

Comments on a putative *Artemia salina* (Linnaeus, 1758) (Branchiopoda: Anostraca) fossil from Cyprus

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ABSTRACT

We present an overview on the identification of a reported fossil from Cyprus which had been classified as *Artemia salina*. There is no taxonomic evidence to support the determination that the material is an anostracan, let alone a species of *Artemia*. The report reviewed here may be right about the identity of the fossil, but the published evidence does not support such a specific identification. Overly specific determinations like this can be cited in other studies (molecular clock analyses or biogeography for example) and cause cascading errors.

KEYWORDS

Branchinectella media, Criticism, identification, *Phallocryptus* sp.



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Manzi et al. (2016) presented a photomicrograph of a fossil in Messinian evaporites (Figure 10b; p. 209), which they identified as the anostracan crustacean *Artemia salina* (Linnaeus, 1758): “In the Psematismenos quarry well-preserved fossils of the hypersaline crustacean *Artemia salina*”. We question this determination.

Anostraca (fairy and brine shrimp) is an order of the Branchiopoda. This order includes two suborders, ten families, 42 genera and more than 350 valid extant species (Rogers, 2013, 2024). Anostraca is defined by the following synapomorphies: 1) antenna I composed of one article, 2) adult antenna II and thoracopods uniramous, 3) compound eyes stalked, 4) naupliar eye with three pigmented cups, 5) trunk limbs with six endites, 6) telson without a pair of dorsal setae, 7) carapace absent, 8) presence of a ventral brood pouch, and 9) telson appendages as lamellar cercopods (Rogers, 2024). Most anostracans have 11 pairs of thoracopods, although some *Parartemia* females have ten, while all members of *Polyartemiella* have 17 thoracopod pairs, and *Polyartemia* has 19 (Rogers, 2024).

All *Artemia* (Artemiidae) are halophiles, however; all (but one) species of *Parartemia* (Parartemiidae) (Timms, 2012, 2014, 2015; Rogers, 2024), *Phallocryptus* (Thamnocephalidae) (Mura, 1987, 1993; Mura and Hadjistephanou, 1987; Thiéry and Puff, 1998; Abatzopoulos et al., 1999; Moscatello et al., 2002; Thiéry and Puente, 2002; Rogers, 2003; Ketmaier et al., 2008; Ben Naceur et al., 2009; Mura et al., 2011; Amarouayache, et al., 2012; Amarouayache, 2014; Marrone et al., 2016; Karagianniet al., 2018; Brendonck, et al., 2022; Rais et al., 2024), *Branchinectella* (Chirocephalidae) (McKenzie, 1981; Albaigés et al., 1984; Alonso, 1990; Alcorlo et al. 2001; Samraoui et al., 2006; Van Stappen et al., 2009; De los Ríos-Escalante and Amarouayache, 2016; Stoch et al., 2016; Pons et al., 2018; Sainz-Escudero et al., 2019), as well as some species of *Branchinella* (Thamnocephalidae) (Timms, 2012) are also typical halophilic anostracans well known from saline and hypersaline environments. While *Parartemia* and *Branchinella* (*sensu stricto*) are endemic to Australia (Timms, 2012, 2014, 2015; Rogers, 2024), *Phallocryptus* sp. (Mura, 1987, 1993; Thiéry and Puff, 1998; Abatzopoulos et al., 1999; Mura et al. 1999, 2011; Moscatello et al., 2002; Thiéry and Puente, 2002; Ben Naceur et al., 2009; Amarouayache

et al., 2012; Amarouayache, 2014; Van den Broeck et al., 2015; Marrone et al., 2021; Marrone, 2023; Chergui et al., 2024; Rais et al., 2024) and *Branchinectella media* (Schmankewitsch, 1873) (Albaigés et al., 1984; Alonso, 1990; Alcorlo et al., 2001; Samraoui et al., 2006; Van Stappen et al., 2009; De los Ríos-Escalante and Amarouayache, 2016; Stoch et al., 2016; Pons et al., 2018;) are distributed in Eurasia, including the Mediterranean region, as is *A. salina* and various *Artemia* parthenogenetic lineages with different ploidy levels (di-, tri-, tetra- and pentaploid) (Asem et al., 2024).

