

A checklist of Norwegian Tardigrada

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Animals of the phylum Tardigrada are microscopical metazoans that seldom exceed 1 mm in length. They are recorded from terrestrial, limnic and marine habitats and they have a distribution from Arctic to Antarctica. Tardigrades are also named 'water bears' referring to their 'walk' that resembles a bear's gait. Knowledge of Norwegian tardigrades is fragmented and distributed across numerous sources. Here this information is gathered and validity of some records is discussed. In total 146 different species are recorded from the Norwegian mainland and Svalbard. Among these, 121 species and subspecies are recorded in previous publications and another 25 species are recorded from Norway for the first time.

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INTRODUCTION

The phylum Tardigrada (water bears) currently holds about 1250 valid species and subspecies (Degma et al. 2007, Degma et al. 2017) and are found in a great variety of habitats. They occur in freshwater, marine sediments, algae, mosses, lichens, litter, grassland, cryoconite holes on glaciers and even on barnacles in marine environments (Kristensen & Hallas 1980). They have a worldwide distribution; from the deep ocean floor to the highest mountains, from Antarctica to the Arctic region (e.g. Ramazzotti & Maucci 1983). Some species of tardigrades are known to survive extreme conditions in cryptobiosis. An example of extreme survival is *Acutuncus antarcticus* (Richters 1904) which is recorded to survive frozen for at least 30 years (Tsujiimoto et al. 2016). Further information on tardigrade cryptobiosis can be found in Guidetti et al. 2011 and Mjøberg et al. 2011. Some species are predators, but most species feed on plants, plant remains or bacteria.

When observed in a stereomicroscope, live tardigrades resemble small bears walking over the substrate, earning them the popular name 'water bears'. They have cylindrical bodies with four pairs of stumpy, unsegmented legs usually

terminating in claws or sucking disks. The first three pairs of legs are directed ventrolaterally and are used to moving over the substrate. The hind legs are directed posteriorly and are used for grasping. Adult Tardigrades usually range from 250 µm to 700 µm in length. Newly hatched juveniles might be as small as 50 µm (Ramazzotti & Maucci 1983) and mature adults as large as 1200 µm (Rahm 1931). In general limnoterrestrial tardigrades of the class Eutardigrada are transparent, while the terrestrial, armour-plated class Heterotardigrada are opaque. They occur in different colours: red, brown, orange, yellow, pink, green or black in the cuticle or gut (Nelson 2002). Reproduction is either sexual or parthenogenetic (Bertolani 1987) and the eggs are laid freely or in the exuvia.

Tardigrades were first described by the German pastor Johann August Ephraim Goeze in 1773. In 1776 the Italian priest and scientist Lazzaro Spallanzani named them Tardigrada, which mean "slow walker" (Spallanzani 1776). The first tardigrade species to be properly described was *Macrobotus hufelandi* Schulze, 1834 and *Milnesium tardigradum* Doyère (1840). These two species were for many years considered to be cosmopolitan and were recorded in many faunistic and other studies from various localities worldwide (Ramazzotti

Table 1. Tardigrada species described from Norway.

Taxon	Species	Author	Type locality
HETEROTARDIGRADA			
Echiniscidae			
	<i>Bryodelphax parvuspolaris</i>	Kaczmarek et al., 2012	Revdalen (Svalbard)
	<i>Diploechiniscus oihonnae</i>	(Richters, 1903b)	Meråker (Nord-Trøndelag) Smeerenburg (Svalbard)
	<i>Echiniscus blumi</i>	Richters, 1903b	Billefjorden (Svalbard)
	<i>Echiniscus loxophthalmus</i>	Richters, 1911a	Tromsø (Troms)
	<i>Echiniscus merokensis</i>	Richters, 1903b	Meråker (Nord-Trøndelag) Smeerenburg (Svalbard)
	<i>Echiniscus wendti</i>	Richters, 1903b	Meråker (Nord-Trøndelag) Smeerenburg (Svalbard)
	<i>Echiniscus spiculifer</i>	Schaudinn, 1901	Storøya (Svalbard)
	<i>Testechiniscus spitsbergensis</i>	(Scourfield, 1897)	Advent Bay (Svalbard)
EUTARDIGRADA			
APOCHELA			
Milnesiidae			
	<i>Bergtrollus dzimbowski</i>	Dastych, 2011	Lyngsalpene (Troms)
	<i>Bertolanius nebulosus</i>	(Dastych, 1983)	Atomfjella (Svalbard)
PARACHELA			
Eohypsibiidae			
	<i>Bertolanius volubilis</i>	(Durante Pasa et al., 1975)	Forså (Nordland)
Hypsibiidae			
	<i>Diphascion stappersi</i>	Richters, 1911b	Advent Bay (Svalbard); Hopen
	<i>Hypsibius arcticus</i>	Murray, 1907	Prins Karls Forland (Svalbard) Franz Josef Land (Russia)
	<i>Adropion belgicae</i>	(Richters, 1911b)	Advent Bay (Svalbard); Hopen
	<i>Itaquascon enckelli</i>	(Mihelčič, 1971/1972)	Alta (Finnmark) Erkenbäcken (Sverige) Kenesjärvi; Saima-Puumala (Finland)
	<i>Mesocrista spitzbergensis</i>	(Richters, 1903b)	Smeerenburg (Svalbard)
	<i>Pilatobiotus recamieri</i>	(Richters, 1911b)	Advent Bay; Hopen (Svalbard) Cap Hold with the Hope (Greenland)
Isohypsibiidae			
	<i>Doryphoribius macrodon</i>	Binda et al., 1980	Atomfjella (Svalbard) Adrono (Sicilia, Italy) Sydney (Australia)
	<i>Halobiotus stenostomus</i>	(Richters, 1908)	Indrepollen (Hordaland)
	<i>Isohypsibius ceciliae</i>	Pilato & Binda, 1987	Magdalenefjorden (Svalbard)
	<i>Isohypsibius coulsoni</i>	Kaczmarek et al., 2012	Revdalen (Svalbard)
	<i>Isohypsibius karenae</i>	Zawierucha, 2013	Ariekammen (Svalbard)
	<i>Isohypsibius pilatoi</i>	Durante Pasa & Muccci, 1977	Kvalsund (Finnmark)
	<i>Isohypsibius pulcher</i>	Mihelčič, 1971/1972	Suså (Denmark) Lakselv (Finnmark) Mörrumsån; Piteelven; Kalix (Sweden)

Table 1. Continued.

