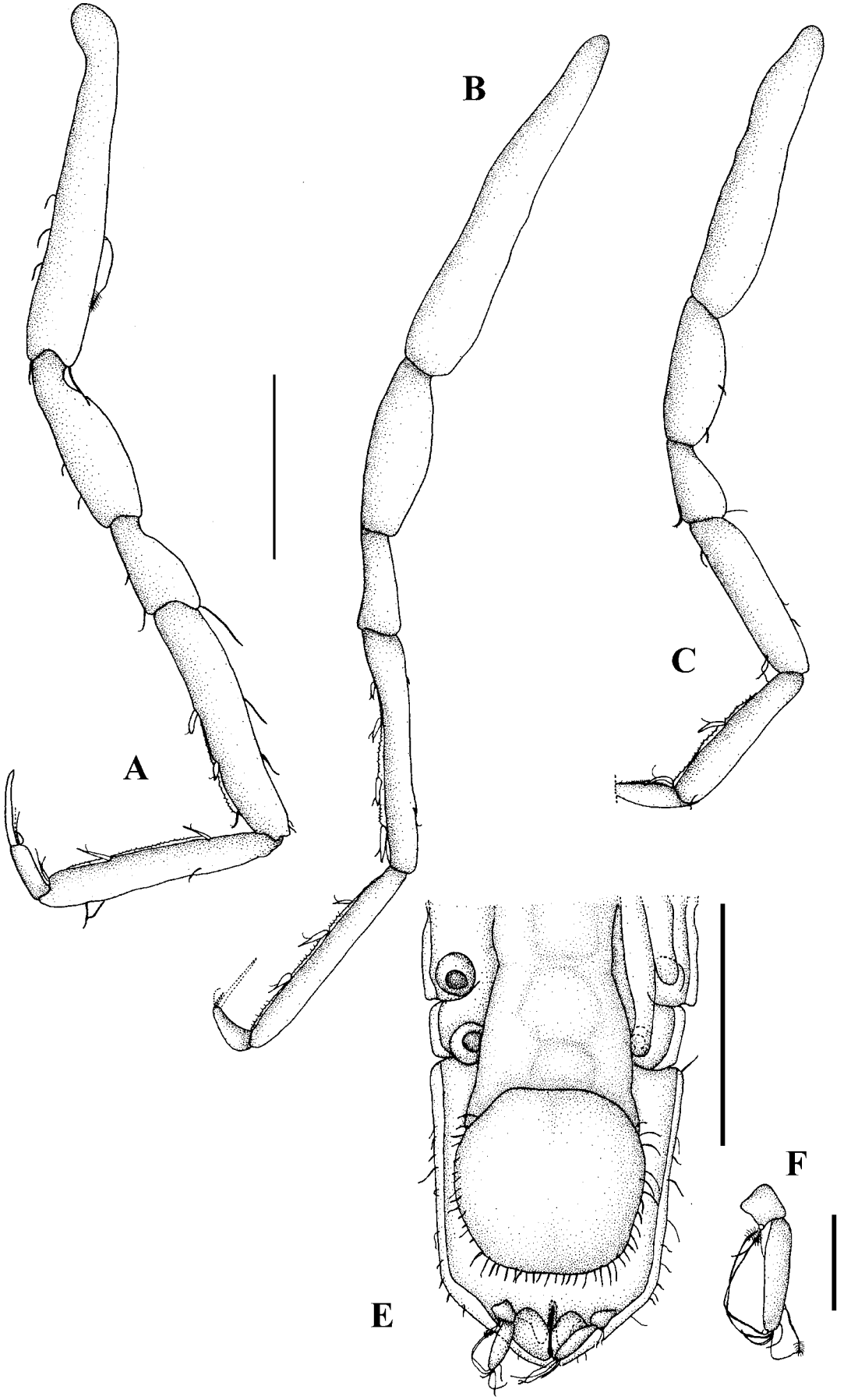

FIGURE 3. *Nymphodora fletcheri* (Paul & George, 1975) comb. nov., holotype female (USNM No. 143607); A–C, P5–7; D, Plt ventrally, Plp 2; E, Urp. Scale bar: A–C = 200 µm, D = 500 µm, E = 100 µm.

