Zoodiversity, **58**(4):269–298, 2024
DOI 10.15407/zoo2024.04.269

Fauna and Systematics

UDC 595.323:591.91(55)

SPECIES DIVERSITY AND DISTRIBUTION OF *ARTEMIA* (CRUSTACEA: ANOSTRACA) IN IRAN: HISTORICAL CONTEXTS AND UPDATED REVIEW

A. Asem[1]*, A. Eimanifar[2]* & M. Wink[3]

[1] *College of Fisheries and Life Science, Hainan Tropical Ocean University, Sanya 572022, China*
[2] *Independent Senior Scientist, Industrial District, Gaithersburg, MD 20878, USA.*
[3] *Department of Biology, Institute of Pharmacy and Molecular Biotechnology, Heidelberg University, Heidelberg, Germany*
** Corresponding authors*
E-mail: asem.alireza@gmail.com, amineimanifar1979@gmail.com

A. Asem (https://orcid.org/0000-0002-8991-4903)
A. Eimanifar (https://orcid.org/0000-0001-6448-5025)
M. Wink (https://orcid.org/0000-0002-7875-4510)

urn:lsid:zoobank.org:pub:F5948E73-481A-41C8-BE51-2E350EBBC032

Species Diversity and Distribution of *Artemia* (Crustacea, Anostraca) in Iran: Historical Contexts and Updated Review. Asem, A., Eimanifar, A. & Wink, M. — In light of the pivotal role of *Artemia* Leach, 1819 as food in larviculture and fisheries, it becomes imperative to continually reassess its resources and deepen our understanding of its species diversity. Such efforts are essential for the effective management of its commercial exploitation and the promotion of sustainable aquaculture activities. Here we present a comprehensive review of historical documents dating back to the 10th century and contemporary scholarly articles. The findings indicate the existence of 59 sites (natural resources and farming sites) across Iran where *Artemia* has been recorded. This is a significant increase from the 23 reported in the last checklist in 2016. The data indicate that regional *A. urmiana* Günther, 1899 occurrences warrant classification as "Critically Endangered" on the "Regional Red List" of Iran. Remarkably, apparently the Bazangan Lake has a natural population of *Artemia*, probably a consequence of climatic change. We highlight the threat posed to *Artemia* species diversity by the invasive American brine shrimp *A. franciscana* Kellogg, 1906, noting its presence in 12 locations compared to 7 in 2016. Preliminary studies suggest that the indigenous parthenogenetic *Artemia* lineages in Iran exhibit superior production potential when compared to both *A. franciscana* and the native *A. urmiana*. In light of these findings, the study recommends prioritizing the utilization of native parthenogenetic *Artemia* in aquaculture, to conserve *Artemia* biodiversity.
Key words: brine shrimp, native species, invasive species, Regional Red List.

Introduction

The small crustaceans of the genus *Artemia* Leach, 1819 predominantly inhabit hypersaline environments including inland salt/soda lakes, pools, ponds, coastal lagoons, salterns, and saline rivers (Gajardo & Beardmore, 2012; Shadrin et al., 2023). *Artemia* comprises nine species with region-specific endemic populations (Asem et al., 2023), aligning with the principles of "island biogeography" (Rogers, 2015; Asem et al., 2023, 2024 a, b), consisting of *A. salina* (Linnaeus, 1758) in the Mediterranean region. Four species inhabit in Asia including *A. urmiana* Günther, 1899 (Iran and the Crimean Peninsula), *A. sinica* Cai, 1989 (China), *A. tibetiana* Abatzopoulos, Zhang & Sorgeloos, 1998 (Tibetan Plateau), *A. amati* Asem, Eimanifar, Hontoria, Rogers & Gajardo, 2023 (Kazakhstan), *A. sorgeloosi* Asem, Eimanifar, Hontoria, Rogers & Gajardo, 2023 (Tibetan Plateau).The other three species are distributed in America containing *A. monica* Verrill, 1869, (endemic in Mono Lake, USA), *A. franciscana* Kellogg, 1906 (the most widely distributed), and *A. persimilis* Piccinelli & Prosdocimi, 1968, (Chile and Argentina). *Artemia franciscana* has been anthropogenically introduced in Africa, Australia and Eurasia.

The genus *Artemia* includes four parthenogenetic lineages distinguished by varying ploidy levels (di-, tri-, tetra-, and pentaploidy) (Asem et al., 2024 b). Barigozzi (1974) described the asexual parthenogenetic forms as "*A. parthenogenetica*". Despite the unresolved biological origins of parthenogenetic *Artemia*, its evolutionary origins have been extensively examined (Asem et al., 2024 b). When analyzing mitochondrial genomic markers, parthenogenetic *Artemia* is identified as a polyphyletic group (Maniatsi et al., 2011; Asem et al., 2016 b, 2024 b), in contrast to its classification as a monophyletic group based on nuclear genomic markers (Nougué et al., 2015; Rode et al., 2022; Asem et al., 2024 b). Consequently, asexual *Artemia* forms cannot be classified as members of a single taxon. Eimanifar et al. (2014) conservatively used term "Eurasian Haplotype Complex" for this group. Asem et al. (2024 b) propose the designation "parthenogenetic *Artemia* lineages" for those *Artemia* groups that reproduce exclusively through asexual means. They advocate for a holistic approach to genomic and biological research to elucidate the evolutionary and taxonomic nuances of the parthenogenetic *Artemia* lineages. Such studies are crucial for enhancing phylogeographic insights and supporting biodiversity monitoring efforts within the genus *Artemia*.

Despite the economic significance of *Artemia* in aquaculture spurring laboratory-based scientific inquiries, its commercial value has limited field researches on this genus (Collins, 1977). This trend persists, limiting contributions from field studies in taxonomy, ecology, and biodiversity. Over recent decades, the biodiversity of *Artemia*, the principle ecological component of hypersaline ecosystems, faces threats from climate change-induced habitat degradation (Asem et al., 2012, 2019; Shadrin et al., 2023), aquaculture practices (notably the colonization by the invasive *Artemia franciscana*) (Zheng et al., 2004; Amat et al., 2005; Hontoria et al., 2012; Eimanifar et al., 2020; Scalone & Rabet, 2013; Asem et al., 2018; 2021 a; Horváth et al., 2018; Saji et al., 2019; Shen et al., 2021; Wu et al., 2022), and anthropogenic activities such as urbanization and industrialization (Zsuga et al., 2021; Anufriieva et al., 2022; Shadrin et al., 2023).