Phallocryptus sp. (*P. spinosa* (Milne-Edwards, 1840)) and one undescribed species in Ketmaier et al. (2008, 2013) and *Artemia* (*A. salina* and/or *Artemia* parthenogenetic lineages) are well known to co-occur in the Mediterranean region (and elsewhere), in places such as Simbirizzi, Sale Porcus, Su Pallosu and Vecchia Salina in Italy (Mura, 1987, 1993; Mura et al. 1999; Moscatello et al., 2002), Salin du Caban in France (Thiéry and Puff, 1998; Thiéry and Puente, 2002), Palioura in Greece (Abatzopoulos et al., 1999), Chott Ariana, Chott El Gharsa and Sabkhet El Adhibet in Tunisia (Ben Naceur et al., 2009), Gökçeada and Tuz Golu in Turkey (Mura et al., 2011), Sebkha Ez-Zemoul and Sebkha Sidi Chami in Algeria (Amarouayache et al., 2012; Amarouayache, 2014; De los Ríos-Escalante and Amarouayache, 2016) and Jbilets in Morocco (Van den Broeck et al., 2015). *Artemia salina* (Muñoz et al., 2008; Ghomari et al., 2011), *B. media*, and *Phallocryptus* sp. (De los Ríos-Escalante and Amarouayache, 2016; Rais and Amarouayache, 2018; Rais et al., 2024) have also been reported from Chott El Tarf (Algeria) in the Mediterranean region. They also co-occur in southwest Siberia (Van Stappen et al., 2009).

In Cyprus, *Artemia* has been reported from Larnaka (= Larnaca/Megali Larnaka) Lake (Persoone and Sorgeloos, 1980; Browne and MacDonald, 1982; Mura and Hadjistephanou, 1987; Vanhaecke et al., 1987; Triantaphyllidis et al., 1998; Van Stappen, 2002; Karagianni et al., 2018), Akrotiri Lake (Persoone and Sorgeloos, 1980; Mura and Hadjistephanou, 1987, based on collected samples by Hadjistephanou; Vanhaecke et al., 1987; Triantaphyllidis et al., 1998; Van Stappen, 2002; Karagianni et al., 2018), Airport Salt Lake, Soros Salt Lake, Orphani Salt Lake and Lake Oroklini (Karagianni et al., 2018), and *Phallocryptus*

sp. co-occurs with *Artemia* in Larnaka Lake (Mura and Hadjistephanou, 1987), Akrotiri Lake (based on collected samples by Hadjistephanou; see Mura and Hadjistephanou, 1987), Airport Salt Lake, Soros Salt Lake, and Orphani Salt Lake (Karagianni et al., 2018). Although, Karagianni et al. (2018) reported all Cypriot *Artemia* using the nomen “*salina*”, only the taxonomic status of *Artemia* from Larnaka Lake has been confirmed as *A. salina* (Vanhaecke et al., 1987; Triantaphyllidis et al., 1998; Van Stappen, 2002; for more information see below).

Morphology of the brood pouch, male second antenna, gonopod, cercopods, number of thoracopods as well as, resting egg morphology are the principal taxonomic characters used in the diagnoses for the Anostraca at all levels (Hill and Shepard, 1997; Shepard and Hill, 2001; Rogers, 2002, 2013, 2024; Timms, 2008, 2012, 2015, 2014; Timms and Lindsay, 2011; Asem et al., 2023). Artemiidae and *Artemia* are separated from other families and genera based on male second antenna and cercopod morphology (Rogers et al., 2019) and *A. salina* is diagnosed from other *Artemia* by the lack of gonopodal spines (Triantaphyllidis et al., 1997). Similarly, *Phallocryptus* in the Thamnocephalidae and *Branchinectella* in Chirocephalidae are identified by gonopod, cercopod, brood pouch, and second antennal morphology (Rogers, 2003; Rogers et al., 2019).

