

**Epibiotic mites associated  
with the invasive Chinese  
mitten crab *Eriocheir  
sinensis* – new records of  
Halacaridae from Poland\***

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**KEYWORDS**

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## Abstract

Seven epibiotic halacarid mites (*Caspihalacarus hyrcanus*, two species of *Copidognathus*, *Halacarellus petiti*, *Porohalacarus alpinus*, *Soldanellonyx monardi* and *S. chappuisi*), two oribatid mites (*Hydrozetes lacustris* and *Trhypochthoniellus longisetus*) and one water mite (*Piona pusilla*) were found on the setae-covered claws of eighteen Chinese mitten crabs (*Eriocheir sinensis*) collected from fresh and brackish waters in Poland and Germany. The most abundant of the 111 mite individuals recorded was one of the *Copidognathus* species ( $N = 52$ ); this was followed by *H. petiti* ( $N = 38$ ) and *C. hyrcanus* ( $N = 13$ ). This is the first record of *H. petiti* and of the genus *Copidognathus* from Polish waters. The possibility of migrating over long distances assisted by catadromous mitten crabs enhances mite dispersal, as well as their introduction to new environments.

## 1. Introduction

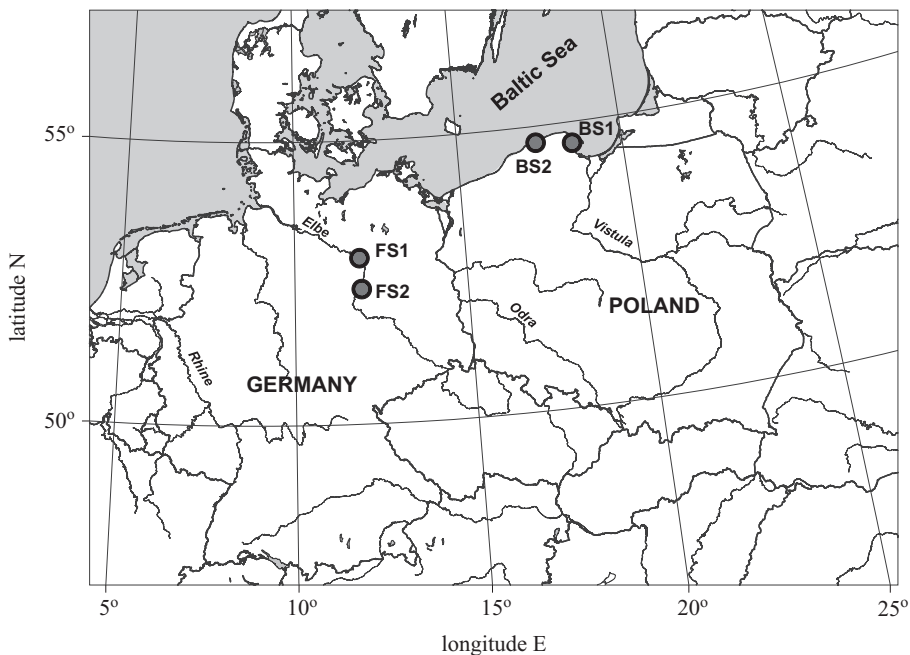
The Chinese mitten crab *Eriocheir sinensis* (Crustacea, Brachyura, Varunidae) has a catadromous life cycle, involving several life stages that are characterized by different levels of tolerance to salinity: the most euryhaline are sexually mature specimens that can live in fresh and brackish waters as well as in the sea (Anger 1991, Veilleux & Lafontaine 2007). This invasive species, a native of East Asian waters, has colonized the coastline and rivers of Europe and North America during the last hundred years (Panning 1938, Cohen & Carlton 1997). In Europe, the oldest and largest self-sustaining population of *E. sinensis* inhabits the River Elbe and its tributaries in Germany. Nevertheless, because they are able to migrate long distances, adult specimens from this population have spread to neighbouring countries (Herborg et al. 2003, Czerniejewski et al. 2012). During the last few years mitten crabs have also increased in abundance in Baltic coastal brackish waters, where they probably encounter better trophic conditions than in their riverine habitats (Normant et al. 2002, Ojaveer et al. 2007, Drotz et al. 2010, Normant et al. 2012).

The exoskeleton of decapod crustaceans has been documented to represent an attachment surface for sessile epibionts which might appear there accidentally or intentionally (e.g. for masking the crab from foraging predators), some being either commensal or pathogenic (e.g. Abelló & Corbera 1996, McGaw 2006). In *E. sinensis*, not only the massive carapace but also the characteristic dense patches of setae covering the claws of adult specimens may well provide a habitat for many different organisms (Normant et al. 2007). Among them are mites belonging to the family Halacaridae, which made up 32.4% of the 1280 associated organisms found on thirteen such crabs collected in the River Havel in Germany (Normant et al. 2007). Being benthic throughout their life, halacarids may occur on different substrates, including basibionts (Bartsch 2008a). Unfortunately,

none of the specimens found in the setae covering the claws of *E. sinensis* from German fresh water samples in the study of Normant et al. (2007) was identified to species level. Here, we present for the first time data on the diversity of mites collected from the mittens of *E. sinensis* from fresh and brackish waters.