Taxon	Species	Author	Type locality	
Macrobotidae	<i>Macrobotus ariekammensis</i>	Węglarska, 1965	Ariekammen (Svalbard)	
	<i>Macrobotus crenulatus</i>	Richters, 1903b	Smeerenburg (Svalbard)	
	<i>Macrobotus echinogenitus</i>	Richters, 1903b	Smeerenburg (Svalbard) Taunus; Hallgarter Zane; Weilburg; Lahn (Germany)	
	<i>Macrobotus norvegicus</i>	Mihelčič, 1971/1972	Kuvatn (Finmark)	
	<i>Mesobotus harmsworthi harmsworthi</i>	(Murray, 1907)	Prins Karls Forland (Svalbard) Franz Josef Land (Russia)	
	<i>Mesobotus harmsworthi obscurus</i>	(Dastych, 1985)	Hornsund; Albert I Land; André Land; Atomfjella (Svalbard)	
	<i>Paramacrobotus areolatus</i>	(Murray, 1907)	Prins Karls Forland (Svalbard) Franz Josef Land (Russia)	
	<i>Tenuibiotus voronkovi</i>	(Tumanov, 2007)	Kongsfjorden (Svalbard)	
	Richtersiidae	<i>Adorybiotus granulatus</i>	(Richters, 1903b)	Meråker (Nord-Trøndelag)
		<i>Richtersius coronifer</i>	(Richters, 1903b)	Billefjorden (Svalbard) Tromsø (Troms)

& Maucci 1983; Tumanov 2006). As new taxonomical tools and traits were added to the identification toolbox in the recent years, more species could be separated and both species are now considered members of more complex species groups (Pilato 1981; Maucci 1988(1991); Binda & Pilato 1990). For instance the genus *Milnesium* now contains more than thirty different species (Morek et al., 2016; Pilato et al., 2016).

The first record of tardigrades from Norway was made by Goës (1862) who reported *Hypsibius dujardini* (Doyère 1840) from Smeerenburg on Svalbard. At the end of the 19th century, Scourfield (1897) reported four species of tardigrades from Svalbard. Among them the common and widespread species *Echiniscus spitsbergensis* (now: *Testechiniscus s.*), which he described as new. The following year Richard (1898) found *Macrobotus macronyx* (Dujardin 1851 (now: *Dactylobiotus*)) on the archipelago. Schaudinn (1901) added another seven species to the list of known tardigrades from Svalbard. Pioneers on tardigrade research in the first decade of the 20th century were the German zoologist Ferdinand Richters and the Scottish biologist James Murray. They both contributed to the knowledge of the Norwegian tardigrade fauna (e.g. Richters 1903, 1904a,b, 1908, 1911a,b and Murray 1907). After this period 58 years elapsed before tardigrades from Norway again were mentioned in literature. The two Polish zoologist, Węglarska (1965) and Dastych (1985) published thorough reports about the tardigrade fauna on Svalbard. Studies of tardigrades from limnic biotopes have hitherto been scarcely reported. Mihelčič (1971, 1971/1972) investigated 426 limnic samples from Scandinavia, Iceland and Finland, whereof 69 Norwegian samples revealed eight different species. Back in 1974 Durante Pasa and Maucci (1975, 1979) collected 204 samples of moss and lichens from

different localities in Norway and their investigation revealed 49 different species. A peculiar species within the family Milnesiidae from Lyngsalpene (Troms) was described by Dastych in 2011. The conspicuously proboscis formed by the mouth region made Dastych establish a new genus for *Bergtrollus dzimbowski* Dastych, 2011.

The main focus of tardigrades from Norway has been on Svalbard and in recent years many articles have focused on taxonomy of tardigrades from the archipelago. (e.g. Binda et al. 1980, Coulson et al., 2014; Dastych 1983, 1985; De Smet and van Rompu 1994; De Smet, Van Rompu and Beyens 1987, 1988; Janiec 1996; Kaczmarek et al. 2012; Klekowski and Opalinski 1986, 1989; Maucci 1996; Mokievsky 1992; Pilato et al., 1982; Pilato and Binda 1987; Smykla et al. 2011; Tumanov 2007; Van Rompu and De Smet 1988, 1991, 1996; Jankovská et al., 2016; Vonnahme et al., 2016; Zawierucha 2013; Zawierucha et al., 2013, 2015a,b,c; 2016a,b,c,d; 2017).

Among all the recorded species from Norway, 34 are originally described as new to science. Thirteen of these were not linked to a specific type locality (Table 1), but reported from two or more localities in the original description. In many cases type material is lost and the designation of neotypes from type localities might be necessary to stabilize the nomenclature and future understanding of these species.

MATERIAL AND METHODS

The current list of Tardigrada species (Table 2) is assembled based on recorded species from 60 papers dealing with tardigrades from the Norwegian mainland and Svalbard. All species listed are valid in «Actual checklist of Tardigrada

Table 2. Tardigrada species recorded from Norway (* New additions to the species list recorded by the author). Abbreviations for Counties: AA = Aust-Agder; Ak = Akershus; Bu = Buskerud; Fi = Finnmark; He = Hedmark; Ho = Hordaland; No = Nordland; NT = Nord-Trøndelag; Op = Oppland; Oslo; Ro = Rogaland; SF = Sogn og Fjordane; Sv = Svalbard; ST = Sør-Trøndelag; Te = Telemark; Tr = Troms; VA = Vest-Agder; Vf = Vestfold; Øf = Østfold.

Taxon	Species	Authority	County	Reference
HETEROTARDIGRADA				
ARTHROTARDIGRADA				
Batillipedidae				
	<i>Batillipes mirus</i>	Richters, 1909	Ho	Thambs-Lyche 1940
Tanarctidae				
	<i>Actinarctus doryphorus doryphorus</i>	Schulz, 1935	Ho	Clausen 2004
ECHINISCOIDEA				
Echiniscoididae				
	<i>Echiniscoides sigismundi groenlandicus</i>	Kristensen & Hallas, 1980	Tr	Kristensen & Hallas 1980
	<i>Echiniscoides sigismundi sigismundi</i>	(M. Schultze, 1865)	Ho, Oslo	Richters 1908; Thambs-Lyche 1940; Kristensen & Hallas 1980
Echiniscidae				
	<i>Acanthechiniscus islandicus</i>	(Richters, 1904)	Sv	Van Rompu & De Smet 1996
	<i>Acanthechiniscus victor</i>	(Ehrenberg, 1853)	Sv	Schaudinn 1901; Richters 1911a; Marcus 1936; Węglarska 1965; Dastych 1985; Łagisz 1999; Zawierucha et al. 2015c; Vonnahme et al. 2016
	<i>Bryodelphax parvulus</i>	Thulin, 1928	Sv, No	Durante-Pasa & Maucci 1979; Łagisz 1999; Zawierucha et al. 2015c
	<i>Bryodelphax parvuspolaris</i>	Kaczmarek et al., 2012	Sv	Kaczmarek et al. 2012
	<i>Bryodelphax sinensis</i>	(Pilato, 1974)	Sv	Dastych 1985
	<i>Diploechiniscus oihonnae</i>	(Richters, 1903)	Sv, No, NT, Ho	Richters 1903, 1904a,b, 1911a,b; Durante Pasa & Maucci 1979
	<i>Echiniscus arctomys</i>	Ehrenberg, 1853	Sv, No, NT	Scourfield 1897; Schaudinn 1901; Richters 1903, 1904b; Murray 1907; Summerhayes & Elton 1923; Marcus 1936; Durante Pasa & Maucci 1979
	<i>Echiniscus blumi blumi</i>	Richters, 1903	Sv, No, NT	Richters 1903, 1904b; Durante Pasa & Maucci 1975, 1979; Dastych 1985; Maucci 1996; Łagisz 1999; Zawierucha et al. 2015c
	<i>Echiniscus capillatus</i>	Ramazzotti, 1956	Sv	Dastych 1985; Łagisz 1999; Zawierucha et al. 2015c
	<i>Echiniscus columinis</i>	Murray, 1911	Sv	Węglarska 1965
	<i>Echiniscus granulatus</i>	(Doyère, 1840)	Sv, No	Richters 1911a; Durante Pasa & Maucci 1975, 1979; Dastych 1985; Maucci 1996; Łagisz 1999; Zawierucha et al. 2016b
	<i>Echiniscus loxophthalmus</i>	Richters, 1911	Tr	Richters 1911a

Table 2. Continued.