Manzi et al., (2016) present a photomicrograph of fossils in a gypsiltite interval. These fossils only include the thorax of possible anostracans in dorsal view and nothing more. The number of thoracopods cannot clearly be counted. There is no morphological evidence to deduce that the fossil is a species of *Artemia*, let alone “*A. salina*”. Previously, a lack of taxonomic attention resulted in two specimens of *P. spinosa* collected from Vecchia Salina (Italy) mistakenly identified and stored as *Artemia* sp. in the Museum of Natural History at the Station of Marine Biology of Porto Cesareo (Italy) (see Mura et al., 1999). Additionally, Daday (1910) noted *B. media* mistakenly identified as “*Artemia salina*” from Lac de la Sénia (Lake Senia) and Sebkhet Oran in Algeria by Blanchard and Richard (1890) (see also Blanchard, 1891). In the same vein, several published records of putative anostracan fossils have been later shown to be insect nymphs

(e.g., *Branchipusites* Goldenberg, 1873 and *Rochdalia* Woodward, 1913) by Tasch (1969). While the fossils may very well belong to anostracans, based on the image provided by Manzi et al. (2016), the possibility that they represent insect larvae or nymphs cannot be ruled out without additional evidence.

Given modern distributions, *Artemia* is not the only possible determination. If the determination by Manzi et al. (2016) is based solely on biogeography, we have no information how far back into the past that modern anostracan biogeography can be used to inform identifications. We think that this determination by Manzi et al. (2016) is an example of the fallacy of over specificity. Manzi et al. (2016) may be right about the identity, but the published evidence does not support such a specific identification. Thus, due to a lack of requisite diagnostic morphological characters, the fossils from Cyprus which Manzi et al. (2016) classified as the common, halophilic *A. salina*, cannot be convincingly determined as *Artemia*, let alone as anostracans at this time. The danger inherent in overly specific determinations is that the errors can be cited in other studies and used to support analytical assumptions (molecular clock analyses or biogeography for example) and cause cascading errors.

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REFERENCES

- Abatzopoulos TJ; Brendonck L and Sorgeloos P 1999. First record of *Branchinella spinosa* (Milne-Edwards) (Crustacea: Branchiopoda: Anostraca) from Greece. *International Journal of Salt Lake Research*, 8: 351–360. <https://doi.org/10.1007/BF02442120>
- Albaigés J; Algaba J and Grimalt J 1984. Extractable and bound neutral lipids in some lacustrine sediments. *Organic Geochemistry*, 6: 223–236. [https://doi.org/10.1016/0146-6380\(84\)90044-5](https://doi.org/10.1016/0146-6380(84)90044-5)
- Alcorlo P; Baltanas A and Montes C 2001. Food-web structure in two shallow salt lakes in Los Monegros (NE Spain): energetic vs dynamic constraints. *Hydrobiologia*, 466: 307–316. <https://doi.org/10.1023/A:1014594408119>