## 2. Material and methods

A total of 18 crabs were analysed. They were collected in fresh (Germany) and brackish (Poland) waters in 2005–2008 (Figure 1). Crabs collected in German waters consisted of 4 specimens (males) from an artificial water course (the Gnevsdorfer Vorfluter) near Abbendorf and of 6 specimens (also males) from the Gülper See near Strodehne. In Poland, 5 specimens (3 males and 2 females) were caught in the Gulf of Gdańsk (southern Baltic Sea, salinity 7 PSU) and 3 others (2 males and 1 female) in the coastal Baltic Lakes Gardno and Łebsko (salinity 2 PSU). All the specimens were caught by local fishermen in fyke nets and then frozen at  $-20^{\circ}\text{C}$  for further analysis. In the laboratory, the crabs were sexed on the basis of the abdominal structure (Panning 1952), after which their



**Figure 1.** The sampling locations of *Eriocheir sinensis* in fresh waters (FS1 – Gnevsdorfer Vorfluter, FS2 – Gülper See; Germany) and brackish waters (BS1 – Gulf of Gdańsk, BS2 – Lakes Gardno and Łebsko; Poland)

carapace width was measured ( $\pm 0.1$  mm). This varied from 58.6 to 80.1 mm in the fresh water specimens and from 57.2 to 79.3 mm in the brackish water specimens. Next, the setae covering the claws were removed with a scalpel and analysed under a stereomicroscope in order to separate the mites present. They were identified to specific or generic level on the basis of Vajnsštejn (1980), Bartsch (2007) and Weigmann & Deischel (2007).

### 3. Results

Altogether, 111 epibiotic halacarid, oribatid and water mites belonging to 8 different genera were found associated with the mittens of the 18 crabs examined. Specimens from the genus *Copidognathus* could not be identified to species level, so they were described as *Copidognathus* A and *Copidognathus* B. Six different mite genera were found on the ten crabs from German fresh waters (Table 1). The most abundant ( $N = 13$ ) species on the 18 crabs was the halacarid *Caspihalacarus hyrcanus* (Viets 1928). In addition, one *Porohalacarus alpinus* Thor, 1910 deutonymph, one *Soldanellonyx monardi* Walter, 1919 female, one *S. chappuisi* Walter, 1917 deutonymph and one *Copidognathus* sp. A male were found. Among the *C. hyrcanus* individuals were six protonymphs, five deutonymphs, one male and one larva. Besides halacarids, one oribatid mite (*Trhypochthoniellus longisetus* female) was also recorded. Mite diversity was higher in the

**Table 1.** Presence (+) of halacarid, oribatid and water mites in setae on the claws of *Eriocheir sinensis* from fresh (FS1 – Gnevsdorfer Vorfluter, FS2 – Gülper See) and brackish (BS1 – Gulf of Gdańsk, BS2 – Lakes Gardno and Łebsko) waters, as recorded in this study

Taxon	Fresh waters		Brackish waters	
	FS1	FS2	BS1	BS2
<b>Halacarid mites</b>				
<i>Caspihalacarus hyrcanus</i>	+			
<i>Copidognathus</i> sp. A	+	+		
<i>Copidognathus</i> sp. B			+	
<i>Halacarellus petiti</i>			+	+
<i>Porohalacarus alpinus</i>	+			
<i>Soldanellonyx chappuisi</i>		+		
<i>Soldanellonyx monardi</i>		+		
<b>Oribatid mites</b>				
<i>Hydrozetes lacustris</i>			+	+
<i>Trhypochthoniellus longisetus</i>	+			
<b>Water mites</b>				
<i>Piona pusilla</i>				+

Gnevsdorfer Vorfluter than in the Gülper See, where only *C. hyrcanus* was found.

Four different mite genera were found on the eight crabs from Polish brackish waters (Table 1). The most abundant ( $N = 52$ ) of the 93 mites found was the halacarid *Copidognathus* sp. B, followed by the halacarid *Halacarellus petiti* (Angelier 1950,  $N = 38$ ). Two females of the oribatid *Hydrozetes lacustris* and one larva of the water mite *Piona pusilla* were found. Identified were 21 males, 28 females and two protonymphs of *Copidognathus* sp. B, as well as 14 males, 22 males and two larvae of *H. petiti*. Five specimens of *Copidognathus* sp. B from the brackish waters of the Gulf of Gdańsk were found to be infected by the suctorian ciliate *Praethecacineta halacari* Schulz, 1933. Each mite was infected by one or two suctorian ciliates. The number of mite genera was identical in the crabs from both brackish water sampling sites; however, their abundance was much higher ( $N = 86$ ) in the specimens from the Gulf of Gdańsk than in those from Lakes Gardno and Łebsko ( $N = 7$ ).