Taxon	Species	Authority	County	Reference
	<i>Echiniscus merokensis merokensis</i>	Richters, 1904	Sv, Fi, Tr, No, NT, ST, OP	Richters 1904b; Marcus 1936; Durante Pasa & Maucci 1979; Dastych 1985; Maucci 1996; Meier 1996; Kaczmarek et al. 2012; Zawierucha et al. 2013, 2015c, 2016b, 2017
	<i>Echiniscus merokensis suecicus</i>	Thulin, 1911	Sv	Maucci 1996
	<i>Echiniscus militaris</i>	Murray, 1911	No	Durante Pasa & Maucci 1975, 1979
	<i>Echiniscus phocae</i>	du Bois-Reymond Marcus, 1944	No	Durante Pasa & Maucci 1979
	<i>Echiniscus quadrispinosus quadrispinosus</i>	Richters, 1902	Sv	Marcus 1936; Kaczmarek et al. 2012; Zawierucha et al. 2016b
	<i>Echiniscus spiculifer</i>	Schaudinn, 1901	Sv	Schaudinn 1901; Marcus 1936
	<i>Echiniscus spinulosus</i>	(Doyère, 1840)	Sv	Schaudinn 1901; Marcus 1936
	<i>Echiniscus testudo</i>	(Doyère, 1840)	Sv, No	Schaudinn 1901; Richters 1903, 1904b; Summerhayes & Elton 1923; Marcus 1936; Durante Pasa & Maucci 1979; Dastych 1985; Maucci 1996; Kaczmarek et al. 2012; Zawierucha et al. 2016b
	<i>Echiniscus trisetosus</i>	Cuénot, 1932	Sv, No, Op	Marcus 1936; Durante Pasa & Maucci 1975, 1979
	<i>Echiniscus wendti</i>	Richters, 1903	Sv, Tr, NT, Op	Richters 1903, 1904b, 1911a,b; Węglarska 1965; Durante Pasa & Maucci 1979; Dastych 1985, 2011; Janiec 1996; Maucci 1996; Łagisz 1999; Kaczmarek et al. 2012; Zawierucha et al. 2015c, 2016b
	<i>Hypechiniscus gladiator gladiator</i>	(Murray, 1905)	ST	*Meier, Mølnbukta (Agdenes, Sør-Trøndelag)
	<i>Proechiniscus hanneae</i>	(Petersen, 1951)	Tr	Unpublished (Dastych – pers. med.)
	<i>Pseudechiniscus suillus</i>	(Ehrenberg, 1853)	Sv, No, NT, ST, Op	Murray 1907; Richters 1911b; Marcus 1936; Węglarska 1965; Durante Pasa & Maucci 1975, 1979; Dastych 1985; Van Rompu & De Smet 1991, 1996; Meier 1996; Maucci 1996; Kaczmarek et al. 2012; Zawierucha et al. 2013, 2015c
	<i>Testechiniscus spitsbergensis</i>	(Scourfield, 1897)	Sv, No	Scourfield 1897; Schaudinn 1901; Richters 1903, 1904b, 1911a,b; Marcus 1936; Węglarska 1965; Durante Pasa & Maucci 1975, 1979; Dastych 1985; Van Rompu & De Smet 1991, 1996; Maucci 1996; Kaczmarek et al. 2012; Zawierucha et al. 2013, 2015c; Vonnahme et al. 2016
EUTARDIGRADA				
APOCHELA				
Milnesiidae				
	<i>Bergtrollus dzimbowski</i>	Dastych, 2011	Tr	Dastych 2011

Table 2. Continued.

Taxon	Species	Authority	County	Reference
	<i>Milnesium asiaticum</i>	Tumanov, 2006	Sv	Kaczmarek et al. 2012; Zawierucha et al. 2015c
	<i>Milnesium eurystomum</i>	Maucci, 1991	Sv, Tr	Dastych 2011; Kaczmarek et al. 2012; Zawierucha et al. 2015c
	<i>Milnesium tardigradum tardigradum</i>	Doyère, 1840	Sv, Fi, Tr, No, NT, Op, Øf	Richters 1903, 1904b, 1911a,b; Marcus 1936; Węglarska 1965; Durante Pasa & Maucci 1975, 1979; Maucci 1996; Łagisz 1999; Dastych 2011: cf. tardigradum
PARACHELA				
Eohypsibioidae				
Eohypsibiidae				
	<i>Bertolanus nebulosus</i>	(Dastych, 1983)	Sv, ST	Durante Pasa & Maucci 1979 (see Maucci 1996); Dastych 1983, 1985; Meier 1996
	<i>Bertolanus smreczynskii</i>	(Węglarska, 1970)	Sv	Klekowski & Opaliński 1986, 1989; De Smet et al. 1988; Janiec 1996
	<i>Bertolanus volubilis</i>	(Durante Pasa & Maucci, 1975)	No, ST	Durante Pasa & Maucci 1975, 1979; Meier 1996
	<i>Bertolanus weglarskae</i>	(Dastych, 1972)	Sv, ST	Van Rompu & De Smet 1988, 1991, 1996; Meier 1996
Hypsibioidae				
Calohypsibiidae				
	<i>Calohypsibius ornatus</i>	(Richters, 1900)	Sv, Tr, No, NT, Op	Schaudinn 1901; Richters 1903, 1904b, 1911a,b; Murray 1907; Durante Pasa & Maucci 1979; Kaczmarek et al. 2012; Zawierucha et al. 2015c
	<i>Calohypsibius schusteri</i>	Nelson & McGlothlin, 1996	ST	*Meier, Mølnbukt (Agdenes, Sør-Trøndelag)
	<i>Calohypsibius verrucosus</i>	(Richters, 1900)	ST	*Meier, Verrafjorden (Agdenes, Sør-Trøndelag)
Hypsibiidae				
Diphasconinae				
	<i>Diphascon alpinum</i>	Murray, 1906	Sv, Fi, Tr, No, NT, Op	Murray 1907; Marcus 1936; Węglarska 1965; Durante Pasa & Maucci 1979; De Smet et al. 1988; Van Rompu & De Smet 1988; Janiec 1996; Łagisz 1999
	<i>Diphascon chilense</i>	Plate, 1888	Sv, Tr	Richters 1903, 1904b, 1911a,b; Murray 1907; Marcus 1936
	<i>Diphascon higginsi</i>	Binda, 1971	ST	*Meier, Søndre Knutshø (Oppdal, Sør-Trøndelag)
	<i>Diphascon pingue pingue</i>	(Marcus, 1936)	Sv	Dastych 1985; Van Rompu & De Smet 1991, 1996; Maucci 1996; Kaczmarek et al. 2012; Zawierucha et al. 2015c, 2016b, 2017
	<i>Diphascon stappersi</i>	Richters, 1911	Sv	Richters 1911a,b; Marcus 1936; Van Rompu & De Smet 1991
	<i>Diphascon tenue</i>	Thulin, 1928	Sv, Tr, ST	Węglarska 1965; Durante Pasa & Maucci 1979; Dastych 1985; Maucci 1996; Meier 1996; Zawierucha et al. 2015c

Table 2. Continued.