- Alonso M 1990. Anostraca, Cladocera and Copepoda of Spanish saline lakes. *Hydrobiologia*, 197: 221–231. <https://doi.org/10.1007/BF00026952>
- Amarouayache M 2014. Observations on *Phallocryptus spinosa* (Branchiopoda, Anostraca) populations from the high plateaus of Northeastern Algeria. *Sustainability, Agri, Food and Environmental Research*, 2(4): 22–31. <https://safer.uct.cl/index.php/SAFER/article/view/36/33>
- Amarouayache M; Derbal F and Kara MH 2012. Note on the carcinological fauna associated to *Artemia salina* (Branchiopoda, Anostraca) from Sebkhia Ez-Zemoul (Northeast, Algeria). *Crustaceana*, 85(2): 129–137. <https://doi.org/10.1163/156854012X623728>
- Asem A; Gajardo G; Hontoria F; Yang C; Shen C; Rastegar-Pouyani N; Padhye SM and Sorgeloos P 2024. The species problem in *Artemia* Leach, 1819 (Crustacea: Anostraca), a genus with sexual species and obligate parthenogenetic lineages. *Zoological Journal of the Linnean Society*, 202(2): zlad192. <https://doi.org/10.1093/zoolinnean/zlad192>
- Asem A; Yang C; Eimanifar A; Hontoria F; Varó I; Mahmoudi F; Fu C; Shen C; Rastegar-Pouyani N; Wang P; Li W; Yao L; Meng X; Dan Y; Rogers C and Gajardo G 2023. Phylogenetic analysis of problematic Asian species of *Artemia* Leach, 1819 (Crustacea, Anostraca), with the descriptions of two new species. *Journal of Crustacean Biology*, 43(1): ruad002. <https://doi.org/10.1093/jcabi/ruad002>
- Ben Naceur H; Jenhani ABR and Romdhane MS 2009. Note on the distribution of *Branchinella spinosa* (H. Milne Edwards, 1840) (Branchiopoda, Anostraca) in Tunisia. *Crustaceana*, 82(5): 635–641. <https://doi.org/10.1163/156854009X404833>
- Blanchard R 1891. Résultats d'une excursion zoologique en Algérie. *Mémoires de la Société Zoologique de France*, 4: 208–245.
- Blanchard R and Richard J 1890. Sur les crustacés des Sebkhias et des chotts d'Algérie. *Bulletin de la Société Zoologique de France*, 45: 136–138.
- Brendonck L; Rogers DC; Vanschoenwinkel B and Pinceel T 2022. Chapter 10 – Large branchiopods. p. 273–305. In: Dalu T and Wasserman RJ (Eds.), *Fundamentals of Tropical Freshwater Wetlands: From Ecology to Conservation Management*. Elsevier. <https://doi.org/10.1016/B978-0-12-822362-8.00007-4>
- Browne RA and MacDonald GH 1982. Biogeography of the brine shrimp, *Artemia*: distribution of parthenogenetic and sexual populations. *Journal Biogeography*, 9: 331–338. <https://doi.org/10.2307/2844719>
- Chergui I; Koulali K; Bouzid A and Samraoui B 2024. First record of *Tanymastigites ajjeri* Thiéry & Rogers 2022 (Crustacea: Branchiopoda: Anostraca) in Algeria, with an updated checklist of Algerian large branchiopods. *Zoology and Ecology*, 34(1): 1–8. <https://doi.org/10.35513/21658005.2024.1.1>
- Daday E von 1910. Monographie Systématique des Phyllopoidea Anostracés. *Annales des Sciences Naturelles, Zoologie series* 9, 11: 91–489. <https://dn790003.ca.archive.org/0/items/biostor-118225/biostor-118225.pdf>
- De los Ríos-Escalante P and Amarouayache M 2016. Crustacean zooplankton assemblages in Algerian saline lakes: a comparison with their Chilean Altiplano counterparts. *Crustaceana*, 89(13): 1485–1500. <https://doi.org/10.1163/15685403-00003581>