#### 4. Discussion

Halacarids, a primarily marine mite family that may also inhabit brackish and fresh waters, were the most diverse and abundant group found to be associated with the setae of Chinese mitten crabs. These mites have already been recorded many times in the brachial cavity or on the gills of different decapods, like crayfish or crabs (Table 2). To date, only pathogenic protozoans from the genus *Epistylis*, eggs of Oligochaeta from the genus *Branchiobdella* and metacercariae of an unidentified digenean species have been found in the gills of *E. sinensis* (Sobecka et al. 2011). While most of the organisms internally associated with decapods could be regarded as facultative parasites that feed on basibiont tissues, it seems that the mites occurring on *E. sinensis* are commensals, which use the dense setae on the crabs' claws only as a habitat. The structure of the setae resembles that of the phytal (e.g. the seaweed *Pilayella*), which is frequently inhabited by different fauna, including halacarid mites (Bartsch 1989). Mites can colonize setae when crabs feed on algae and vascular plants, which dominate in their diet (Fladung 2000, Czerniejewski et al. 2010). It might be assumed that the association of halacarids with the crabs is probably facultative and temporary. Because adult crabs moult the carapace relatively rarely, just once a year (Panning 1938), epibiotic mites potentially spend considerable amounts of time on the basibiont. The finding of males and females of *Copidognathus* sp. B, *H. petiti* or *C. hyrcanus* together with their larvae or nymphal stages on the same crab indicates that halacarids may complete their life cycle in the crabs' setae, where they probably find diverse items of

**Table 2.** List of halacarid species associated with decapod crustaceans, as recorded in previous studies (*continued on next page*)

Halacarid species	Decapod species	Location on the host	Place of record	Reference
<i>Arhodeoporus arenarius</i> Newell, 1947	<i>Libinia emarginata</i>	–	Rhode Island, US	Bartsch (1979)
<i>Astacopsiphagus parasiticus</i> Viets, 1931	<i>Astacopsis serratus</i>	gill chamber	Queensland, Australia	Viets (1931)
<i>Caspihalacarus hyrcanus</i> Viets, 1928	<i>Eriocheir sinensis</i>	setae on chelipeds	fresh water, Germany	present study
<i>Copidognathus celatus</i> Bartsch, 1979	<i>Libinia emarginata</i>	among cuticular structures	Rhode Island, USA	Bartsch (1979)
<i>Copidognathus gasconi</i> (Gil & Garzon, 1979)	<i>Peltarion spinulosum</i>	gill chamber	Uruguayan coast	Gil & Garzón (1979)
<i>Copidognathus libiniensis</i> Pepato, Santos & Tiago, 2005	<i>Libinia spinosa</i>	–	São Sebastião Island, Brazil	Pepato et al. (2005)
<i>Copidognathus maculatus</i> Bartsch, 1979	<i>Libinia emarginata</i>	–	Atlantic North West, USA	Bartsch (1979)
<i>Copidognathus matthewsi</i> Newell, 1956	<i>Parribacus antarcticus</i>	on the gills	Hawaiian Islands	Newell (1956)
<i>Copidognathus menippensis</i> Pepato, Santos & Tiago, 2005	<i>Menippe nodifrons</i>	–	São Sebastião, Brazil	Pepato et al. (2005)
<i>Copidognathus novus</i> Bartsch, 1980	<i>Libinia emarginata</i>	–	eastern United States	Bartsch (1979)
<i>Copidognathus punctatissimus</i> Gimbel, 1919	<i>Libinia emarginata</i>	–	Rhode Island, US	Bartsch (1979)
<i>Copidognathus stevcici</i> Bartsch, 1976	<i>Maja squinado</i>	between eggs	Adriatic Sea	Bartsch (1976b)
<i>Copidognathus</i> sp. A	<i>Eriocheir sinensis</i>	setae on chelipeds	fresh water, Germany	present study
<i>Copidognathus</i> sp. B	<i>Eriocheir sinensis</i>	setae on chelipeds	brackish waters, Poland	present study

Table 2. (continued)

Halacarid species	Decapod species	Location on the host	Place of record	Reference
<i>Halacarellus petiti</i> (Angelier, 1950)	<i>Eriocheir sinensis</i>	setae on chelipeds	brackish waters, Poland	present study
<i>Limnohalacarus wackeri</i> Walter, 1914	<i>Astacus astacus</i> <i>Orconectes limosus</i>	brachial cavity brachial cavity	Poland Lake Ińsko, Poland	Wiszniewski (1939) Zawal (1998)
<i>Lohmanella falcata</i> Hodge, 1863	<i>Libinia emarginata</i>	–	Rhode Island, USA	Bartsch (1979)
<i>Porohalacarus alpinus</i> Thor, 1910	<i>Astacus astacus</i> <i>Potamobius leptodactylus</i> <i>Orconectes limosus</i>	brachial cavity brachial cavity brachial cavity	Poland Poland River Ina, Lake Ińsko, Poland	Wiszniewski (1939) Wiszniewski (1939) Zawal (1998)
<i>Soldanellonyx chappuisi</i> Walter, 1917	<i>Eriocheir sinensis</i> <i>Eriocheir sinensis</i>	setae on chelipeds setae on chelipeds	fresh water, Germany fresh water, Germany	present study present study
<i>Soldanellonyx monardi</i> Walter, 1919	<i>Eriocheir sinensis</i>	setae on chelipeds	fresh water, Germany	present study
<i>Thalassarachna basteri</i> (Johnston, 1836)	<i>Libinia emarginata</i>	–	Rhode Island, USA	Bartsch (1979)
<i>Thalassarachna longipes</i> (Trouessart, 1888)	<i>Libinia emarginata</i>	–	Rhode Island, USA	Bartsch (1979)

food, like fungi, organic matter and algae, as well as potential prey in the case of predators (Normant et al. 2007).