Importantly, species like *Artemia monica* and *Artemia amati* have been classified as "threatened species" following their "Conservation Dependent" (CD) and "Extinct in the Wild" (EW) statuses, respectively (IWCSP, 1996; Asem et al., 2023, 2024 c). Several *Artemia* habitats have also faced degradation, exemplified by the cases of Lymington in the UK and Capodistria in Slovenia (Vanhaecke et al., 1987). Since the 1970s, the introduction and colonization of the American *A. franciscana* across Eurasia, Africa, and Australia for aquaculture purposes (Sorgeloos, 1980; Zheng et al., 2004; Amat et al., 2005; Hontoria et al., 2012; Scalone & Rabet, 2013; Zheng & Sun; 2013, Eimanifar et al., 2020; Asem et al., 2018, 2021 a; Saji et al., 2019; Shen et al., 2021; Wu et al., 2022) have caused significant threats to the biodiversity of indigenous *Artemia* populations.

The formulation of an updated checklist is critical for effective environmental conservation programs (Frankham et al., 2002; Mace et al., 2006; Asem et al., 2023). Therefore, routine monitoring of *Artemia* resources should be integrated into conservation management strategies, simultaneously aiding the development of the aquaculture industry and preserving the biodiversity of native *Artemia*.

Iran serves as an informative case study, with its prolonged droughts in central and northern regions and rapid aquaculture expansion along the southern coasts which significantly impacting the commercial production, biodiversity, and distribution of *Artemia*. From 1915 to 2016, a series of 15 checklists, comprising eight global (Abonyi, 1915; Artom, 1922; Stella, 1933; Persoone & Sorgeloos, 1980; Brown & Donald, 1982; Vanhaecke et al., 1987; Triantaphyllidis et al., 1998; Van Stappen, 2002) and seven regional studies (Noori, 1995; Agh et al., 2001; Hafezieh, 2003 a; Jafari & Vatandoost 2005; Abatzopoulos et al., 2006 a; Jafari & Astani, 2011; Hafezieh et al., 2015; Agh, 2016), have documented *Artemia* sites in Iran, with 23 identified localities in the latest checklist (Agh, 2016).

This comprehensive checklist aims to review the biodiversity, distribution, and aquaculture potential of *Artemia* from Iran, tracing its historical context from early reports to present publications.

Geographical distribution of *Artemia* in Iranian localities

In the present investigation, a diversity of sources including academic research papers, comprehensive checklists, detailed project reports, and conference presentations, alongside firsthand personal observations, were utilized to document the presence and distribution of *Artemia* within Iran. In table 1 all identified *Artemia* natural habitats and aquaculture sites are characterized, organizing them by province. This tabulation is enriched with extensive details encompassing geographical coordinates, taxonomic status, and the specific dates of survey or sample collection. Additionally, the geographical distribution of these habitats is illustrated in figure 1.

Natural resources

Urmia Lake

Urmia Lake (east of Urmia city, West Azerbaijan Province), was previously ranked as the 20th largest lake on a global scale, with its surface area spanning between 4750 and 6100 km^2 (Eimanifar & Mohebbi, 2007). The lake's diverse biological and ecological attributes led to its inclusion in the Ramsar Convention on Wetlands in 1975 (https://rsis.ramsar.org/), and it was subsequently designated as one of the 59 world biosphere reserves by UNESCO in 1976 (Asem et al. 2014, 2016 a). However, over the past twenty years, Urmia Lake has experienced a substantial decrease in its water level, primarily attributed to a series of environmental disturbances and human activities (Karimi et al., 2016; Golabian, 2011; Asem et al., 2012; Wurtsbaugh et al., 2017; Sima et al., 2021). Post-2007, there has been a marked increase in the lake's salinity, reaching saturation levels exceeding 300 g/l (Asem et al., 2012, 2019). The period between 1995 and 2013 saw the lake losing nearly 60 % of its surface area and over 90 % of its volume (Schulz et al., 2020). Concurrently, several resource assessments have indicated fluctuations in the population of *A. urmiana*, with egg densities varying from 339 eggs/liter in 1995, to less than 1 egg/liter between 2008–2012, and then rising to 4.6 eggs/liter during 2018–2020 (see Asem et al., 2012; Ahmadi, 2007;

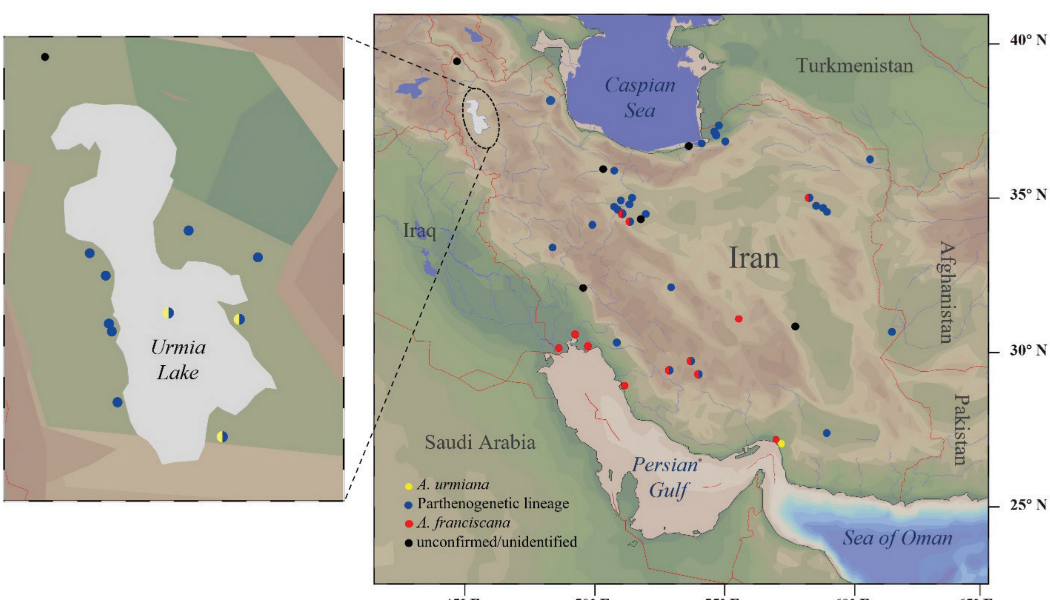

Fig. 1. Distribution of *Artemia* sites in Iran.