- Ghomari MS; Selselet GS; Hontoria F and Amat F 2011. *Artemia* Biodiversity in Algerian Sebkhias. *Crustaceana*, 84(9): 1025–1039. <https://doi.org/10.1163/001121611X586729>
- Goldenberg F 1873. Fauna Saraepontona Fossilis: Die fossilen Thiere aus der Steinkohlenformation von Saarbrücken. 1: 1–26, text-figs. 1–25, pl. 1. Saarbrücken.
- Hill RE and Shepard WD 1997. Observations on the identifications of California anostracan cysts. *Hydrobiologia*, 359: 113–24. <https://doi.org/10.1023/A:1003134013838>
- Karagianni A; Stamou G; Katsiapi M; Polykarpou P; Dörfliinger G and Michaloudi E 2018. Zooplankton communities in Mediterranean temporary lakes: the case of saline lakes in Cyprus. *International Journal of Limnology*, 54: 14. <https://doi.org/10.1051/limn/2018007>
- Ketmaier V; Pirolo D; De Matthaeis E; Tiedemann R and Mura G 2008. Large-scale mitochondrial phylogeography in the halophilic fairy shrimp *Phallocryptus spinosa* (Milne-Edwards, 1840) (Branchiopoda: Anostraca). *Aquatic Sciences*, 70: 65–76. <https://doi.org/10.1007/s00027-007-7028-7>
- Ketmaier V; Pirolo D; De Matthaeis E; Tiedemann R and Mura G. 2013. Erratum to: Large-scale mitochondrial phylogeography in the halophilic fairy shrimp *Phallocryptus spinosa* (Milne-Edwards, 1840) (Branchiopoda: Anostraca). *Aquatic Sciences*, 75: 333–334. <https://doi.org/10.1007/s00027-013-0288-5>
- Linnaeus C 1758. *Systema Naturae*, Vol. 1 (10th ed., Reformata). Holmiae [= Stockholm], Laurentii Salvii. 824 pp.
- Manzi V; Lugli S; Roveri M; Pierre FD; Gennari R; Lozar F Natalicchio M; Schreiber BC; Taviani M and Turco E 2016. The Messinian salinity crisis in Cyprus: a further step towards a new stratigraphic framework for Eastern Mediterranean. *Basin Research*, 28(2): 207–236. <https://doi.org/10.1111/bre.12107>
- Marrone F 2023. On the occurrence of *Phallocryptus spinosus* (Milne-Edwards, 1840) in Sicily (Crustacea, Branchiopoda). *Biogeographia – The Journal of Integrative Biogeography*, 38(1): a026. <https://doi.org/10.21426/B638159103>
- Marrone F; Alfonso G; Cottarelli V; Botta MM; Koepp C and Stoch F 2021. An updated checklist and biogeography of the Sardinian large branchiopods, with a focus on Spinicaudata (Crustacea, Branchiopoda). *Biogeographia – The Journal of Integrative Biogeography*, 36: a010. <https://doi.org/10.21426/B636054480>
- Marrone F; Korn M; Stoch F; Naselli-Flores L and Turki S 2016. Updated checklist and distribution of large branchiopods (Branchiopoda: Anostraca, Notostraca, Spinicaudata) in Tunisia. *Biogeographia – The Journal of Integrative Biogeography*, 31: 27–53. <https://doi.org/10.21426/B631132736>
- McKenzie KG 1981. Palaebiogeography of some salt lake faunas. *Hydrobiologia*, 82: 407–418. <https://doi.org/10.1007/BF00048728>
- Moscattello S; Belmonte G and Mura G 2002. The co-occurrence of *Artemia parthenogenetica* and *Branchinella spinosa* (Branchiopoda: Anostraca) in a saline pond of south eastern Italy. *Hydrobiologia*, 486: 201–206. <https://doi.org/10.1023/A:1021307019891>
- Milne-Edwards M 1840. Histoire naturelle des Crustacés, T.3: 367. Paris, Librairie Encyclopedique De Roret, 638 pp.
- Muñoz J; Gómez A; Green AJ; Figuerola J; Amat F and Rico C 2008. Phylogeography and local endemism of the native Mediterranean brine shrimp *Artemia salina* (Branchiopoda:

- Anostraca). *Molecular Ecology*, 17(13): 3160–3177. <https://doi.org/10.1111/j.1365-294x.2008.03818.x>
- Mura, G 1987. Occurrence of *Artemia* in Solar Saltworks and Coastal Brine Ponds in Sardinia, Italy. *Journal of Crustacean Biology*, 7(4): 697–703. <https://doi.org/10.1163/193724087X00441>
- Mura G 1993. Seasonal distribution of *Artemia salina* and *Branchinella spinosa* in a saline astatic pond in south west Sardinia Italy (Anostraca). *Crustaceana*, 64(2): 172–191. <https://doi.org/10.1163/156854093X00225>
- Mura G and Hadjstephanou N 1987. First records of *Branchinella spinosa*, Milne Edwards (Crustacea, Anostraca) in Cyprus. *Rivista di Idrobiologia*, 26: 111–115.
- Mura G; Ferreri D and Belmonte G 1999. Prima segnalazione di *Branchinella spinosa* Milne-Edwards 1840 (Crustacea, Branchiopoda, Anostraca) per l'Italia peninsulare. *Thalassia Salentina*, 23: 59–65. <http://dx.doi.org/10.1285/i15910725v23p59>
- Mura G; Özkütük SR; Aygen C and Cottarelli V 2011. New data on the taxonomy and distribution of anostracan fauna from Turkey. *Journal of Biological Research-Thessaloniki*, 15: 17–23.
- Persoon G and Sorgeloos P 1980. General aspects of the ecology and biogeography of *Artemia*. p. 3–24. In: Persoon G; Sorgeloos P; Roels O and Jaspers E (Eds.), *The Brine Shrimp Artemia*, Vol. 3. Wetteren, Universa Press.
- Pons P; Gonçalves MSS; Gil-Delgado JA and Ortells R 2018. Spatial distribution of *Branchinella media* (Crustacea, Branchiopoda) in a saline pond from “La Mancha Húmeda”: a case of habitat selection? *Limnetica*, 37(1): 69–83. <http://dx.doi.org/10.23818/limn.37.07>
- Rais L and Amarouayache M 2018. The co-occurrence of two anostracan species *Branchinella media* (Schmankewitsch, 1873) and *Phallocryptus spinosus* (Milne-Edwards, 1840) (Crustacea) in saline lakes from the Aures region (North-East Algeria). *Vie et milieu-Life and environment*, 68: 167–174. <https://www.php.obs-banyuls.fr/Viemilieu/index.php/volume-68-2018/68-issues-2-3.html>
- Rais L; Amarouayache M and Rochon A 2024. Resting eggs bank and their hatching pattern in two co-occurring anostracans *Phallocryptus spinosus* and *Branchinella media* (Crustacea) from saline lakes of the Aurès region (Northeastern Algeria). *Biologia*, 79: 3119–3127. <https://doi.org/10.1007/s11756-024-01757-8>
- Rogers DC 2002. Female-based characters for anostracan (Crustacea: Branchiopoda) identification: A key for species of California and Oregon, USA. *Hydrobiologia*, 486: 125–132. <https://doi.org/10.1023/A:1021390416256>
- Rogers DC 2003. Revision of the thamocephalid genus *Phallocryptus* (Crustacea, Branchiopoda: Anostraca). *Zootaxa*, 257(1): 1–14. <https://doi.org/10.11646/zootaxa.257.1.1>
- Rogers DC 2013. Anostraca catalogus (Crustacea: Branchiopoda). *The Raffles Bulletin of Zoology*, 61(2): 525–546. <https://lknhm.nus.edu.sg/wp-content/uploads/sites/11/app/uploads/2017/06/61rbz525-546.pdf>
- Rogers DC 2024. Current status of the systematics of large branchiopod crustaceans (Branchiopoda: Anostraca, Notostraca, Laevicaudata, Spinicaudata, Cyclestherida). *Journal of Crustacean Biology*, 44(3): ruae046. <https://doi.org/10.1093/jcblol/ruae046>
- Rogers DC; Kotov AA; Sinev AY; Glagolev SM; Korovchinsky NM; Smirnov NN and Bekker EI 2019. Chapter 16.2 – Arthropoda: Class Branchiopoda. p. 643–724. In: Rogers DC and Thorp JH (Eds.), *Thorp and Covich's Freshwater Invertebrates: Keys to Palaearctic Fauna*, Vol. IV. London, Academic Press. <https://doi.org/10.1016/B978-0-12-385024-9.00018-6>
- Sainz-Escudero L; Stănescu F; Rodríguez-Flores PC and García-París M 2019. First record of *Branchinella media* (Schmankewitsch, 1873) (Branchiopoda, Anostraca) in Romania. *Crustaceana*, 92(10): 1231–1247. <https://doi.org/10.1163/15685403-00003936>
- Samraoui B; Khemissa C and Samraoui F 2006. Large branchiopods (Branchiopoda: Anostraca, Notostraca and Spinicaudata) from the salt lakes of Algeria. *Journal of Limnology*, 65(2): 83–88. <https://doi.org/10.4081/jlimnol.2006.83>
- Schmankewitsch WJ 1873. Facts relevant to the influence of the environment on the physiological functions and organization of animals. *Trudy tret'ego syezda russkikh estestvoispytateley, Zoologiya, Anatomiya i fi Ziologiya, Kiev*, 65: 117.
- Shepard WD and Hill RE 2001. Anostracan cysts found in California salt lakes. *Hydrobiologia*, 466: 149–58. <https://doi.org/10.1023/A:1014591503151>
- Stoch F; Korn M; Turki S; Naselli-Flores L and Marrone F 2016. The role of spatial environmental factors as determinants of large branchiopod distribution in Tunisian temporary ponds. *Hydrobiologia*, 782: 37–51. <https://doi.org/10.1007/s10750-015-2637-y>
- Tasch P 1969. Branchiopoda. p. 128–191. In: Moore RC (Ed.), *Treatise on Invertebrate Palaeontology*, Part R Arthropoda 4, Vol. I. Geological Society of America, University of Kansas Press. <https://doi.org/10.17161/dt.v0i0.5632>
- Thiery A and Puente L 2002. Crustacean assemblage and environmental characteristics of a man-made solar saltwork in southern France, with emphasis on anostracan (Branchiopoda) population dynamics. *Hydrobiologia*, 486: 191–200. <https://doi.org/10.1023/A:1021354903052>
- Thiery A and Puff J 1998. First find of *Branchinella spinosa* (H. Milne Edwards, 1840) in a southern French man-made saltwork. *Crustaceana*, 71(2): 223–227. <https://doi.org/10.1163/156854098X00185>
- Timms BV 2008. Further studies on the fairy shrimp genus *Branchinella* (Crustacea, Anostraca, Thamocephalidae) in Western Australia, with descriptions of new species. *Records of the Western Australian Museum*, 24: 289–306.
- Timms BV 2012. An identification guide to the brine shrimps (Crustacea: Anostraca: Artemiina) of Australia. *Museum Victoria Science Reports*, 16: 1–36. <https://doi.org/10.24199/j.mvsr.2012.16>
- Timms BV 2014. A review of the biology of Australian halophilic anostracans (Branchiopoda: Anostraca). *Journal of Biological Research-Thessaloniki*, 21: 21. <https://doi.org/10.1186/2241-5793-21-21>
- Timms BV 2015. A revised identification guide to the fairy shrimps (Crustacea: Anostraca: Anostracina) of Australia. *Museum Victoria Science Reports*, 19: 1–44. <https://doi.org/10.24199/j.mvsr.2015.19>