The occurrence of oribatid mites (*H. lacustris* and *T. longisetus*) as well as water mites (*P. pusilla*) on crabs was probably occasional. *T. longisetus* is a globally widespread species (Weigmann 1997, Kagainis 2011, Mahunka 2011, Olmeda et al. 2011, Subías 2011), which was earlier reported in fresh water as free-living, associated with moss, hydrophytes, soil etc. Olmeda et al. (2011) also reported this species as a parasite of the tilapia fish (*Oreochromis niloticus*). The eurytopic *P. pusilla* is likewise a widely distributed species, occurring in small water bodies and the phytolittoral of lakes (Biesiadka 1972, Zawal 1992, 2006, 2007). Its larvae parasitize Diptera (Davids 1997, Zawal 2003).

There were noticeable differences in the diversity and abundance of epibiotic mite species found in the crabs from fresh and brackish waters. The former had a higher diversity of mites, but a much lower abundance. This could have been due, for example, to a lower abundance in the environment, or to greater crab mobility, in consequence of which mites have fewer opportunities to colonize their setae. Only halacarids from the genus *Copidognathus* were found in both environments. *P. alpinus* and *S. monardi* were associated only with fresh water mitten crabs here, but they can also inhabit slightly brackish coastal waters (Bartsch 2007). *P. alpinus* has been recorded in the brachial cavity of the crayfish *Astacus astacus*, *Astacus (Potamobius) leptodactylus* and *Orconectes limosus*, collected in Polish fresh waters (Table 2) near the German border (Wiszniewski 1939, Zawal 1998). There are records of this species from all continents except Antarctica, i.e. from North America (Canada, United States), Australia (Western Australia) and New Zealand, Asia (Turkey, Russia), Africa (Algeria) and Europe (from Finland in the north to Italy in the south, from Iceland and north-western France to Russia) (Bartsch 2007, 2009, 2011). It occurs mostly in oligo- and mesotrophic waters (Bartsch 2007), but also in mosses in springs, colonies of the zebra mussel *Dreissena polymorpha* and in aquaria. *P. alpinus* was also found as an epibiont on *Phragmites* reeds (Bartsch 2007), and was reported from charcoal filters in waterworks (Husmann 1982). *S. monardi* and *S. chappuisi* are widely distributed species living in a variety of habitats. The former species is commonly found in sediment and mud, amongst mosses and vascular plants, in both hypogean and epigean, stagnant and flowing, continental and coastal waters (Bartsch 2008c). It has been recorded from Europe (from Finland to Italy), Africa (Kenya, Tunisia), North America (Canada, US), the Hawaiian Islands, the Falkland Islands, Asia (Java, Japan), Australia (New South Wales, Queensland) and New Zealand. Two subspecies of *S. monardi* have been reported from Japan and



one from Java (Bartsch 1996, 2007, 2008a,b, 2009, 2011, Chatterjee et al. 2010). *S. chappuisi* inhabits interstitial waters, lakes down to great depths, and streams in Europe, North America, Korea, Japan and South America (Bartsch 1996, 2007, Pešić et al. 2010).

There were also differences in mite diversity and abundance among the crabs collected at different sites within the same water body type/country. This was probably due to variability in ecological factors. For example, the diversity of mites in the crabs from the Gnevsdorfer Vorfluter was the highest (4 taxa were identified) but the abundance was the lowest ( $N = 5$ ). This water body is a canal of depth not exceeding four metres, linking the River Havel with the Elbe, and the bottom is mostly sandy with very little mud. On the other hand, in the crabs collected from the Gülper See, our second sampling site in Germany, the three halacarid taxa identified were present in greater abundance ( $N = 13$ ). The Gülper See is a small, fresh water lake of depth 0.8–1.0 m. Its bottom is mostly muddy, but a significant part is covered with the empty shells of the zebra mussel *D. polymorpha*. The flora consists of the water lilies *Nymphaea alba* and *Nuphar lutea*, Canadian waterweed *Elodea canadensis*, pondweed *Potamogeton* spp. and the common reed *Phragmites australis* (Nixdorf et al. 2004). Mite diversity in the crabs' setae could also reflect seasonality: three crabs collected from brackish waters in June and July had the highest abundances of mites (52 epibionts per crab) compared to those collected in November (maximum: 1 epibiont per crab).