Taxon	Species	Authority	County	Reference
Hypsibiinae				
	<i>Borealibius zetlandicus</i>	(Murray, 1907)	Sv, Fi, ST, He, Op, Bu	Murray 1907; Marcus 1936; Meier 1996; Łagisz 1999
	<i>Hypsibius arcticus</i>	(Murray, 1907)	Sv	Murray 1907; Richters 1911b; Marcus 1936; Węglarska 1965; Dastyh 1985: cf. <i>arcticus</i> ; Van Rompu & De Smet 1991; Janiec 1996; Zawierucha et al. 2015b,c; Vonnahme et al. 2016
	<i>Hypsibius biscuitiformis</i>	Bartoš, 1960	Sv	Łagisz 1999 (uncertain identification according to the author)
	<i>Hypsibius convergens</i>	(Urbanowicz, 1925)	Sv, Fi, Tr, No, NT	Murray 1907; Marcus 1936 (uncertain); Węglarska 1965; Mihelčič 1971; Durante Pasa & Maucci 1975, 1979; Dastyh 1985; Van Rompu & De Smet 1991; Janiec 1996; Łagisz 1999; Kaczmarek et al. 2012; Zawierucha et al. 2013, 2016b
	<i>Hypsibius dujardini</i>	(Doyère, 1840)	Sv, Fi, ST, Op, Bu	Goës 1862; Richters 1903, 1904b, 1911a,b; Marcus 1936; Węglarska 1965; Dastyh 1985; De Smet et al. 1987, 1988; Van Rompu & De Smet 1988, 1991, 1996; Janiec 1996; Maucci 1996; Meier 1996; Zawierucha et al. 2013, 2015b, 2016a,b,d, 2017; Vonnahme et al. 2016
	<i>Hypsibius microps</i>	Thulin, 1928	Sv, Fi, Tr, No, Øf	Durante Pasa & Maucci 1975, 1979; Maucci 1996; Kaczmarek et al. 2012; Zawierucha et al. 2015c
	<i>Hypsibius pallidoides</i>	Pilato et al., 2011	ST	*Meier, Mølnbukt (Agdenes, Sør-Trøndelag)
	<i>Hypsibius pallidus</i>	Thulin, 1911	Sv, Fi, Tr, No, ST, Op, Øf	Węglarska 1965; Durante Pasa & Maucci 1979; Dastyh 1985; Janiec 1996; Maucci 1996; Meier 1996; Kaczmarek et al. 2012; Zawierucha et al. 2015c, 2016b
	<i>Hypsibius scabropygus</i>	Cuénot, 1929	Vf	*Meier, Havna (Tjøme, Vestfold)
Itaquasconinae				
	<i>Adropion arduifrons</i>	(Thulin, 1928)	Sv	Dastyh 1985
	<i>Adropion behanae</i>	(Dastyh, 1987)	Sv	Dastyh 1985, 1987
	<i>Adropion belgicae</i>	(Richters, 1911)	Sv, Bu	Richters 1911a,b; Marcus 1936; Mihelčič 1971; Dastyh 1985; Maucci 1996; Zawierucha et al. 2015c
	<i>Adropion prorsirostre</i>	(Thulin, 1928)	Sv, Tr, No, Op	Durante Pasa & Maucci 1979; Maucci 1996; Kaczmarek et al. 2012; Zawierucha et al. 2013, 2015c, 2017
	<i>Adropion scoticum scoticum</i>	(Murray, 1905)	Sv, Fi, No, ST, Op, Øf	Murray 1907; Richters 1911b; Węglarska 1965; Durante Pasa & Maucci 1979; Dastyh 1985; De Smet et al. 1988; Van Rompu & De Smet 1991, 1996; Janiec 1996; Meier 1996; Łagisz 1999; Kaczmarek et al. 2012; Zawierucha et al. 2015c, 2017

Table 2. Continued.

Taxon	Species	Authority	County	Reference
	<i>Astatumen trinacriae</i>	(Arcidiacono, 1962)	Op	*Meier, Eid (Gran, Oppland)
	<i>Itaquascon enckelli</i>	(Mihelčič, 1971/ 1972)	Fi	Mihelčič 1971, 1971/1972
	<i>Mesocrista spitzbergensis</i>	(Richters, 1903)	Sv, Fi, Tr, No, Op	Richters 1903, 1904b, 1911b; Murray 1907; Marcus 1936; Węglarska 1965; Durante Pasa & Maucci 1979; Dastych 1985; Klekowski & Opalinski 1986, 1989; De Smet et al. 1988; Janiec 1996; Van Rompu & De Smet 1988, 1996
	<i>Platicrista angustata</i>	(Murray, 1905)	Sv, Fi, Tr, No, NT, Op	Murray 1907, Richters 1911b; Marcus 1936; Durante Pasa & Maucci 1979; Dastych 1985; Maucci 1996; Kaczmarek et al. 2012; Zawierucha et al. 2013, 2015c, 2017
	<i>Platicrista itaquasconoide</i>	(Durante Pasa & Maucci, 1975)	ST	*Meier, Mølnbukt (Agdenes, Sør-Trøndelag)
Pilatobiinae	<i>Pilatobius bullatus</i>	(Murray, 1905)	ST	*Meier, Søndre Knutshø (Oppdal, Sør-Trøndelag)
	<i>Pilatobius oculatus oculatus</i>	(Murray, 1906)	Op, Øf	Richters 1911b; Durante Pasa & Maucci 1979; Dastych 1985
	<i>Pilatobius recamieri</i>	(Richters, 1911)	Sv, Ho	Richters 1911b; Marcus 1936; Węglarska 1965; Dastych 1985; De Smet & Van Rompu 1994; Janiec 1996; Maucci 1996; Meier 1996; Van Rompu & De Smet 1996; Kaczmarek et al. 2012; Zawierucha et al. 2013, 2015b,c, 2016a,b,d; Vonnahme et al. 2016
Incerta subfamilia	<i>Mixibius saracenus</i>	(Pilato, 1973)	ST	*Meier, Søndre Knutshø (Oppdal, Sør-Trøndelag)
Microhypsibiidae	<i>Fractonotus caelatus</i>	(Marcus, 1928)	ST	*Meier, Søndre Knutshø (Oppdal, Sør-Trøndelag)
	<i>Microhypsibius bertolanii</i>	Kristensen, 1982	Sv	Zawierucha et al. 2016b
	<i>Microhypsibius truncatus</i>	Thulin, 1928	No, ST	Durante Pasa & Maucci 1979; Meier 1996
Ramazottiidae	<i>Hebesuncus conjungens</i>	(Thulin, 1911)	Sv, Tr, No	Marcus 1936; Durante Pasa & Maucci 1979; Dastych 1985, 2011; Van Rompu & De Smet 1991; Kaczmarek et al. 2012; Zawierucha et al. 2015c, 2016b
	<i>Ramazottius cataphractus</i>	(Maucci, 1974)	Sv	Dastych 1985
	<i>Ramazottius montivagus</i>	(Dastych, 1983)	Sv	Dastych 1983, 1985
	<i>Ramazottius oberhaeuseri</i>	(Doyère, 1840)	Sv, NT	Richters 1903, 1904b, 1911a,b; Murray 1907; Marcus 1936; Węglarska 1965; Dastych 1985
	<i>Ramazottius cf. rupeus</i>	Biserov, 1999	Sv	Zawierucha et al. 2016b
	<i>Ramazottius subanomalous</i>	(Biserov, 1985)	Oslo	*Meier, Prinsdal (Oslo)

Table 2. Continued.