Table 1. ***Artemia*** **natural resources and farming sites in Iran (Map data© 2023 Google Earth™ was used to define geographic coordinates)**

Province Locality / Nearby city	Geographic coordinates	Description	SUY/ SAY	Ref.
1	2	3	4	5
West Azerbaijan Province				
Urmia Lake[a]	37°36'47.3" N 45°28'15.7" E	(Aquatic dog)[b]	NA	Estakhri (930-933)
		(Aquatic dog)[b]	NA	Zakariya-Qazwini (1275)
		(Worm)[b]	NA	Anonymous (982)
		(Herbal-morphic animal)[b]	NA	Etemad-Alsaltane (1877)
		(Jelly-fish)[b]	NA	Curzon (1892)
		(Jelly-fish)[b]	NA	Sclater (1893)
		(crustaceans)[b]	NA	de Morgan (1894)
		(Medusa)[b]	1898	Günther (1898 a)
		[*Branchipus* sp.][c]	1898	Günther (1898 a)
		the *Artemia* group of varieties of the [*Branchipus*][c] type	1898	Günther (1898 b)
		Artemia sp.	1898	Günther (1899 a)
		Artemia urmiana	1898–2023	Günther (1899 b); Barigozzi (1980); Browne & MacDonald (1982); Beardmore & Abreu-Grobois (1983); Barigozzi et al. (1987); Vanhaecke et al. (1987); Azari Takami (1989); Ahmadi et al. (1990)[d]; Abreu-Grobois & Beardmore (1991); Pilla & Beardmore (1994); Noori (1995); Sorgeloos (1997); Triantaphyllidis et al. (1998); Mura & Azari Takami (2000); Van Stappen et al. (2001); Agh et al. (2001); Van Stappen (2002); Yar-Mohammadi (2002); Hafezieh (2003 a); Jafari & Vatandoost (2005); Abatzopoulos et al. (2006 a); Abatzopoulos et al.(2006 b); Eimanifar et al. (2006 a); Eimanifar et al. (2006 b); Asem et al. (2007); Eimanifar et al. (2007); Asem & Rastegar-Pouyani (2008 a); Asem & Rastegar-Pouyani (2008 b); De los Ríos & Asem (2008); Hajirostamloo et al. (2008 a); Agh et al. (2009); Asem & Rastegar-Pouyani (2010); Jafari & Astani (2011); Asem & Rogers (2012); Eimanifar & Wink (2013); Eimanifar et al. (2014); Asem et al. (2014); Hafezieh et al. (2015); Zeynalpour et al. (2015); Asem et al. (2016 a); Agh (2016); Eimanifar et al. (2016); Hafezieh (2016); Asem et al. (2019); Eimanifar et al. (2020); Asem et al. (2021 b); Mohebbi et al. (2022); Asem et al. (2023); Mohebbi et al. (2023 b)
		[*Artemia salina* var. *Milhausenii*][c]	NA	Abonyi (1915)
		[*Artemia micropirenica*][c]	NA	Artom (1922)

1	2	3	4	5
		[*Artemia salina*][c]	NA	Stella (1933); Plattner (1955); Löffler (1956); Löffler (1959); Löffler (1961); McCarraher (1972); Daneshgar (1975); Hoveida (1976)[e]; Saberi (1978); Javanshir (1986); Kargarnejad (1986)[e]
		Crab form animals	NA	Melikian (1940)[f]
		Lake Urmia shrimps	NA	Clark & Bowen (1976)
		Artemia	NA	Persoone & Sorgeloos (1980); Mohammadyari et al. (2001); Mohebbi et al. (2023 a)
		Parthenogenetic *Artemia*[g]	1987–1999	Barigozzi et al. (1987); Barigozzi & Baratelli (1989); Azari Takami (1989); Ahmadi et al. (1990); Agh et al. (2001); Yar-Mohammadi (2002); Abatzopoulos et al. (2006 a); Asem et al. (2010 b); Asem et al. (2014); Hafezieh et al. (2015); Jafari & Astani (2011); Agh (2016)
Rashakan	(37°20'13.1″ N 45°17'56.8" E)	Parthenogenetic *Artemia*	NA	Asem et al. (2009); Agh (2016)
Zanbil	(37°45'32.8" N 45°16'26.3" E)	Parthenogenetic *Artemia*	1998–2011	Yar-Mohammadi (2002); Atashbar et al. (2014); Manaffar et al. (2018); Hajirostamloo (2019); Agh (2016)
Chichest	(37°34'35.6" N 45°16'24.7" E)	Parthenogenetic *Artemia*	2008–2011	Atashbar et al. (2014); Hajirostamloo (2019)
Hassar	(37°32'15.0" N 45°16'41.5" E)	Parthenogenetic *Artemia*	2008–2011	Atashbar et al. (2014); Hajirostamloo (2019)
Eider	(37°49'50.5" N 45°5'14.0" E)	Parthenogenetic *Artemia*	2008–2011	Atashbar et al. (2014); Hajirostamloo (2019)
Fesendooz	(37°8'46.3" N 45°49'41.5" E)	*Artemia urmiana*	2000	Ahmadi et al. (2012); Nekoueifard et al. (2020)
		Parthenogenetic *Artemia*	2000–2005	Ahmadi et al. (2012); Abatzopoulos et al. (2006 a); Eimanifar et al. (2007); Hafezieh et al. (2015); Agh (2016)
Doz Daghi	38°31'13.8" N 44°55'13.1" E	*Artemia urmiana* (?)	NA	Nekoueifard et al. (2023)
Agh Gol[h]	39°32'33.26" N 44°45'35.10" E	*Artemia* (?)[h]	NA	Noori (1995)
East Azerbaijan Province				
Gobadloo	(37°32'33.2" N 45°44'41.5" E)	*Artemia urmiana*	NA	Manaffar et al. (2004); Agh et al. (2007)
		Parthenogenetic *Artemia*	NA	Manaffar et al. (2004); Agh et al. (2007)
Khaslou	(37°45'8.3" N 45°49'46.1" E)	Parthenogenetic *Artemia*	2008–2011	Atashbar et al. (2014); Hajirostamloo (2019)
Sarai	(37°51'25.6" N 45°35'9.2" E)	Parthenogenetic *Artemia*	2005	Eimanifar et al. (2007)