*C. hyrcanus* was recorded from brackish waters in the Caspian and Black Seas (Viets 1928, Bartsch 2004). It was also found in fresh water, in the Dniepr and Danube, in the latter river upstream as far as Bratislava (Motaş & Şoarec-Tănăsachi 1943, Szalay 1970, Bartsch & Panesar 2000). It recently colonized the Rhine in the Netherlands and France (Bij de Vaate et al. 2002), as well as in Germany near Karlsruhe (Martens et al. 2006). In the present study, *C. hyrcanus* was found on crabs collected from the Gnevsdorfer Vorfluter in Germany, which lies ca 600 km north-east of Karlsruhe. Presumably, *E. sinensis* was a vector in the introduction of this halacarid species to Polish waters. *C. hyrcanus* is similar to *H. petiti* (Bartsch 1996), a halacarid that inhabits shallow brackish and fresh waters, where it lives on various substrata, often on soft sediment. The genus *Caspihalacarus* was recently synonymized as *Halacarellus* by Bartsch & Gerecke (2011). Although the known distribution of *H. petiti* covers the north-eastern Atlantic, and the Baltic and Mediterranean Seas (Angelier 1950, Bartsch 1976a, Green & MacQuitty 1987), this is the first record of this species in Polish waters. Arguably, mitten crabs assist in the dispersal of *Copidognathus* sp., one of the largest and geographically

most widespread halacarid genera, whose representatives inhabit diverse environments (Chatterjee et al. 2006, 2008, 2012, Bartsch 2008a, 2009). Eight representatives of this genus have already been reported as epibionts of different decapods (Table 2). *Copidognathus* occurs mostly in marine waters, with few species adapted to fresh and brackish habitats (Bartsch 1996). Hence, the catadromous *E. sinensis* could enable these halacarids to cross geographical and ecological boundaries, and thus to colonize new areas together with their own associate, the suctorian ciliate *P. halacari*. This latter species is a common epibiont on halacarid mites, reported from the Atlantic, Indian and Pacific Oceans (Dovgal et al. 2008, 2009). Although *Copidognathus* species have already been recorded in Germany, here we report this genus from Polish waters for the first time.

The dispersal of fresh and sea water mites often takes place passively, with the aid of other organisms (Bartsch 1989). The considerable migration capabilities of *E. sinensis* appear to be beneficial to epibiotic mites, promoting their dispersal as well as their introduction to new environments. Although the Chinese mitten crab, a semi-terrestrial species, spends a considerable amount of time out of the water, the dense setae prevent the mites suffering from desiccation.

The International Union for the Conservation of Nature and Natural Resources has placed *E. sinensis* on its list of the 100 most invasive alien species in the world because it has led to extinctions among native invertebrates, modified habitats by its intensive burrowing activities, caused losses in fisheries and aquaculture by consuming bait and trapped fish, and damaged gear (Lowe et al. 2000). However, in the context of hosting as well as dispersing and introducing associated organisms to new habitats, it also seems to have a considerable impact on biodiversity. Similar effects for alien species have been recorded in terrestrial ecosystems (Veldtman et al. 2011). On the other hand, knowledge of epibiotic species can provide important information on the ecology and migration routes of the host species. Unfortunately, however, the available information on the spatial and seasonal abundance of mites in Polish and German water bodies inhabited by *E. sinensis* is at present insufficient for such a detailed interpretation.