Taxon	Species	Authority	County	Reference
Isohypsibiodea				
Isohypsibiidae				
	<i>Doryphoribius flavus</i>	(Iharos, 1966)	ST	*Meier, Søndre Knutshø (Oppdal, Sør-Trøndelag)
	<i>Doryphoribius macrodon</i>	Binda et al., 1980	Sv, ST	Binda et al. 1980; Dastych 1985; Meier 1996
	<i>Eremobiotus alicatai</i>	(Binda, 1969)	SF	*Meier, Refvikstranda (Måløy, Sogn og Fjordane)
	<i>Halobiotus arcturulus</i>	Crisp & Kristensen, 1983	Sv	Mokievsky 1992
	<i>Halobiotus crispae</i>	Kristensen, 1982	Sv	Møbjerg et al. 2007; Smykla et al. 2011
	<i>Halobiotus stenostomus</i>	(Richters, 1908)	Tr, Ho	Richters 1908; Geddes 1968
	<i>Isohypsibius annulatus annulatus</i>	(Murray, 1905)	Sv, ST	Murray 1907; Marcus 1936; Meier 1996
	<i>Isohypsibius asper</i>	(Murray, 1906)	Sv, ST	Richters 1903, 1911a; Murray 1907; Meier 1996; Węglarska 1965; Łagisz 1999 (uncertain identification according to the author)
	<i>Isohypsibius ceciliae</i>	Pilato & Binda, 1987	Sv	Pilato & Binda 1987
	<i>Isohypsibius coulsoni</i>	Kaczmarek et al., 2012	Sv	Kaczmarek et al. 2012; Zawierucha et al. 2013, 2015c, 2016b
	<i>Isohypsibius dastychi</i>	Pilato et al., 1982	Sv	Pilato et al. 1982; Dastych 1985
	<i>Isohypsibius elegans</i>	Binda & Pilato, 1971	Sv	Dastych 1985; Van Rompu & De Smet 1996; Zawierucha et al. 2016b
	<i>Isohypsibius granulifer granulifer</i>	Thulin, 1928	Sv	Dastych 1985; De Smet et al. 1988; Van Rompu & De Smet 1988, 1991, 1996; De Smet & Van Rompu 1994; Janiec 1996; Zawierucha et al. 2015b
	<i>Isohypsibius karenae</i>	Zawierucha, 2013	Sv	Zawierucha 2013, 2016b
	<i>Isohypsibius marcellinoi</i>	Binda & Pilato, 1971	Sv, Fi	Meier 1996; Łagisz 1999; Zawierucha et al. 2013
	<i>Isohypsibius marii</i>	R. Bertolani, 1982	ST	*Meier, Agdenes fyr (Agdenes, Sør-Trøndelag)
	<i>Isohypsibius monoicus</i>	R. Bertolani, 1982	He	Meier 1996
	<i>Isohypsibius papillifer bulbosus</i>	(Marcus, 1928)	Sv	Van Rompu & De Smet 1988, 1991
	<i>Isohypsibius papillifer papillifer</i>	(Murray, 1905)	Sv	Richters 1911b; Van Rompu & De Smet 1991, 1996
	<i>Isohypsibius pilatoi</i>	(Durante Pasa & Maucci, 1979)	Fi	Durante Pasa & Maucci 1979
	<i>Isohypsibius prosostomus prosostomus</i>	Thulin, 1928	Sv, Fi, Tr, No, NT, Bu	Węglarska 1965; Mihelčič 1971; Durante Pasa & Maucci 1979; Dastych 1985; Maucci 1996; Janiec 1996; Zawierucha et al. 2015c
	<i>Isohypsibius pulcher</i>	(Mihelčič, 1971/1972)	Fi	Mihelčič 1971, 1971/1972
	<i>Isohypsibius reticulatus</i>	Pilato, 1973	Sv, ST	Meier 1966; Zawierucha et al. 2016b: cf. <i>reticulatus</i>
	<i>Isohypsibius sattleri</i>	(Richters, 1902)	Sv, ST	Dastych 1985; Meier 1996; Zawierucha et al. 2015c, 2016b

Table 2. Continued.

Taxon	Species	Authority	County	Reference
	<i>Isohypsibius schaudinni</i>	(Richters, 1909)	Sv	Richters 1909; Węglarska 1965
	<i>Isohypsibius tuberculatus</i>	(Plate, 1888)	Sv	Scourfield 1897; Schaudinn 1901; Richters 1903; Murray 1907; Marcus 1936; Zawierucha et al. 2016b
	<i>Thulinus augusti</i>	(Murray, 1907)	Sv, Fi, Tr, No, NT, SF, Ho, Ro, AA, VA, Te, Bu, Ak	Mihelčič 1971, Meier 1996 (both records are uncertain identifications)
Macrobioidea				
Macrobotidae				
	<i>Macrobotus ariekammensis</i>	Węglarska, 1965	Sv	Węglarska 1965; Dastych 1985; Łagisz 1999
	<i>Macrobotus crenulatus</i>	Richters, 1904	Sv	Richters 1904b; Murray 1907; Maucci 1996; Van Rompu & De Smet 1996; Kaczmarek et al. 2012; Zawierucha 2013; Zawierucha et al. 2013, 2015c, 2016b, 2017
	<i>Macrobotus echinogenitus</i>	Richters, 1904	Sv, Fi, Tr, No, Op	Richters 1903, 1904b, 1911a,b; Murray 1907; Węglarska 1965; Durante Pasa & Maucci 1979; Dastych 1985; Klekowski & Opalinski 1986, 1989; De Smet et al. 1988; Van Rompu & De Smet 1991, 1996; Meier 1996; Zawierucha et al. 2013
	<i>Macrobotus hibiscus</i>	de Barros, 1942	ST	Durante Pasa & Maucci 1979
	<i>Macrobotus hufelandi hufelandi</i>	C.A.S. Schultze, 1834	Sv, Fi, Tr, No, NT, ST, Op, Bu, Ho	Scourfield 1897; Schaudinn 1901; Richters 1903, 1904a,b, 1911b; Murray 1907; Summerhayes & Elton 1923; Marcus 1936; Węglarska 1965; Durante Pasa & Maucci 1975, 1979; Dastych 1985; Van Rompu & De Smet 1988; Meier 1996; Kaczmarek et al. 2012; Zawierucha et al. 2013, 2015c
	<i>Macrobotus macrocalix</i>	Bertolani et al., 1993	Op	*Meier, Hafjelltoppen (Øyer, Oppland)
	<i>Macrobotus norvegicus</i>	Mihelčič, 1971/1972	Fi	Mihelčič 1971, 1971/1972
	<i>Macrobotus occidentalis occidentalis</i>	Murray, 1910	Sv, Tr	Węglarska 1965; Durante Pasa & Maucci 1979
	<i>Macrobotus pallarii</i>	Maucci, 1954	No	Durante Pasa & Maucci 1979
	<i>Macrobotus persimilis</i>	Binda & Pilato, 1972	ST	*Meier, Søndre Knutshø (Oppdal, Sør-Trøndelag)
	<i>Macrobotus polonicus</i>	Pilato et al., 2003	Vf	*Meier, Havna (Tjøme, Vestfold)
	<i>Macrobotus recens</i>	Cuénot, 1932	ST	* Meier, Austråt (Ørland, Sør-Trøndelag)
	<i>Macrobotus spectabilis</i>	Thulin, 1928	Sv, No, Op	Durante Pasa & Maucci 1979; Klekowski & Opaliński 1986, 1989
	<i>Macrobotus vladimiri</i>	Bertolani et al., 2011	ST	*Meier & Ekrem, Kalvskinnet (Trondheim, Sør-Trøndelag)