1	2	3	4	5
		Ardabil Province		
Shurabil Lake (extinct)	38°12'46.6" N 48°16'56.7" E	[*Artemia salina*][b]	1974–1975	Pirsamadi (1975); Gafurifard et al. (1977)
		Artemia	1984	Ahmadi (1987); Vanhaecke et al. (1987); Noori (1995); Triantaphyllidis et al. (1998); Van Stappen (2002); Hafezieh (2003 a); Jafari & Vatandoost (2005); Jafari & Astani (2011)
		Parthenogenetic *Artemia*	NA	Abatzopoulos et al.(2006 a); Hafezieh et al. (2015); Agh (2016)
		Fars Province		
Tashk Lake[i]	29°45'48.6" N 53°36'5.3" E	[*Artemia salina*][b]	NA	Löffler (1956); Löffler (1959)
		Artemia sp.	NA	Noori (1995)
		Parthenogenetic *Artemia*	NA	Agh et al. (2001); Van Stappen (2002); Hafezieh (2003 a); Jafari & Vatandoost (2005); Abatzopoulos et al.(2006 a); Jafari & Astani (2011); Hafezieh et al. (2015); Agh (2016)
		Artemia franciscana	2011	Shafaie et al. (2012 a, b)
Bakhtegan Lake[j]	29°22'13.9" N 53°46'43.1" E	[*Artemia salina*][b]	NA	Löffler (1956); Löffler (1959)
		Artemia sp.	NA	Noori (1995)
		Parthenogenetic *Artemia*	NA	Agh et al. (2001); Van Stappen (2002); Hafezieh (2003 a); Jafari & Vatandoost (2005); Abatzopoulos et al.(2006 a); Hajirostamloo et al. (2008 b); Jafari & Astani (2011); Hafezieh et al. (2015); Agh (2016)
		Artemia franciscana	2011	Shafaie et al. (2012 b)
Maharlu Lake[k]	29°27'41.2" N 52°48'17.9" E	*Artemia* sp.	NA	Noori (1995)
		Parthenogenetic *Artemia*	1998	Agh et al. (2001); Van Stappen (2002); Hafezieh (2003 a); Hafezieh (2003 b); Jafari & Vatandoost (2005); Abatzopoulos et al.(2006 a); Hajirostamloo et al. (2008 b); Agh et al. (2009); Jafari & Astani (2011); Eimanifar et al. (2014); Falahatkar & Rafatnezhad (2015); Hafezieh et al. (2015); Manaffar et al. (2018); Agh (2016)
		Artemia	NA	Mohammadyari et al. (2001)
		Artemia franciscana	NA	Manaffar et al. (2008); Asem & Aliabadian (2008); Hoseini & Zare (2012); Jafari & Astani (2011); Eimanifar et al. (2014); Eimanifar et al. (2020); Agh (2016)
		Golestan Province		
Shor Lake[l]	37°23'47.8" N 54°38'35.8" E	[*Artemia salina*][b]	NA	McCarraher (1972)
		Artemia	NA	Persoone & Sorgeloos (1980); Vanhaecke et al. (1987); Makhdoumi (1992); Noori (1995); Triantaphyllidis et al. (1998)

1	2	3	4	5
		Parthenogenetic *Artemia*	NA	Agh et al. (2001); Van Stappen (2002); Makhdoumi (2000); Hafezieh (2003 a); Jafari & Vatandoost (2005); Abatzopoulos et al.(2006 a); Hajirostamloo et al. (2008 b); Jafari & Astani (2011); Hafezieh et al. (2015); Agh (2016)
Incheh Lake	37°14'1.6" N 54°31'55.7" E	*Artemia*	NA	Makhdoumi (1992); Noori (1995); Makhdoumi et al. (2002); Mohammadyari et al. (2001)
		Parthenogenetic *Artemia*	2008	Makhdoumi (2000); Agh et al. (2001); Azarnia et al. (2002); Van Stappen (2002); Hafezieh (2003 a); Jafari & Vatandoost (2005); Abatzopoulos et al.(2006 a); Hajirostamloo et al. (2008 b); Hami-Tabari et al. (2013 a); Hami-Tabari et al. (2013 b); Eimanifar et al. (2014); Eimanifar et al. (2020); Jafari & Astani (2011); Hami-Tabari (2011); Hafezieh et al. (2015); Agh (2016)
Agh-Gala Pond[m]	?	*Artemia* sp.	NA	Javanshir (1986)
Qarasu Pond	36°50'52" N 54°2'23" E	*Artemia* sp.	2007–2008	Hami-Tabari (2011)
Anbar Olum Pond[n]	37°9'4" N 54°34'36" E	*Artemia* sp.	2007–2008	Hami-Tabari (2011)
Mazraeye Nemuneh[n]	(37°7'34.0" N 54°36'14.1" E)	*Artemia* sp.	NA	Makhdoumi (2000)
Zamiri Farm	(36°52'50.5" N 54°57'25.1" E)	*Artemia* sp.	NA	Makhdoumi (2000)
Qom Province				
Qom Salt Lake	34°32'41.8" N 51°53'10.1" E	*Artemia*	NA	Mohammadyari et al. (2001)
		Parthenogenetic *Artemia*	1999–2001	Agh et al. (2001) Van Stappen (2002); Hafezieh (2003 a); Mohaghegh & Mohamadpor (2004); Jafari & Vatandoost (2005); Abatzopoulos et al.(2006 a); Khalili et al. (2007); Hajirostamloo et al. (2008 b); Agh et al. (2009); Jafari & Astani (2011); Eimanifar et al. (2014); Hafezieh et al. (2015); Agh (2016); Manaffar et al. (2018); Eimanifar et al. (2020)
Houze Sultan Lake	35°0'2.4" N 50°56'6.5" E	Parthenogenetic *Artemia*	1999–2001	Hafezieh (2003 a); Mohaghegh & Mohamadpor (2004); Jafari & Vatandoost (2005); Abatzopoulos et al.(2006 a); Hajirostamloo et al. (2008 b); Jafari & Astani (2011); Hafezieh et al. (2015); Soltanifar et al. (2012); Agh (2016)
Shams Abad	(34°34'8.1" N 51°0'4.2" E)	Parthenogenetic *Artemia*	2013	Asadpoor (2016 a)
		Artemia franciscana	2013	Asadpoor (2016 a)
Shoor River	(35°3'36.6" N 51°23'22.0" E)	Parthenogenetic *Artemia*	1999–2001	Mohaghegh & Mohamadpor (2004)
Moshk Abad	(34°52'16.9" N 51°15'36.5" E)	Parthenogenetic *Artemia*	1999–2001	Mohaghegh & Mohamadpor (2004)