and ventrally. Carpus of pereopods 2–3 length 4.3 times width. Carpus of pereopod 2 with 3 short simple setae dorsally, with 4 robust unequally bifid setae, 1 somewhat longer, slender seta and a fringe of small setae, membranously embedded, ventrally. Carpus of pereopod 3 with 5 slender simple setae of varying size dorsally and 3 robust unequally bifid setae and a fringe of small simple setae, membranously embedded, ventrally. Carpus of pereopod 4 very slender, 7.8 times longer than wide; with 4 small simple setae dorsally and 3 robust unequally bifid setae and a fringe of small setae, membranously embedded, ventrally. Propodus and dactylus of pereopod 2 missing. Propodus of pereopods 3–4 length 6.6 times width; pereopod 3 and 4 with 3–4 slender simple setae dorsally and with 3–4 robust unequally bifid setae and a fringe of setae, membranously embedded, ventrally, pereopod 4 with 1 long slender seta distoventrally. Dactylus of pereopod 3 very slender, length 7.3 times width; with 3 slender setae of varying size medially and with fringe of setae, membranously embedded, ventrally. Ungius with 2 robust cuspidate setae of varying size and 2 somewhat longer slender setae in between. Dactylus of pereopod 4 length 5.3 times width; with 3 slender setae of varying size medially. Unguis with 2 robust cuspidate setae of varying size and 2 somewhat longer slender setae in between.

Pereopods 5–7 (Figs 3A–C): Basis of pereopods 5–6 length 6 times width, of pereopod 7 length 5 times width; basis of pereopod 5 with 1 long broom seta and 1 long simple seta dorsally and with 4 somewhat smaller simple setae ventrally. Ischium of pereopods 5–7 length 3 times width, pereopod 5 with 2 simple setae ventrally; pereopod 7 with 2 simple setae dorsally. Merus of pereopods 5 and 7 length 2 times width; pereopod 5 with 1 long simple seta dorsally and 2 somewhat shorter simple setae ventrally; pereopod 7 with 1 simple seta dorsally and 1 small unequally bifid seta ventrally. Merus of pereopod 6 slender, length 2.6 times width. Carpus of pereopod 5 length 5.1 times width; with 4 simple setae dorsally, with 3 robust unequally bifid setae decreasing in size distally and a fringe of small setae, membranously embedded, ventrally. Carpus of pereopod 6 length 6.4 times width; with 2 simple setae dorsally, with 4 robust, unequally bifid setae increasing in size distally and with a fringe of small setae, membranously embedded, ventrally. Carpus of pereopod 7 length 3.9 times width; with 2 simple setae dorsally and with 3 simple setae ventrally. Propodus of pereopod 5 length 6.6 times width; with 3 simple setae dorsally, with 3 robust unequally bifid setae and a fringe of small setae, membranously embedded, ventrally. Propodus of pereopod 6 very slender, length 8.8 times width; with 3 robust unequally bifid setae and a fringe of small setae, membranously embedded, ventrally. Propodus of pereopod 7 length 4.7 times width; with 1 simple seta dorsally and with 2 robust unequally bifid setae and a fringe of small setae, membranously embedded, ventrally. Dactylus of pereopods 6–7 damaged. Dactylus of pereopod 5 length 7.4 times width. Ungius with 1 long seta, 1 short robust cuspidate seta and 2 somewhat longer, slender setae in between.

Pleopod 2 (operculum, Fig. 3D) nearly round**,** almost as long as wide, lateral margins with numerous small setae.