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## References

- Abelló P., Corbera J., 1996, *Epibiont bryozoans (Bryozoa, Ctenostomatida) of the crab Goneplax rhomboids (Brachyura, Goneplacidae) off the Ebro delta (western Mediterranean)*, Misc. Zool., 19, 43–52.
- Angelier E., 1950, *Halacarus (Halacarellus) petiti – halacariens nouveau d'étang de salses (Pyrénées Orientales)*, Vie Milieu, 1, 214–216.
- Anger K., 1991, *Effects of temperature and salinity on the larval development of the Chinese mitten crab Eriocheir sinensis (Decapoda: Grapsidae)*, Mar. Ecol.-Prog. Ser., 72, 103–110, <http://dx.doi.org/10.3354/meps072103>.
- Bartsch I., 1976a, *Zur Systematik und Verbreitung der Halacarellus-Arten (Halacaridae, Acari) an der Bretagne-Küste*, Ent. Mitt. Zool. Mus. Hamburg, 5, 97–109.
- Bartsch I., 1976b, *Copidognathus stevcici n. sp., eine parasitisch lebende Halacaride (Halacaridae, Acari)*, Thalassia Jugosl., 12, 399–404.
- Bartsch I., 1979, *Halacaridae (Acari) von der Atlantikküste Nordamerikas: Beschreibung der Arten*, Mikrofauna Meeresbod., 79, 1–62.
- Bartsch I., 1989, *Marine mites (Halacaroida: Acari): a geographical and ecological survey*, Hydrobiologia, 178 (1), 21–42, <http://dx.doi.org/10.1007/BF00006111>.
- Bartsch I., 1996, *Halacarids (Halacaroida, Acari) in freshwater. Multiple invasions from the Paleozoic onwards?*, J. Nat. Hist., 30 (1), 67–99, <http://dx.doi.org/10.1080/00222939600770051>.
- Bartsch I., 2004, *The Black Sea halacarid fauna (Halacaridae, Acari): faunal comparison with the Mediterranean, Eastern North Atlantic, North Sea, and Baltic and reflection on its origin*, Zoosystemat. Evol., 80 (2), 143–158, <http://dx.doi.org/10.1002/mmnz.20040800202>.
- Bartsch I., 2007, *Acari: Halacaroida*, [in:] *Chelicerata: Areneae, Acari I. Süßwasserfauna von Mitteleuropa*, R. Gerecke (ed.), Spektrum Akad. Verlag, 7 (2–1), 113–157.
- Bartsch I., 2008a, *Global diversity of halacarid mites (Halacaridae: Acari: Arachnida) in freshwater*, Hydrobiologia, 595 (1), 317–322, <http://dx.doi.org/10.1007/s10750-007-9026-0>.
- Bartsch I., 2008b, *Freshwater halacarid mites (Halacaridae: Prostigmata: Acari) from Tunisia, three new records and notes on geographical distribution of these species*, Ent. Mitt. Zool. Mus. Hamburg, 15, 15–27.
- Bartsch I., 2009, *Checklist of marine and freshwater halacarid mite genera and species (Halacaridae: Acari) with notes on synonyms, habitats, distribution and descriptions of the taxa*, Zootaxa, 1998, 1–170.
- Bartsch I., 2011, *North American freshwater Halacaridae (Acari): Literature survey and new records*, Int. J. Acarol., 37 (6), 490–510, <http://dx.doi.org/10.1080/01647954.2010.525528>.
- Bartsch I., Gerecke R., 2011, *A new freshwater mite of the marine genus Halacarellus (Acari: Halacaridae) from the Austrian Alps (Styria, Gesäuse*

- National Park*): Description and reflections on its origin, Zool. Anz., 250 (2), 151–159, <http://dx.doi.org/10.1016/j.jcz.2011.02.003>.
- Bartsch I., Panesar A. R., 2000, *Die Meeresmilbe Caspidohalacarus hyrcanus in der Donau bei Wien, ein ponto-kaspisches Relikt*, Nat. Mus., 130, 258–263.
- Biesiadka E., 1972, *Water mites (Hydracarina) of the Wielkopolski National Park*, Pr. Monogr. Przyr. Wielkop. Parku Nar., 5, 1–103, (in Polish).
- Bij de Vaate A., Jażdżewski K., Ketelaars H. A. M., Gollasch S., Van der Velde G., 2002, *Geographical patterns in range extension of Ponto-Caspian macroinvertebrate species in Europe*, Can. J. Fish. Aquat. Sci., 59 (7), 1159–1174, <http://dx.doi.org/10.1139/f02-098>.
- Chatterjee T., De Troch M., Chan B. K. K., 2008, *Descriptions of two species of Copidognathus halacarid mites (Acari, Halacaridae) from Zanzibar, Tanzania*, Zootaxa, 1809, 49–60.
- Chatterjee T., De Troch M., Chang C. Y., 2006, *Three halacarid mites of the genus Copidognathus (Acari, Halacaridae) from Zanzibar, Tanzania*, Cah. Biol. Mar., 47 (2), 177–187.
- Chatterjee T., Marshall D. J., Pesic V., 2012, *New records of Copidognathus mites (Acari: Halacaridae) from mangroves in Brunei Darussalam with descriptions of two new species*, Zootaxa, 3269, 18–30.
- Chatterjee T., Pavićević A., Pešić V., 2010, *New records of the halacarid mites (Acari: Halacaridae) from Croatia*, Zesz. Nauk. Univ. Szczecińskiego, Acta Biol., 17, 85–89.
- Cohen A. N., Carlton J. T., 1997, *Transoceanic transport mechanisms: introduction of the Chinese mitten crab, Eriocheir sinensis, to California*, Pac. Sci., 51, 1–11.
- Czerniejewski P., Rybczyk A., Wawrzyniak W., 2010, *Diet of the Chinese mitten crab, Eriocheir sinensis H. Milne Edwards, 1853, and potential effects of the crab on the aquatic community in the River Odra/Oder estuary (N.-W. Poland)*, Crustaceana, 83 (2), 195–205, <http://dx.doi.org/10.1163/001121609X12591347509202>.
- Czerniejewski P., Skuza L., Drotz M. K., Berggren M., 2012, *Molecular connectedness between self- and non-self-sustainable populations of Chinese mitten crab (Eriocheir sinensis, H. Milne Edwards, 1853) with focus to the Swedish Lake Vänern and the Oder and Vistula River in Poland*, Hereditas, 149 (2), 55–61, <http://dx.doi.org/10.1111/j.1601-5223.2012.02246.x>
- Davids C., 1997, *The influence of larval parasitism on history strategies in water mites (Acari, Hydrachnidia)*, Arch. Hydrobiol., 141, 35–43.
- Dovgal I., Chatterjee T., Ingole B., 2008, *An overview of Suctorian ciliates (Ciliophora, Suctorina) as epibionts of halacarid mites (Acari, Halacaridae)*, Zootaxa, 1810, 60–68.
- Dovgal I., Chatterjee T., Subba Rao D. V., Chan B. K. K., De Troch M., 2009, *New records of Praethecacineta halacari (Schilz) (Suctorea: Ciliophora) from Taiwan, Tanzania and Canada*, Mar. Biodivers. Rec., 2 (1), <http://dx.doi.org/10.1017/S175526720999056X>.