1	2	3	4	5
Garmanuri	(34°42'35.3" N 50°50'6.5" E)	Parthenogenetic *Artemia*	NA	Mohaghegh (2014)
Kuhe Namak[o]	(34°45'10.3" N 50°43'21.2" E)	Parthenogenetic *Artemia*	NA	Soltanifar et al. (2012); Mohaghegh (2014)
Aliabad[p]	?	*Artemia* sp.	NA	Noori (1995)
Massileh[q]	?	Parthenogenetic *Artemia*	1999–2001	Mohaghegh & Mohamadpor (2004)
Iaq-Shoar River	?	Parthenogenetic *Artemia*	1999–2001	Mohaghegh & Mohamadpor (2004)
Markazi Province[r]				
Mighan Lake	34°12'38.7" N 49°50'17.3" E	Parthenogenetic *Artemia*	2010–2020	Hafezieh (2003a); Jafari & Vatandoost (2005); Eimanifar et al. (2014); Abatzopoulos et al.(2006 a); Hajirostamloo et al. (2008 b); Jafari & Astani (2011); Hesami et al. (2018); Hafezieh et al. (2015); Manaffar et al. (2015); Agh (2016); Eimanifar et al. (2020); Hafezieh et al. (2021)
		Artemia sp.	NA	Khangholi et al. (2018)
Isfahan Province				
Gavkhouni Wetland[s]	32°9'26.2" N 52°51'51.0" E	[*Artemia salina*][b]	NA	Löffler (1961)
		Artemia sp.	NA	Noori (1995)
		Parthenogenetic *Artemia*	NA	Hafezieh (2003 a); Jafari & Vatandoost (2005); Abatzopoulos et al.(2006 a); Jafari & Astani (2011); Aalamifar et al. (2014); Hafezieh et al. (2015); Agh (2016)
Ab Shirin	(34°17'49.5" N 51°17'28.9" E)	Parthenogenetic *Artemia*	2009	Mohaghegh (2014); Soltanifar et al. (2012); Asadpoor (2016 b)
		Artemia franciscana	2009	Asadpoor (2016 b)
Jandag	(34°2'18" N 54°24'51" E)	*Artemia* sp.	2019	IRIB (2019)
Maranjab	(34°14'1.0" N 51°36'41.8" E)	*Artemia* sp.	2022	IRIB (2021 a, b)
Sistan va Baluchestan Province				
Varmal Lake[t]	(30°43'32.4" N 61°20'0.8" E)	Parthenogenetic *Artemia*	1996–1997	Mohammad-Piri & Tehrani (1997); Agh et al. (2001); Van Stappen (2002); Hafezieh (2003 a); Jafari & Vatandoost (2005); Abatzopoulos et al.(2006 a); Agh et al. (2009); Jafari & Astani (2011); Hafezieh et al. (2015); Agh (2016)
		Artemia	NA	Mohammadyari et al. (2001)
Hamun-e Jaz Murian wetland	27°24'33.5" N 58°49'35.8" E	Parthenogenetic *Artemia*	NA	Hafezieh (2003 a); Jafari & Vatandoost (2005)

1	2	3	4	5
Razavi Khorasan Province				
Bazangan Lake	36°18'55.1" N 60°28'50.5" E	Parthenogenetic *Artemia*	2015	Mohammadyari et al. (2015)
Kal-e Shoor[u]	34°40'17.13" N 58°47'18.47" E[v]	*Artemia* sp.	2001–2002	Ghassemzadeh et al. (2005)
		Parthenogenetic *Artemia*	2003	Banihashemy (2010)
Kal-e Shoor[u]	34°44'50.0" N 58°40'21.1" E	Parthenogenetic *Artemia*	2008–2011	Atashbar et al. (2014)
Kal-e Shoor[u]	(35°10' N 57°58' E) ?[w]	Parthenogenetic *Artemia*	NA	Abatzopoulos et al.(2006 a)
		Parthenogenetic *Artemia*	NA	Hafezieh et al. (2015)
		Parthenogenetic *Artemia*	NA	Agh (2016)
		Artemia franciscana	NA	Agh (2016)
Yunesi[x]	(34°48'0.7" N 58°26'8.8" E)	*Artemia* sp.	2001–2002	Ghassemzadeh et al. (2005)
Kerman Province				
Nough Lake[y]	31°7'52.7" N 55°27'53.6" E	Parthenogenetic *Artemia*	NA	Agh et al. (2001); Van Stappen (2002); Abatzopoulos et al.(2006 a); Jafari & Astani (2011)
		Artemia franciscana	NA	Abatzopoulos et al.(2006 a); Hajirostamloo et al. (2008 a); Hajirostamloo & Pourrabbi (2011); Jafari & Astani (2011); Eimanifar et al. (2014); Hafezieh et al. (2015); Agh (2016); Eimanifar et al. (2020)
Gandom Beryan	(31°2'15.2" N 57°38'48.1" E)	*Artemia* sp.	NA	MNA (2014)
		Artemia sp.	2013	Tajrobehkar (per. com. 2022)
Hormozgan Province				
Kolahi	(27°3'24.8" N 56°51'57.0" E)	*Artemia urmiana*	1993	Fayazi (1994)
Tiab[z] [Minab]	(27°6'41.8" N 56°51'58.2" E)	*Artemia franciscana*	2000s	Agh (2016); Atashbar (per. com. 2023)
Khouzestan Province				
Hendijan	(30°12'44.9" N 49°43'32.1" E)	*Artemia franciscana*	NA	Agh et al. (2002); Agh (2016)
Choeibdeh	(30°11'35.9" N 48°33'17.5" E)	*Artemia franciscana*	NA	Agh (2016)

1	2	3	4	5
Mahshahr Port	(30°33'11.4" N 49°11'31.6" E)	*Artemia franciscana*	NA	Jafari & Astani (2011); Eimanifar et al. (2014); Agh (2016); Eimanifar et al. (2020)
Bushehr Province				
Bushehr	(28°54'42.3" N 50°49'14.8" E)	*Artemia franciscana*	NA	Agh (2016)
Karaj Province				
Kal-e Shoor[u]	(35°57'51.6" N 50°40'44.2" E)	Parthenogenetic *Artemia*	NA	Abatzopoulos et al. (2006 a); Jafari & Astani (2011); Hafezieh et al. (2015); Agh (2016)
Lorestan Province				
Kal-e Shoor[u]	(33°27'26.9" N 48°20'10.6" E)	Parthenogenetic *Artemia*	NA	Abatzopoulos et al. (2006 a); Jafari & Astani (2011); Agh (2016)
Qazvin Province				
Basharyan	36°0'41.9" N 50°18'0.9" E	*Artemia urmiana* (?)	NA	Nekoueifard et al. (2023)
Mazandaran Province				
Behshahr	36°45'6.7" N 53°32'41.5" E	*Artemia sinica* (?)	NA	Nekoueifard et al. (2023)
Kohgiluyeh and Boyer-Ahmad Province				
Gachsaran countryside(s)	(30°21'50.9" N 50°47'35.0" E)	Parthenogenetic *Artemia*	NA	Hafezieh (2003 a); Jafari & Vatandoost (2005)
Khuzestan province				
Masjed Soleyman	(31°56'2.48" N 49°18'9.84" E)	*Artemia* sp.	NA	Noori (1995)

Note:
- The type of locality (natural resource/farming site) is not mentioned in this table. For more information, see the text and the original reference(s).
- SUY = survey year; /SAY = sampling year
- non-scientific names were shown in parentheses.
- invalid specific name or invalid description were shown in brackets.
- uncertain geographic coordinates were shown in parentheses.
- The names of localities are in Persian or local languages/accents. Maybe different spellings have been used for a locality in different references
- Phrases of "lake", "pond", "catchment", "Lagoon" and etc. are used with widely explanation in Persian, maybe different phrases have been utilized for one locality in both Persian and English references. Here we followed popular statements in Persian.
- symbol "?" was referred to non-confirmed taxonomic status and unknown locality.
[a] in some old references "Urmia Lake" also called as "Lake Rezaiyeh"