Table 2. Continued.

Taxon	Species	Authority	County	Reference
	<i>Mesobiotus harmsworthi harmsworthi</i>	(Murray, 1907)	Sv, Fi, No, Op	Murray 1907; Richters 1911a,b; Węglarska 1965; Durante Pasa & Maucci 1975, 1979; Dastych 1985; Klekowski & Opalinski 1986, 1989; Maucci 1996; Meier 1996; Van Rompu & De Smet 1996; Łagisz 1999; Kaczmarek et al. 2012; Zawierucha et al. 2013, 2015c, 2016b, 2017
	<i>Mesobiotus harmsworthi obscurus</i>	(Dastych, 1985)	Sv	Dastych 1985; Maucci 1996; Kaczmarek et al. 2012; Zawierucha et al. 2015c, 2016b
	<i>Mesobiotus montanus</i>	(Murray, 1910)	Fi, NT, Op	Durante Pasa & Maucci 1979
	<i>Mesobiotus nuragicus</i>	(Pilato & Sperlinga, 1975)	Ho	*Meier, Bondhusvannet (Kvinnherad, Hordaland)
	<i>Mesobiotus orcadensis</i>	(Murray, 1907)	Fi, Tr, No	Durante Pasa & Maucci 1975, 1979
	<i>Mesobiotus peterseni</i>	(Maucci, 1991)	Sv	Jankovská et al. 2016
	<i>Minibiotus crassidens</i>	(Murray, 1907)	Sv	Węglarska 1965
	<i>Minibiotus cf. formosus</i>	Zawierucha et al., 2014	Sv	Zawierucha et al. 2016b
	<i>Minibiotus harrylewisi</i>	Meyer & Hinton, 2009	Oslo	*Meier, Hvervenbukta (Oslo)
	<i>Minibiotus intermedius</i>	(Plate, 1888)	Sv, Tr, No, NT, Op, He, Øf, Ho	Richters 1903, 1904a,b, 1911b; Murray 1907; Marcus 1936; Durante Pasa & Maucci 1975, 1979; Łagisz 1999; Jankovská et al. 2016: cf. <i>intermedius</i>
	<i>Paramacrobotus areolatus</i>	(Murray, 1907)	Sv, ST	Murray 1907; Richters 1911b; Marcus 1936; Węglarska 1965; Dastych 1985; Maucci 1996; Meier 1996; Łagisz 1999; Zawierucha et al. 2015c
	<i>Paramacrobotus richtersi</i>	(Murray, 1911)	Sv, Tr, NT, ST, Op, Øf	Węglarska 1965; Mihelčič 1971; Durante Pasa & Maucci 1979; Dastych 1985; Łagisz 1999; Zawierucha et al. 2016b
	<i>Tenuibiotus voronkovi</i>	(Tumanov, 2007)	Sv	Tumanov 2007; Zawierucha et al. 2013, 2016b
	<i>Tenuibiotus willardi</i>	(Pilato, 1977)	Sv	Dastych 1985 (see Zawierucha et al. 2016c); Maucci 1996
Murrayidae				
	<i>Dactylobiotus ambiguus</i>	(Murray, 1907)	Sv, Fi, ST, Op	Murray 1907; Mihelčič 1971; De Smet et al. 1988; Van Rompu & De Smet 1988; Janiec 1996; Meier 1996; Maucci 1996
	<i>Dactylobiotus ampullaceus</i>	(Thulin, 1911)	ST	*Meier, Søndre Knutshø (Oppdal, Sør-Trøndelag)
	<i>Dactylobiotus dispar</i>	(Murray, 1907)	Sv, ST, Op, Ak, Bu, SF	Murray 1907; Marcus 1936; Mihelčič 1971; Klekowski & Opalinski 1986, 1989; Van Rompu & De Smet 1991, 1996; Meier 1996

Table 2. Continued.

Taxon	Species	Authority	County	Reference
	<i>Dactylobiotus macronyx</i>	(Dujardin, 1851)	Sv	Richard 1898; Schaudinn 1901; Richters 1903; Summerhayes & Elton 1923
	<i>Dactylobiotus octavi</i>	Guidetti et al., 2006	Op	*Meier, Hafjelltoppen (Øyer, Oppland)
	<i>Murrayon dianeae</i>	(Kristensen, 1982)	Sv	Van Rompu & De Smet 1991, 1996
	<i>Murrayon hastatus</i>	(Murray, 1907)	ST, Bu, Vf	*Meier, Søndre Knutshø (Oppdal, Sør-Trøndelag)
	<i>Murrayon hibernicus</i>	(Murray, 1911)	Sv, No, NT	Durante Pasa & Maucci 1979; Dastych 1985; Łagisz 1999; Zawierucha et al. 2013
	<i>Murrayon pullari</i>	(Murray, 1907)	Sv, Fi, ST, Op	Murray 1907; Marcus 1936; De Smet et al. 1987, 1988; Meier 1996
Richtersiidae				
	<i>Adorybiotus granulatus</i>	(Richters, 1903)	Tr, NT, ST	Richters 1903, 1904b; Durante Pasa & Maucci 1975, 1979; Meier 1996
	<i>Diaforobiotus islandicus islandicus</i>	(Richters, 1904)	Sv, Fi, Tr, No	Murray 1907; Węglarska 1965; Durante Pasa & Maucci 1975, 1979; Dastych 1985; Klekowski & Opalinski 1986, 1989; Maucci 1996; Łagisz 1999; Dastych 2011: cf. islandicus; Kaczmarek et al. 2012; Jankovská et al. 2016; Zawierucha et al. 2013, 2015a,c, 2016b
	<i>Richtersius coronifer</i>	(Richters, 1903)	Sv, Tr, No, NT	Richters 1903, 1904b; Węglarska 1965; Durante Pasa & Maucci 1975, 1979; Dastych 1985; Maucci 1996; Łagisz 1999; Zawierucha et al. 2015c, 2016b

species» (Degma et al. 2017), although some are questionable, probable synonyms or should be split into separate species (see comments to the checklist below). 121 species are retrieved from published literature and another 25 new species to Norway (Table 3) based on own findings over many years.