Uropods (Fig. 3E) biramous. Protopodite rectangular, as long as wide. Exopodite minute, with 2 long, simple setae. Endopodite length about 25 times exopodite length, 4.7 times longer than wide, length 3.5 times protopodite length; with 4 long broom setae and 2 long simple setae distally.

Type locality. Canada Basin, north west of Queen Elizabeth Islands.

Distribution. Only known from type locality.

Etymology. `*Nymphe´* (greek) is feminine and refers to a Greek natural deity. `*Doris*` (lat.), feminine, is an allegory for *ocean*. The name refers to the inhabited realm and the head structure of the species resembling a hexapod nymph.

Remarks. A redescription of *Nymphodora fletcheri* comb. nov. was necessary due to the previously inaccurate description of the pereonites 6, 7 and pleotelson, uropods and antennae. Paul & George (1975) first assigned the species to the genus *Mirabilicoxa*, which is characterised by the following synapomorphies (cf. Hessler 1970): pleotelson widest anteriorly, with posterolateral spines; uropod uniramous or biramous with rudimentary exopodite; propodus of pereopod 1 without robust setae, carpus of pereopod 1 with a row of robust, unequally bifid setae; coxae strongly produced in male, though visible in dorsal view in female.

Kussakin (1999) transferred the species to the desmosomatid genus *Chelibranchus* Mezhov, 1986. However, the existence of this genus is doubted, as Mezhov (1986) defined it on the basis of two badly

damaged specimens, which were even less accurately described (Brix 2006). *Nymphodora* gen. nov. differs from *Chelibranchus* as follows: 5-segmented antenna 1 with bulbous terminal article; pereonites 6, 7 and pleotelson fused, posterior margin of pleopod 2 (operculum) strongly rounded, uropods biramous (in *Chelibranchus* with 4-segmented antenna 1, terminal article not enlarged, free pereonites and pleotelson, posterior margin of operculum strongly concave, uniramous uropods). The new genus (*Nymphodora*) bears characters with a greater affinity to Nannoniscidae than to Desmosomatidae, i.e. bulbous terminal article of the 5-segmented antenna 1, coxae not dorsally visible, inserting ventrally, fused pereonites 6, 7 and pleotelson, uropods inserting close together (cf. Wägele 1989; Wilson 2008).

Nymphodora can be distinguished from all other genera of this family by the fusion of the pereonites 6, 7 and pleotelson. It most closely resembles *Panetela* Siebenaller & Hessler, 1981. The latter can be distinguished from the new genus as follows: all pereonites free; body length more than 5 times pereonite 2 width, pereopod 6 with natatory setae. *Nymphodora* also resembles *Nannoniscus* Sars, 1870; the latter can be distinguished from the new genus by the following characters: pereonites 6 and 7 fused (not in all species); ventral spines on pereonite 7 or operculum. Due to the described differences between these similar species, *Nymphodora fletcheri* cannot be assigned to either *Nannoniscus* Sars, 1870 or *Panetela* Siebenaller & Hessler 1981.

Siebenaller & Hessler (1981) noted that the genus *Nannoniscus* is characterised by plesiomorphies (antenna 1 with bulbous terminal article; pereopods 1 and 2 equally robust; fusion of pereonites 6 and 7) rather than apomorphies and needs to be revised. In a recent review on Nannoniscidae, Wilson (2008) modified the generic diagnosis of *Nannoniscus* and transferred some species in other genera of the family. However, the generic diagnosis given by Wilson (2008) cannot be applied to all species in the genus. For example, *N. ovatus* Menzies & George 1972 is still included in the genus despite possessing uniramous uropods. Thus, the genus *Nannoniscus* still lacks a comprehensive revision.