[b] non-scientific name
[c] invalid name
[d] binominal specific name has mistakenly been written *Artemia uromiana*.
[e] binominal specific name has erroneously been written *Artemia salinor*.
[f] see Hakupian (1990)
[g] *Artemia parthenogenetica* is an invalid binominal specific name, in this table it was replaced to "Parthenogenetic *Artemia*" (see Asem et al. 2024b).
[h] It is also romanized as "Akh Gol" (Atashbar, 2014). Atashbar et al. (2014) reported *Branchinecta orientalis* from Agh Gol, but their recorded geographic coordinates (39°33' 18"N 44° 44' 10"E) 1.1 km is out of Agh Gol's shore.
[i] It is also romanized as "Taschk Lake" (Löffler, 1959). It is also known as "Nargis Lake" (Löffler, 1956) and "Nargiz Lake" (Löffler, 1959). Noori (1995) mistakenly called this lake as "Neyriz Lake".
[j] It is also known as "Niris Lake" (Löffler, 1956) and "Niriz Lake" (Löffler, 1959).
[k] It is also romanized as "Maharloo Lake" and "Maharlo Lake".
[l] It also romanized as "Schor-gol", "Schor-Gol" and "Shor Gul"
[m] This locality might be same as Incheh Lake
[n] "Anbar Olum Pond" and "Mazraeye Nemuneh" are in Voshmgir District, in Aqqala County. These two sites might be referred to same locality.
[o] It also known as "Qom Salt Dome" (Alvandi & Asil, 2014).
[p] Aliabad is referred to two localities in Qom Provins (34°48'0.79"N 51° 5'11.18"E and 34°17'1.88"N 50°43'20.13"E).
[q] "Massileh" (mostly romanized as "Masileh") is the name of plain and its most part is located in Qom Province (Rahmatizadeh & Jafari, 2014). The exact locality of *Artemia* site has not been reported.
[r] "Markazi Province" is official term of the province in governmental documents in English (MOI, 2021). In some references it was erroneously named as "Central Province" (The word *Markazi* means *central* in Persian).
[s] Löffler (1961) called it as "Gavkhaneh". It is also known as "Gaav Khooni Lake" (Abatzopoulos et al., 2006a), "Gaav Khooni Wetland" (Aalamifar et al., 2014) and "Gavkhouni Marsh" (Goodarzi et al., 2014).
[t] Abatzopoulos et al. (2006a) and Hafezieh et al. (2015) reported 30°80'E 61°50'N as geographic coordinates, it is referred to Russia (although 80' is also not correct, because maximum amount of each minute is 60 and 30°80'E should be changed to 31°20'E). We changed "N" and "E" following 30°80'N 61°50'E, it is referred to Afghanistan. In this table, the geographic coordinates refer to "Varmal Village".
[u] Several salty rivers named "Kal-e Shoor" in some provinces (Abatzopoulos et al., 2006a). Lengths of these rivers are several kilometers and the location of the sampling sites are mostly unclear.
[v] Banihashemy, per. comm. (2022)
[w] Abatzopoulos et al. (2006a) and Hafezieh et al. (2015) reported 35°10'E 57°58'N as geographic coordinates, it is referred to Russia. We changed "N" and "E" following 31°20'N 57°58'E, it is referred to Bardaskan County from Shahrabad District in Razavi Khorasan Province.
[x] This site located along "Kal-e Shoor" river.
[y] It is also known as Nough catchment (Abatzopoulos et al. 2006a; Hajirostamloo & Pourrabbi 2011; Eimanifar et al., 2014, 2020) and Nough Pool (Hajirostamloo et al., 2008a). This locality erroneously referred to Yazd Province by Agh et al. (2001).
[z] Minab has been reported in its original reference (see Agh, 2016). The exact locality should be Tiab (Atashbar per. comm. 2023). Tiab is a village in Tiab Rural District of Minab County.

Ahmadi, 2005; Mohebbi et al., 2023 a, b). This environmental crisis has caused a drastic reduction in the annual production of *Artemia* eggs, decreasing from a minimum of 4243 t dry weight (in the top 0.5 m of water) in 1995 (Sorgeloos, 1997) to approximately 55 t dry weight (across the entire volume of the lake) in 2018 (Mohebbi et al., 2023 a). Prior to the drought, the total yield of *Artemia* eggs, harvested between 2000 and 2002, was estimated to be around 204,000 t (wet weight) (Mohebbi et al., 2023 a).

The initial scientific documentation of *Artemia*, dating back to the first half of the 10th century, originates from Urmia Lake and is attributed to the Iranian geographer, Abu-Ishaq Estakhri. In his seminal work, "Al-Masalik wa Al-Mamalik" (commonly known as "Roads and Kingdoms"), Estakhri referred to *Artemia* as the "aquatic dog". This codex, penned between 930 and 933 A.D. (Asem & Eimanifar, 2016; Al-e-Dawoud, 1995). Illustrations in this codex, specifically page 107 depicting a map with Urmia Lake and page 109 detailing the lake and *Artemia*, are preserved in the Iranian Parliamentary Library.

Subsequent to Estakhri's account, an anonymous Persian geographer made references to *Artemia* in the manuscript "Hadud Al-alam min Al-Mashriq Ilal-Maghrib" (translated as "The Limits of the World from the East to the West" and known also as "The regions of the world: A Persian geography") in 982 A.D. (Anonymous, 982). This manuscript describes *Artemia* as a resilient worm capable of surviving in the saline waters of Urmia Lake (Asem, 2008). Later, in 1275 A.D., another Iranian geographer, Zakariya-Qazwini, reported the existence of an "aquatic dog" as the sole living organism in Urmia Lake in his work, "Asar Al-Beldan wa Akhbar Al-Ebad" (also known as "Monuments of the Land and Histories of the People") (Zakariya-Qazwini 1275; Asem & Eimanifar, 2016).

Furthermore, in 1877, Muhammad Etemad-Alsaltane, an Iranian politician, documented *Artemia* in Urmia Lake, describing it as a "herbal-morph animal" in his book "Merat Al-Boldan" (or "Mirror of Cities") (Etemad-Alsaltane, 1877). In a later account by George Curzon, a British diplomat, in his 1892 publication "Persia and the Persian Question", *Artemia* from Urmia Lake was identified as a species akin to "Jelly-Fish" (Curzon, 1892; Sclater, 1893). This series of historical accounts confirms the long-standing recognition and significance of *Artemia* in the ecological study of Urmia Lake and its surrounding regions.

In the later part of the 19th century, Robert Günther, a British zoologist, received a research grant from the Committee of the Royal Society in the United Kingdom to study the fauna and flora of Urmia Lake (Günther & Manley, 1899). During the initial stages of his research, in collaboration with his father Albert Günther, who held the position of Keeper of Zoology at the British Museum in London, the *Artemia* species in Urmia Lake were initially identified as a "Medusa" and a species of "*Branchipus*" (Günther, 1898 a), and later categorized within "the *Artemia* group of varieties of the *Branchipus* type" (Günther, 1898 b). However, subsequent investigations led Robert Günther to ascertain that the specimens observed in Urmia Lake were indeed species of the genus *Artemia* (Günther, 1899a). Eventually in 1899, he described *Artemia urmiana* from Urmia Lake, illustrating a male specimen as well as the brood pouch of a female and the cercopod of both males and females (Günther, 1899 b).