Samples of mosses, lichens and detritus from ponds and streams were collected and kept in a freezer at -18 °C. Prior to examination the samples were soaked in water for two hours, then shaken in a beaker for two minutes, and finally the detritus from the bottom of the beaker was decanted over a Petri dish. Hoyer was used for preparation of permanent slides. Mounted slides were kept on a hot plate for one week at 55 °C. A Zeiss Axiostar plus light microscope, with oil immersion on the objective (x100) and the condenser was used for identification of the species. Slides with these species are currently in the author's collection, but will be transferred to the invertebrate collection at the NTNU University Museum in Trondheim together with a reference collection of Norwegian tardigrades.

Comments to the checklist

For a long time the genus *Milnesium* was considered monotypic with *Milnesium tardigradum* Doyère, 1840 as the

only, cosmopolitan species (Tumanov 2006). In recent years new taxonomic criteria have revealed a greater variety in morphology (Pilato 1981; Maucci 1988 (1991); Binda & Pilato 1990) and over some years more than 30 new species have been added to the genus (see: Michalczyk et al. 2012a,b; Degma et al. 2016; Morek et al. 2016). Nine Norwegian studies have reported *Milnesium tardigradum* Doyère, 1840, (Richters 1903, 1904b, 1911a,b; Węglarska 1965; Durante Pasa & Maucci 1975, 1979; Maucci 1996; Dastych 2011) some of them published before the most recent taxonomic revisions. It is therefore not unlikely that re-examination of these specimens and/or new material in light of new taxonomic criteria will uncover a greater diversity of *Milnesium* species from Norway.

Macrobiotus hufelandi Schultze, 1834 was the first tardigrade described and for many years recorded in faunistic studies from many localities worldwide and therefore considered cosmopolitan (Ramazzotti & Maucci, 1983). To make valid identification of species in the *hufelandi*-group the following characters from the taxonomic toolbox must be taken into consideration; *pt* values, granulation and pores in the cuticula, dentate or smooth lunula and egg chorion structures. Many of these characters are not mentioned in numerous studies from

Table 3. Species recorded as new to Norway by the author.

Species	Authority	Locality	Longitude/Latitude	Substrate
<i>Hyechinus gladiator gladiator</i>	(Murray, 1905)	Mølnbukt, Agdenes, Sør-Trøndelag	N 63.3716°, E 9.3850°	Moss on rock
<i>Calotyphs schusteri</i>	Nelson & McGlothlin, 1996	Mølnbukt, Agdenes, Sør-Trøndelag	N 63.3716°, E 9.3850°	Moss on rock
<i>Calotyphs verrucosus</i>	(Richters, 1900)	Verrafjorden, Agdenes, Sør-Trøndelag	N 63.3203°, E 9.3504°	Moss on ground
<i>Diphascon higginsii</i>	Binda, 1971	Søndre Knutshø, Oppdal, Sør-Trøndelag	N 62.1804°, E 9.3712°	Moss on ground
<i>Hypsibius pallidoides</i>	Pilato et al., 2011	Mølnbukt, Agdenes, Sør-Trøndelag	N 63.3716°, E 9.3850°	Moss on ground
<i>Hypsibius scabropygus</i>	Cuénot, 1929	Havna, Tjøme, Vestfold	N 59.0458°, E 10.2458°	Moss on rock
<i>Astatumen trinaetae</i>	(Arcidiacono, 1962)	Eid, Gran, Oppland	N 60.2909°, E 10.2539°	Litter from spruce forest
<i>Platierista itaquasconoide</i>	(Durante Pasa & Maucci, 1975)	Mølnbukt, Agdenes, Sør-Trøndelag	N 63.3716°, E 9.3850°	Moss on ground
<i>Pilatobius bullatus</i>	(Murray, 1905)	Søndre Knutshø, Oppdal, Sør-Trøndelag	N 62.1804°, E 9.3712°	Moss on ground
<i>Mixibius saracenus</i>	(Pilato, 1973)	Søndre Knutshø, Oppdal, Sør-Trøndelag	N 62.1804°, E 9.3712°	Moss from a stream
<i>Fractonotus caelatus</i>	(Marcus, 1928)	Søndre Knutshø, Oppdal, Sør-Trøndelag	N 62.1804°, E 9.3712°	Moss on ground
<i>Ramazottius subanomalous</i>	(Biserov, 1985)	Prinsdal, Oslo	N 59.4931°, E 10.4823°	Lichen on pear tree
<i>Doryphoribius flavus</i>	(Iharos, 1966)	Søndre Knutshø, Oppdal, Sør-Trøndelag	N 62.1804°, E 9.3712°	Moss on ground
<i>Eromobiotus alicatai</i>	(Binda, 1969)	Refvikstranda, Vågsøy, Sogn og Fjordane	N 65.0580°, E 5.5114°	Sand from seashore
<i>Isolyphsibius marii</i>	R. Bertolani, 1982	Agdenes fyr, Agdenes, Sør-Trøndelag	N 63.3845°, E 9.4450°	Moss submerged in small pond
<i>Macrobiotus macrocalix</i>	Bertolani et al., 1993	Hafjelltoppen, Øyer, Oppland	N 61.1333°, E 10.3044°	Lichen on tree trunk
<i>Macrobiotus persimilis</i>	Binda & Pilato, 1972	Søndre Knutshø, Oppdal, Sør-Trøndelag	N 62.1804°, E 9.3712°	Moss on ground
<i>Macrobiotus polonicus</i>	Pilato et al., 2003	Havna, Tjøme, Vestfold	N 59.0458°, E 10.2458°	Moss on rock
<i>Macrobiotus recens</i>	Cuénot, 1932	Austråt, Ørland, Sør-Trøndelag	N 63.4230°, E 9.4319°	Moss on stone
<i>Macrobiotus vladimiri</i>	Bertolani et al., 2011	Kalvskinnet, Trondheim, Sør-Trøndelag	N 63.2544°, E 10.2314°	Lichen on tree trunk
<i>Mesobiotus nuragicus</i>	(Pilato & Sperlinga, 1954)	Bondhusvatnet, Kvinnherad, Hordaland	N 63.0440°, E 6.18.20°	Moss on ground
<i>Mimibiotus harrylewisi</i>	Meyer & Hinton, 2009	Hvervenbukta, Oslo	N 59.5004°, E 10.4620°	Lichen on tree trunk
<i>Dactylobiotus ampullaceus</i>	(Thulin, 1911)	Hjerkinn, Dovre, Oppland	N 62.1312°, E 9.3228°	Moss from a stream
<i>Dactylobiotus octavi</i>	Guidetti et al., 2006	Hafjelltoppen, Øyer, Oppland	N 61.1333°, E 10.3044°	Moss from a stream
<i>Murrayon hastatus</i>	(Murray, 1907)	Søndre Knutshø, Oppdal, Sør-Trøndelag	N 62.1804°, E 9.3712°	Moss from a stream