- Drotz M.K., Berggren M., Lundberg S., Lundin K., von Proschwitz T., 2010, *Invasion routes, current and historical distribution of the Chinese mitten crab (Eriocheir sinensis H. Milne Edwards, 1853) in Sweden*, Aquat. Inv., 5 (4), 387–396, <http://dx.doi.org/10.3391/ai.2010.5.4.08>.
- Fladung E., 2000, *Untersuchungen zur Bestandsregulierung und Verwertung der Chinesischen Wollhandkrabbe (Eriocheir sinensis) unter besonderer Berücksichtigung der Fischereiverhältnisse im Elbe/Havel-Gebiet*, Schriften des Instituts für Binnenfischerei e.V. Potsdam-Sacrow, Band 5, 1–82.
- Gil J.I., Garzón F.M., 1979, *Verlardeacarus gasconi n. gen. n. sp. parasitando las branquias de Peltarium spinulosum (White, 1843) (Decapoda Brachyura)*, Rev. Biol. Uruguay, 7, 107–116.
- Green J., MacQuitty M., 1987, *Halacarid Mites*, SBF, 36, 178 pp.
- Herborg L.M., Rushton S.P., Clare A.S., Bentley M.G., 2003, *Spread of the Chinese mitten crab (Eriocheir sinensis, H. Milne Edwards) in Continental Europe: analysis of a historical data set*, Hydrobiologia, 503 (1–3), 21–28, <http://dx.doi.org/10.1023/B:HYDR.0000008483.63314.3c>.
- Husmann S., 1982, *Aktivkohlefilter als künstliche Biotope stygophiler und stygobionter Grundwassertiere*, Arch. Hydrobiol., 95, 139–155.
- Kagainis U., 2011, *Revision of the checklist of Latvian oribatid mites (Acari: Oribatida), with notes on previous studies and new species for the fauna of Latvia*, Latv. Entomol., 50, 31–40.
- Lowe S., Browne M., Boudjelas S., De Poorter M., 2000, *100 of the World's Worst Invasive Alien Species A selection from the Global Invasive Species Database*, The Invasive Species Specialist Group (ISSG), Special. Group of Species Survival Commission (SSC), World Conserv. Union, 12 pp.
- Mahunka S., 2011, *New and little known oribatid mites from Madagascar (Acari: Oribatida) II*, Acta Zool. Acad. Sci. Hung., 57, 1–21.
- Martens A., Gerecke R., Grabow K., 2006, *Caspihalacarus hyrcanus (Acari) im Oberrhein, Der erste Fund einer neozoischen Wassermilbe in Deutschland und Frankreich*, Lauterbornia, 56, 27–34.
- McGaw I. J., 2006, *Epibionts of sympatric species of cancer crabs in Barkley sound, British Columbia*, J. Crustacean Biol., 26 (1), 85–93, <http://dx.doi.org/10.1651/C-2601.1>.
- Motaş C., Şoarec-Tănăsachi J., 1943, *Un Halacaride reliquat ponto-caspian dans le Danube*, Bul. Soc. Natur. Romania, 16, 1–7.
- Newell I.M., 1956, *A parasitic species of Copidognathus (Acari: Halacaridae)*, P. Hawaii. Entomol. Soc., 16, 122–125.
- Nixdorf B., Hemm M., Hoffmann A., Richter P., 2004, *Gülper See*, [in:] *Dokumentation von Zustand und Entwicklung der wichtigsten Seen Deutschlands*, Teil 5, Brandenburg, 51–53.
- Normant M., Chrobak M., Skóra K.E., 2002, *The Chinese mitten crab Eriocheir sinensis – an immigrant from Asia in the Gulf of Gdańsk*, Oceanologia, 44 (1), 124–126.