Notably, there has been some confusion regarding the nomenclature of *A. urmiana*. In certain references, the binominal specific name *A. urmiana* has been mistakenly cited to Clark and Bowen (1976), although their work merely referred to the population as "Urmia Lake shrimps" without specifying the name *A. urmiana*. Additionally, the publication date of *A. urmiana* has been cited under various years (1890, 1899, and 1900), but it was later clarified that the correct date of description for the species *A. urmiana* is 1899 (Asem & Rogers, 2012).

In a significant number of studies spanning from the early 1950s to the late 1980s, *Artemia urmiana* was mistakenly reported as "*Artemia salina*" (e.g. Plattner, 1955; Löffler, 1956, 1959, 1961; McCarraher, 1972; Daneshgar, 1975; Hoveida, 1976; Saberi, 1978; Kargarnejad, 1986). The name *Artemia salina* had been generically and inaccurately applied to various species and populations, regardless of their taxonomic status (Abreu-Grobois & Beardmore, 1982; Gajardo et al., 2002; Asem et al., 2010 a). This misidentification issue has recurred in contemporary studies, particularly those investigating *Artemia* toxicity.

In 1987, a critical question was raised about the taxonomic status of Urmia Lake *Artemia* by Barigozzi et al. (1987). Their study focused on the reproductive modes of approximately 500 individuals in a laboratory setting, identifying exclusively parthenogenetic lineages. Through meticulous examination of 24 nauplii to determine chromosome numbers, they recognized three distinct parthenogenetic lineages: diploid (15 specimens), tetraploid (1 specimen), and pentaploid (8 specimens). They proposed that both *A. urmiana* and parthenogenetic *Artemia* might exist in Urmia Lake but due to ecological differentiation are located in separate places. Additionally, they concluded that it seems too unlikely that their observation is the result of a replacement of parthenogenetic *Artemia* with the extinction of *A. urmiana* (Barigozzi et al., 1987). In concurrence with these findings, Azari Takami (1989) reported the observation of both sexual and parthenogenetic *Artemia* in Urmia Lake, suggesting the coexistence of *A. urmiana* and parthenogenetic *Artemia* within the same habitat (see also Barigozzi & Baratelli, 1989; Browne & Bowen, 1991). Further supporting this notion, Ahmadi et al. (1990) documented the coexistence of *A. urmiana* and parthenogenetic individuals along the western shoreline of the lake, based on samples collected in 1987.

Eskandari (2001) analyzed chromosome numbers and reproductive modes of *Artemia* from 11 different locations in Urmia Lake. His findings revealed the presence of polyploid parthenogenetic *Artemia* lineages, although the specific ploidy levels and their distribution, as well as those of *A. urmiana*, remained unclear. Yar-Mohamadi et al. (2002), in their study conducted between 1998 and 1999, found diploid parthenogenetic *Artemia* in the Zambil District (west of the lake) and confirmed the presence of both *A. urmiana* and diploid parthenogenetic *Artemia* in Urmia Lake.

In a 2005 study, Agh et al. (2007) reported that while only parthenogenetic *Artemia* were present in three surrounding lagoons, both *A. urmiana* and parthenogenetic *Artemia* coexisted within Urmia Lake, which *A. urmiana* being the dominant population. Further, Asem et al. (2009) observed that parthenogenetic *Artemia* from Urmia Lake and an adjacent lagoon in Rashakan District were morphologically clustered into two distinct subgroups. Subsequent generations of isolated parthenogenetic *Artemia* from Urmia Lake exhibited rare males in the laboratory, indicating a diploid lineage (Asem et al., 2010 b; for more information see Saleem et al., 2019). The results of morphological characteristics of collected *Artemia* specimens in four stations of Urmia Lake between 2003 and 2004 did not reveal parthenogenetic *Artemia* (Asem & Rastegar-Pouyani, 2008 a, b).

Lagoons in the neighborhood of Urmia Lake

In the West Azerbaijan and East Azerbaijan provinces, several lagoons in the neighborhood of Urmia Lake have been identified as natural habitats of *Artemia*, as described in figure 1 and table 1. These lagoons, characterized as diminutive, ephemeral, and shallow bodies of water, occasionally coalesce with the lake during periods of increased precipitation (Agh et al., 2007; Asem et al., 2009, 2021 b). Comprehensive surveys of these lagoons have exclusively recorded the presence of parthenogenetic *Artemia* lineages (Yar-Mohamadi et al., 2002; Hafezieh, 2003 a; Agh et al., 2001; Eimanifar et al., 2007; Asem et al., 2009; Atashbar et al., 2014; Hajirostamloo, 2019; Manaffar et al., 2018). In conclusion, it is inferred that while the lagoons in the vicinity of Urmia Lake harbor parthenogenetic *Artemia*, the principal body of Urmia Lake itself is primarily a habitat for *A. urmiana*, alongside a limited presence of parthenogenetic *Artemia* lineage(s). Additionally, unspecified localities within the "Dashte Tabriz" (Tabriz plain) have been recognized as habitats of parthenogenetic *Artemia* lineages (Agh, 2016). The geographical expanse of the Tabriz plain, situated between latitudes 37°56' N and 38°17' N, and longitudes 45°30' E and 46°15' E, encompasses approximately 1000 km², extending from the eastern periphery of Urmia Lake to the western boundaries of Tabriz city in the East Azerbaijan Province (Barzegar et al., 2016, 2017; Khatibi & Nadiri, 2021). Therefore, the "Lagoons" identified in proximity to Urmia Lake in East Azerbaijan, following Agh (2016) checklist, are likely congruent with the Khaslou and Sarai lagoons enumerated in our catalog (figure 1, table 1). Future research should prioritize the exploration of Urmia Lake's lagoons to augment the existing data on *Artemia* biodiversity within this region.