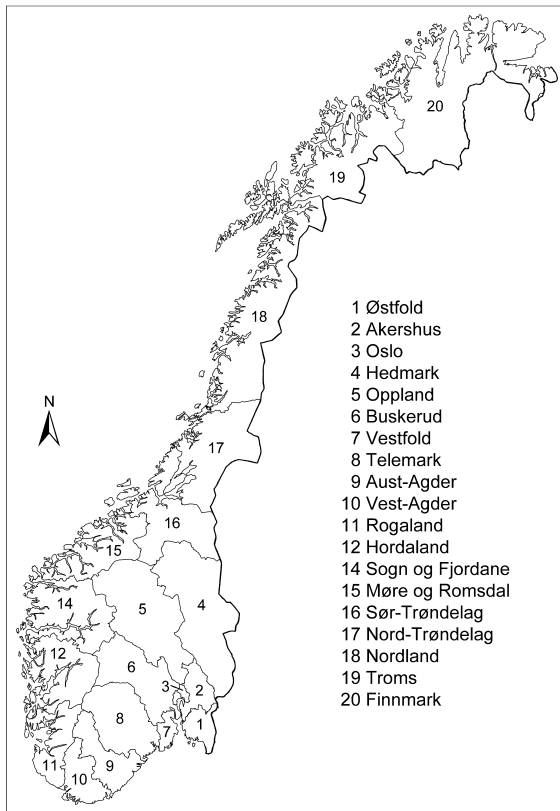


Figure 1. Counties in Norway per December 2017 numbered according to Statistics Norway. Map source: www.geonorge.no.

Table 4. Number of species found in different Norwegian counties.

Name	County		Number of species
	Numbers in Figure 1	Abbrev. in Table 2	
Svalbard	-	Sv	97
Nordland	18	No	37
Sør-Trøndelag	16	ST	37
Oppland	5	Op	32
Troms	19	Tr	30
Finnmark	20	Fi	26
Nord-Trøndelag	17	NT	21
Buskerud	6	Bu	8
Hordaland	12	Ho	8
Østfold	1	Øf	7
Sogn og Fjordane	14	SF	3
Vestfold	7	Vf	3
Hedmark	4	He	3
Oslo	3	Oslo	2
Akershus	2	Ak	2
Vest-Agder	10	VA	2
Aust-Agder	9	AA	2
Telemark	8	Te	1
Rogaland	11	Ro	1
Møre og Romsdal	15	-	0

the early 20th century. Thirteen publications report to have found *Macrobiotus hufelandi* from Norway, but most of them do not present any detailed discussion of important taxonomic characters. Thus, correct species attribution is questionable.

Durante Pasa & Maucci (1979) recorded *Acuntuncus antarcticus* (Richters, 1904) from Bodø, but it is not listed in the current checklist since his identification is dubious. *A. antarcticus* was redescribed by Dastych (1991) who discussed the possibility of synonymy between *A. antarcticus* and *Hypsibius arcticus* (Murray, 1907). The taxonomic status of *H. arcticus* is unsettled because of its inadequate description (Richters, 1904b) and lack of type material. *Acuntuncus antarcticus* was described from Antarctica and *Hypsibius arcticus* from the Arctic and only a redescription of the latter taxon from the type locality can contribute to a solution of this question.

Mihelčič (1971/1972) described three limnic species from Norway; *Macrobiotus norvegicus* from Kuvatn, Finnmark, *Itaquascon enckelli* from Sagelva, Troms (and also reported it from localities in Sweden and Finland) and *Isohypsibius pulcher* from Lakselv, Finnmark (also reported from Denmark and Sweden). Unfortunately his descriptions lack photos and his poor drawings emphasize the fact that these three species require redescription. In the description of *M. norvegicus* Mihelčič wrote: «Die glatten Eier werden in die alte Kutikula abgelegt». All known species of the superfamily Macrobitoidea (except *Dactylobiotus macronyx*) lay their ornamented eggs freely. Therefore his identification is dubious and the type locality should be revisited in order to solve the true systematic position of this species.

Schaudinn (1901) found five specimens of *Calohypsibius ornatus* var. *spinossissimus* from Bjørnøya; Dastych (1985) reported *C. ornatus* var. *carpathicus* from Svalbard and Durante Pasa and Maucci (1979) found *C. ornatus* *γ-septemcinctus* from Norway. They have not been included in the checklist due to the fact that their taxonomic status is doubtful. The morphological variation within the species was thoroughly studied by Bartoš (1940) and he reported as many as 32 different forms. He divided these varieties in two separate groups; *Calohypsibius ornatus typicus* (1 – 13) and *Calohypsibius ornaus carpathicus* (14 – 32), without giving a name to each variety. It seems likely that all these forms should not be treated as valid denominations, but considered as natural intraspecific variability (Durante Pasa and Maucci, 1979). *Calohypsibius ornatus* occur quite often in *Hylocomnium* sp. mosses in Norway and the great variation described by Bartoš has not been observed. However, the dispute regarding the status of the *Calohypsibius ornatus* species complex is not brought to an end. For instance Pilato (1989) states that «under the name *Calohypsibius ornatus* various species, and perhaps genera, very different from each other as regards the characters of the bucco-pharyngeal apparatus are gathered.»

DISCUSSION

In total 146 species of Tardigrada are recorded from Norwegian territory (Table 2); whereof 102 species recorded from the mainland and 97 species from Svalbard. From neighbouring Sweden 101 species are found (Guidetti et al. 2015). 74 species are found in both countries – that gives a total of 172 species recorded from the Scandinavian peninsula and Svalbard. 43 species are recorded from Svalbard and not found in mainland Norway. There are no investigations that support an assumption that these species are found on Svalbard only, and not in similar climate and biotopes in mountainous mainland Norway. Therefore there is reason to assume that the number of species from both Sweden and Norway are underestimated.

Meier (1996) recorded 37 species from limnic biotopes like streams and ponds. Species from the genera *Pseudechiniscus*, *Echiniscus*, *Macrobiotus*, *Paramacrobiotus*, *Diphascion*, *Astatumen* and *Adropion* sometimes occur submerged in water. Occasionally, by heavy rainfalls, terrestrial species from the genera mentioned above are washed into water environments and therefore the real status of these species as genuine limnic species are questionable.

Our knowledge of Norwegian marine tardigrades is almost non-existent. Only seven species have been reported so far (Richters 1908; Tambs-Lyche, 1940; Geddes 1968; Mokievsky 1992; Møbjerg et al., 2007; Kristensen & Hallas 2008; Ringvold 2015; Smykla et al., 2011) and due to the great variation of biotopes along the Norwegian coastline there is reason to believe that the real number of species is considerably higher. For instance, Hansen et al. (2001) reported 35 different species of Heterotardigrada from the Faroe Bank, which emphasize the great potential of investigating tardigrade species from the marine environment along the Norwegian coast and offshore banks.

Although 146 species are recorded from Norway so far, there is no doubt that most of the country lack thorough knowledge of tardigrade dispersal and number of species (Table 4). The Tardigrada fauna of Svalbard is best documented with 97 different species recorded. Records of Tardigrada from western and southern part of the country are scarce or hardly mentioned in literature. The number of species found in each county reflect the road followed by Mihelčič (1971, 1971/1972) and Durante Pasa and Maucci (1975, 1979) when they collected moss, lichens and samples from freshwater during their travel in Norway. They both started collecting in eastern Finnmark following the main road towards south and ending up in Østfold. Consequently the greatest number of species are found in the counties along their travelling route. Best known is the fauna of Nordland and Sør-Trøndelag with 37 species each, while Møre og Romsdal remain without any records of Tardigrada.

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