- Timms BV and Lindsay S 2011. Morphometrics of the resting eggs of the Australian species of the fairy shrimp *Branchinella* (Anostraca: Thamnocephalidae). *Proceedings of the Linnean Society of New South Wales*, 133: 53–70. <https://openjournals.test.library.sydney.edu.au/LIN/article/view/5309>
- Triantaphyllidis GV; Criel GRJ; Abatzopoulos TJ; Thomas KM; Peleman J; Beardmore JA and Sorgeloos P 1997. International study on *Artemia*: 57. Morphological and molecular characters suggest conspecificity of all bisexual European and North African *Artemia* populations. *Marine Biology*, 129: 477–487. <https://doi.org/10.1007/s002270050188>
- Triantaphyllidis GV; Abatzopoulos TJ and Sorgeloos P 1998. Review of the biogeography of the genus *Artemia* (Crustacea, Anostraca). *Journal Biogeography*, 25(2): 213–226. <https://doi.org/10.1046/j.1365-2699.1998.252190.x>
- Van den Broeck M; Waterkeyn A; Rhazi L and Brendonck L 2015. Distribution, coexistence, and decline of Moroccan large branchiopods. *Journal of Crustacean Biology*, 35(3): 355–365. <https://doi.org/10.1163/1937240X-00002316>
- Van Stappen G 2002. Zoogeography. p. 171–224. In: Abatzopoulos TJ; Beardmore JA; Clegg JS and Sorgeloos P (Eds.), *Artemia Basic and Applied Biology*. Dordrecht, Kluwer Academic Publishers. <https://doi.org/10.1007/978-94-017-0791-6>
- Van Stappen G; Litvinenko LI; Litvinenko AI; Boyko EG; Marden B and Sorgeloos P 2009. A Survey of *Artemia* Resources of Southwest Siberia (Russian Federation). *Reviews in Fisheries Science*, 17(1): 116–148. <https://doi.org/10.1080/10641260802590095>
- Vanhaecke P; Tackaert W and Sorgeloos P 1987. The biogeography of *Artemia*: an updated review. p. 129–155. In: Sorgeloos P; Bengtson DA; Declerck W and Jaspers E (Eds.), *Artemia Research and its Applications*, Vol. 1. Wetteren, Universa Press.
- Woodward H 1913. *Rochdalia parkeri*, a new branchiopod crustacean from the Middle Coal Measures of Sparth, Rochdale. *Geological Magazine* 10: 352–356.

ADDITIONAL INFORMATION AND DECLARATIONS

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