- Normant M., Korthals J., Szaniawska A., 2007, *Epibiota associated with setae on Chinese mitten crab claws (Eriocheir sinensis H. Milne-Edwards, 1853): a first record*, *Oceanologia*, 49 (1), 137–143.
- Normant M., Król M., Jakubowska M., 2012, *Effect of salinity on the physiology and bioenergetics of adult Chinese mitten crabs Eriocheir sinensis*, *J. Exp. Mar. Biol. Ecol.*, 416–417, 215–220, <http://dx.doi.org/10.1016/j.jembe.2012.01.001>.
- Ojaveer H., Gollasch S., Jaanus A., Kotta J., Laine A. O., Minde A., Normant M., Panov V. E., 2007, *Chinese mitten crab Eriocheir sinensis in the Baltic Sea – a supply-side or invader?*, *Biol. Invasions*, 9 (4), 409–418, <http://dx.doi.org/10.1007/s10530-006-9047-z>.
- Olmeda A. S., Blanco M. M., Perez-Sanchez J. L., Luzon M., Villarroel M., Gibello A., 2011, *Occurrence of the oribatid mite Trhypochthoniellus longisetus (Acari: Trhypochthoniidae) on tilapia Oreochromis niloticus*, *Dis. Aquat. Organ.*, 94 (1), 77–82, <http://dx.doi.org/10.3354/dao02309>.
- Panning A., 1938, *The Chinese mitten crab*, Rep. Board Regent. Smithsonian Inst., 3508, Washington, 361–375.
- Panning A., 1952, *Die Chinesische Wollhandkrabbe, Die Neue Brehm-Bücherei*, H. 70, Akad. Verlagsgesellsch, Geest & Portig K.-G., Leipzig, 1–46.
- Pepato A. R., Santos C., Tiago C. G., 2005, *Two new closely related species of Copidognathus (Acari, Halacaridae) associated with crabs*, *Cah. Biol. Mar.*, 46, 69–79.
- Pešić V., Smit H., Datry T., 2010, *New records of water mites (Acari: Hydrachnidia, Halacaroidea) from Patagonia (Chile)*, *Syst. Appl. Acarol.*, 15, 151–160.
- Sobecka E., Hajek G. J., Skorupiński Ł., 2011, *Four pathogens found associated with Eriocheir sinensis H. Milne-Edwards, 1853 (Crustacea: Brachyura: Grapsidae) from Lake Dąbie (Poland)*, *Oceanol. Hydrobiol. St.*, 40 (1), 96–99, <http://dx.doi.org/10.2478/s13545-011-0010-y>.
- Subías L. S., 2011, *Listado sistemático, sinónimo y biogeográfico de los Ácaros Oribátidos (Acariformes, Oribatida) del mundo (excepto fósiles)*, edn. April 2012, 561 pp., <http://www.ucm.es/info/zoo/Artropodos/Catalogo.pdf>.
- Szalay L., 1970, *Verzeichnis der aus dem Karpatenbecken bisher bekannt gewordenen Wassermilben (Hydracarina, Acari)*, *Acarologia*, 12, 136–159.
- Vajnštejn B. A., 1980, *Key to larval water mites*, Nauka, Leningrad, 238 pp., (in Russian).
- Veilleux E., de Lafontaine Y., 2007, *Biological synopsis of the Chinese mitten crab (Eriocheir sinensis)*, *Can. Manuscr. Rep. Fish. Aquat. Sci.*, 2812, vi + 45 pp.
- Veldtman R., Lado T. F., Botes A., Proches S., Timm A. E., Geertsema H., Chown S. L., 2011, *Creating novel food webs on introduced Australian acacias: indirect effects of galling biological control agents*, *Divers. Distrib.*, 17 (5), 958–967, <http://dx.doi.org/10.1111/j.1472-4642.2011.00781.x>.
- Viets K., 1928, *Wassermilben aus dem Schwarzen Meer, dem Kaspischen Meer und dem Aral See*, *Abh. Nat. Wiss. Ver. Brem.*, 27, 47–80.

- Viets K., 1931, *Über eine an Krebskiemen parasitierende Halacaride aus Australien*, Zool. Anz., 96, 115–120.
- Weigmann G., 1997, *New and old species of Malaconothroidea from Europe (Acari, Oribatida)*, Spixiana, 20 (3), 199–218.
- Weigmann G., Deischel R., 2007, *Acari: Limnic Oribatida*, [in:] *Chelicerata: Areneae, Acari I. Süßwasserfauna von Mitteleuropa*, R. Gerecke (ed.), Spektrum Akad. Verlag 7/2-1, 89–112 pp.
- Wiszniewski J., 1939, *Über die Fauna der Kiemenhöhle der Flusskrebse*, Arch. Hydrobiol. Ryb., 12, 124–162.
- Zawal A., 1992, *Water mites (Hydracarina) of three small lakes in the neighbourhood of Poznań*, Acta Hydrobiol., 34, 157–174.
- Zawal A., 1998, *Water mites (Hydracarina) in the brachial cavity of crayfish Orconectes limosus (Raf. 1817)*, Acta Hydrobiol., 40, 49–54.
- Zawal A., 2003, *The role of insects in the dispersion of water mites*, Acta Biol. Univ. Daugavpilensis, 3, 9–15.
- Zawal A., 2006, *Materials for knowledge of water mites (Acari: Hydrachnidia) in the neighbourhood of Złocieniec (NW Poland)*, Acta Biologica, 13, 163–169, (in Polish).
- Zawal A., 2007, *Water mites (Hydrachnidia) of the 'Szare Lake' nature reserve and its protection zone*, Par. Nar. Rez. Przyr., 26, 57–78, (in Polish).