Nymphodora fletcheri most closely resembles *Panetela compacta* Malyutina & Kussakin, 1996 by the shape of the habitus, cephalothorax, uropods and operculum, as well as the setation and proportions of the pereopods. The latter species differs from *N. fletcheri* by the following characters: terminal article of antenna 1 length 3.5 times width (2.1 times in *N. fletcheri*); propodus of pereopod 3 with 3 unequally bifid setae ventrally (while *N. fletcheri* possess 4 unequally bifid setae); carpus of pereopod 4 length 5.1 times width (in *N. fletcheri* length 7.8. times width); no ventral fringe of setae on propodus and carpus of pereopods 4–6, carpus of pereopods 7 with 1 robust unequally bifid seta ventrally (*N. fletcheri* with 3 simple setae); uropod's exopodite length 0.14 times endopodite length (in *N. fletcheri* endopodit length 25 times exopodit length).

Nymphodora fletcheri is also very similar to the female of *Nannoniscus arctoabyssalis* Just, 1980 in the shape of the habitus, cephalothorax, pereopod 1 and the lateral view of pereonite 7. *Nannoniscus arctoabyssalis* can be distinguished from *Nymphodora fletcheri* as follows: body surface and pereopods with numerous setae (*N. fletcheri* with just few setae*)*; pereonites 6 and 7 fused (in *N. fletcheri* pereonites 6, 7 and pleotelson fused); pereonite 3 widest (in *N. fletcheri* pereonite 2 widest); uropods completely covering anus valves (uropods of *N. fletcheri* just partly covering anus valves); uropods with relatively long exopodite (about half of endopodite length).

Malyutina & Kussakin (1996) discussed the arguable classification of *P. compacta* in *Panetela* due to the relatively wide habitus and the short pereonite 6, 7 and pleotelson. Wilson (2008) discussed the shape of the rostral crest more resembling Joeropsidae or Acanthaspidiidae, but proposed a position in Nannonicidae due to the bulbous form of the terminal article of antenna 1, and the shape of the molar process. A further classification was not possible, though, as the holotype was dissected (cf. Wilson 2008).

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References

Bluhm, B.A., MacDonald, I.R., Debenham, C. & Iken, K. (2005) Macro- and megabenthic communities in the high Arctic Canada Basin: initial findings. *Polar Biology*, 28, 218–231.

Brandt, A. (1995) Peracarid fauna (Crustacea, Malacotraca) of the Northeast Water Polynya off Greenland: documenting close benthic-pelagic coupling in the Westwind Trough. *Marine Ecology Progress Series*, 121, 39–51.

Brandt, A., Vassilenko, S., Piepenburg, D. & Thurston, M. (1996) The species composition of the peracarid fauna (Crustacea, Malacostraca) of the Northeast Water Polynya (Greenland). *Meddelelser om Grønland, Bioscience*, 44, 1–30.

Brix, S. (2006) *Evolution, Systematics and Distribution of Desmosomatidae (Isopoda, Peracarida, Crustacea) in the deep sea*. Dissertation, Universität Hamburg, pp. 369.

Brix, S. (2007) Four new species of Desmosomatidae Sars, 1897 (Crustacea: Isopoda) from the deep sea of the Angola Basin. *Marine Biology Research*, 3(4), 205–230.

Dahl, E., Laubier, L., Sibuet, M. & Strømberg, J.-O. (1976) Some quantitative results on benthic communities of the Norwegian Sea. *Astarte*, 9, 61–79.

Hansen, H.J. (1916) Crustacea, Malacostraca: The order Isopoda. *Danish Ingolf Expedition*, 3 (5), 1–262, plates 1–16.

Hessler, R.R. (1970) The Desmosomatidae (Isopoda, Asellota) of the Gay Head-Bermuda Transect. *Bulletin of the Scripps Institution of Oceanography*, 15, 1–185.

Just, J. (1980) Polar sea abyssal and deep bathyal Isopoda (Crustacea). *Steenstrupia*, 6(14), 197–230.

Kussakin, O.G. (1999) *Marine and salt-water Asellota (Isopoda) of the cold and temparate Waters of the northern hemisphere*. Vol. III, Suborder Asellota, Part 2, Nauka, Leningrad – AH SSSR, pp. 383 [in Russian].

Latréille, P.A. (1803) Histoire Naturelle des Crustacés et des Insectes. *In*: de Buffon, G.L.L. (Ed.). *Histoire Naturelle, nouvelle édition, accompagnée des notes*. 1802–1805, Volume 5, C. S. Sonnini, Paris.

Malyutina, M.V. & Kussakin, O.G. (1996) Addition to the Polar Sea bathyal and abyssal Isopoda (Crustacea). Part 1. Anthuridea, Valvifera, Asellota (Ischnomesidae, Macrostylidae, Nannoniscidae). *Zoosystematica Rossica*, 4 (1), 49–62.

Mezhov, B.V. (1986) Bathyal and abyssal Nannoniscidae and Desmosomatidae (Isopoda, Asellota) from Alaska Bay. *Archives of the Zoological Museum*, Moscow State Unversity, 24, 126–167 [in Russian].

Ohlin, A. (1901) Arctic Crustacea collected during the Swedish Arctic Expeditions 1898 and 1899 under the direction of Professor A.G. Nathorst. I. Leptostraca, Isopoda, Cumacea. *Bihang till Kongliga Svenska Vetenskaps-Akademiens Handlingar*, 26 (part 4, no. 12), 1–54.

Paul, A.Z. & Menzies, R.J. (1974) Benthic Ecology of the High Arctic Deep Sea. *Marine Biology*, 27, 251–262.

Paul, A.Z. & George, R.Y. (1975) High Arctic Benthic Isopods from Fletcher's Ice Island, T-3, with a description of one new species, *Mirabilicoxa fletcheri* n. sp. *Crustaceana*, 29(2), 166–168.

Piepenburg, D. (2005) Recent research on Arctic benthos: common notions need to be revised. *Polar Biology*, 28, 733–755.

Sars, G.O. (1870) Nye Dybvandscrustaceer fra Lofoten. *Forhandlinger i Videnskaps-selskabet I Christiania* 1869, 205–221.

Sars, G.O. (1897) *An account of the Crustacea of Norway, volume 2, parts 3–8. Isopoda*. Bergen, 103 pp.

Sars, G.O. (1899) *An account of the Crustacea of Norway, volume 2, parts 13–14. Isopoda*. Bergen, 270 pp.

Siebenaller, J.F. & Hessler, R.R. (1977) The Nannoniscidae (Isopoda, Asellota): *Hebefustis* n. gen. and *Nannoniscoides* Hansen, 1916. *Transactions of the San Diego Society of Natural History*, 19(2), 17–43.

Siebenaller, J.F. & Hessler, R.R. (1981) The genera of the Nannoniscidae (Isopoda, Asellota). *Transactions of the San Diego Society of Natural History*, 19(16), 227–250.

Svavarsson, J. (1997) Diversity of isopods (Crustacea): new data from the Arctic and Atlantic Ocean. *Biodiversity and Conservation*, 6, 1579–1579.

Svavarsson, J., Brattegard, T. & Strømberg, J.-O. (1990) Distribution and diversity patterns of asellote isopods (Crustacea, Isopoda) in the deep Norwegian and Greenland Seas. *Progress in Oceanography*, 24, 297–310.

Svavarsson, J., Strømberg, J.-O. & Brattegard, T. (1993) The deep-sea asellote (Isopoda, Crustacea) fauna of the Northern Seas: species compostion, distributional patterns and origin. *Journal of Biogeography*, 20, 537–555.

Wägele, J.W. (1989) *Evolution und phylogenetisches System der Isopoda. Stand der Forschung und neue Erkenntnisse*. Zoologica, Stuttgart, 262 pp.
Wilson, G.D.F. (2008) A review of taxonomic concepts in the Nannoniscidae (Isopoda, Asellota), with a key to the genera and a description of *Nannoniscus oblongus* Sars. *Zootaxa*, 1680, 1–24.