Shurabil (Shorabil) Lake

Shurabil Lake (south of Ardabil city, Ardabil Province) is situated at an altitude of approximately 1365 meters above sea level (Daneshi et al., 2017). Historically, for several decades, this lake was characterized as an alkaline hypersaline water body. In the period of 1974–1975, its salinity was recorded between 107.4 and 121.5 g/l (Gafurifard et al., 1977). The early documentation of *Artemia* in Shurabil Lake dates back to 1975, as reported by Pirsamadi (1975). Despite uncertainties in taxonomic classification, this was then referred to as "*A. salina*" (Pirsamadi, 1975; see also Gafurifard et al., 1977). Since 1995, with the integration of the Balıglı River (Balıglı Chay) and Yamch Dam's spillway in 2003 into the lake's ecosystem, a significant reduction in salinity levels was observed, transitioning the lake from a hypersaline to a freshwater environment (Sabkara & Makaremi, 2011; Keramati et al., 2016). This ecological shift was accompanied by an expansion of the lake's surface area from 0.74 to 1.7 km² (Daneshi, et al., 2017). Consequently, *Artemia* in Shurabil Lake diminished and eventually became extinct (Hafezieh, 2003 a; Abatzopoulos et al., 2006 a). In later developments, the narrow-clawed crayfish, *Astacus leptodactylus* (Crustacea: Decapoda), was introduced into the lake's ecosystem (see Abd-Almaleki et al., 2009).

Tashk Lake

Tashk Lake (east of Shiraz city, Fars Province) is classified as a saline lake, encompassing an area of roughly 800 km² (Pakzad et al., 2021). The first scientific observation of *Artemia* species in Tashk Lake was made by Löffler in 1956, who described it as "*A. salina*", noting that the crustaceans were exclusively female with an average length of 1.13 cm (Löffler, 1956; see also Löffler, 1959). Further studies have validated that Tashk Lake harbors parthenogenetic *Artemia* (Agh et al., 2001; Hafezieh, 2003 a; Abatzopoulos et al., 2006 a). A comprehensive analysis conducted using samples collected in 2011 from Tashk Lake revealed the introduction of the exotic American *A. franciscana* into this ecosystem (Shafaie et al., 2012 a, b).

Bakhtegan Lake

Bakhtegan Lake (northwest of Neyriz town, Fars Province) alternatively referred to as Neyriz Lake in various scholarly sources (Löffler, 1956, 1959; Hafezieh, 2003 a), has been identified as a seasonal inland salt lake (Azareh et al., 2021). In 2003, its surface area was recorded as 1271 km^2 (Pakzad et al., 2021), with salinity levels ranging between 60 and 250 g/l (Abatzopoulos et al., 2006 a). During periods of increased rainfall, Bakhtegan Lake is naturally connected to Tashk Lake through a channel (Hafezieh, 2003 a; Abatzopoulos et al., 2006 a; Safarpour et al., 2018). In some publications, these interconnected lakes are collectively referred to as "Bakhtegan-Tashak Lake" (Nezami et al., 2013), "Tashak-Bakhtegan Lake" (Mahabadi et al., 2018), or "Neiriz Lakes", as listed in the Ramsar Convention on Wetlands (https://rsis.ramsar.org/). The initial reports of *Artemia* in Bakhtegan Lake date back to Löffler's studies in 1956 and 1959 (Löffler, 1956, 1959), with subsequent research identifying the crustaceans as parthenogenetic lineage (Agh et al., 2001; Hafezieh 2003 a; Abatzopoulos et al., 2006 a; Hajirostamloo et al., 2008 a). Additionally, Shafaie et al. (2012 b) documented the presence of the non-native *A. franciscana* in the lake.

Maharlu Lake

Maharlu Lake (southeast of Shiraz city, Fars Province) is a hypersaline lake with maximum surface area of 258 km^2 (Samiei et al., 2017) and exhibits a salinity range from 140 to 280 g/l (Hafezieh, 2003 b). The first occurrence of *Artemia* in Maharlu Lake was reported by Noori in 1995, although regarding her presented *Artemia* distribution map, she mistakenly called this lake as "Parishan Lake" (Parishan Lake is a freshwater lake in Jereh and Baladeh District in Fars Province, see Karimian Torghabeh et al., 2021). A field study conducted in 1998 confirmed the presence of parthenogenetic *Artemia* in Maharlu Lake (Hafezieh, 2003 b). In subsequent years, numerous studies have corroborated the existence of both parthenogenetic *Artemia* (Agh et al., 2001; Abatzopoulos et al., 2006 a; Hajirostamloo et al., 2008 a; Eimanifar et al., 2014; Falahatkar & Rafatnezhad, 2015) and the exotic *A. franciscana* (Asem & Aliabadian, 2008; Manaffar et al., 2008; Hoseini & Zare, 2012; Eimanifar et al., 2014, 2020; Manaffar et al., 2018) within the lake. The estimated average annual biomass of *Artemia* in Maharlu Lake was reported to be 7.54 g/m^3 in June 1998 (Hafezieh, 2003 b).

Shor Lake

Shor Lake (north of Gorgan city, Golestan Province) encompasses a surface area of 2 km^2 and exhibits a salinity spectrum ranging from 64.1 to 262.4 g/l (Makhdoumi, 2000). The presence of *Artemia* in Shor Lake was first documented by McCarraher in 1972, who utilized the conventional nomenclature "*A. salina*" as a species name (McCarraher, 1972). Subsequent research by Makhdoumi (2000) not only corroborated the existence of *Artemia* in the lake, it also identified its mode of reproduction as asexual, with the occasional production of male individuals. Makhdoumi (1992) reported that the peak density of *Artemia*, encompassing various life stages, reached approximately 924.5 individuals/m^3 in the month of April (see also Makhdoumi, 2000). However, due to the influence of the Esteghlal Gorgan Dam's spillway, a notable reduction in the lake's salinity levels was observed, resulting in a transition to freshwater conditions. The latest surveys conducted between 2008 and 2009 indicated that *Artemia* have subsequently vanished from Shor Lake (Hami-Tabari, 2011). Agh (2016) reported that the lake has dried up.

Incheh Lake

Incheh Lake (north of Gorgan city, Golestan Province) is situated approximately 20 km from Shor Lake (Abatzopoulos et al., 2006 a). This lake spans a surface area of 0.6 km^2 and exhibits an annual salinity range between 91.1 and 325.1 g/l (Makhdoumi, 2000). The first detection of *Artemia* in Incheh Lake was reported by Makhdoumi in 1992. At its peak, the density of *Artemia*, including various life stages, was estimated at 2426.7 individuals/m^3 in the month of May (Makhdoumi, 1992; see also Makhdoumi, 2000). Further investigations by Makhdoumi revealed that Incheh Lake serves as a natural habitat for parthenogenetic *Artemia*, which also includes a minority group of rare male specimens (Makhdoumi, 2000).

Mighan Lake

Mighan Lake (northeast of Arak city, Markazi Province) is classified as a shallow, seasonal salt lake with a fluctuating surface area between 81 and 120 km^2 (Hafezieh et *al.*, 2021). In the year 2019, the lake's average annual salinity was measured at 48.32 g/l (Hafezieh et al., 2021). Extensive research has consistently demonstrated that Mighan Lake is exclusively inhabited by parthenogenetic *Artemia* (Hafezieh, 2003 a; Abatzopoulos et al., 2006 a; Hajirostamloo et al., 2008 a; Manaffar et al., 2015; Eimanifar et al., 2014, 2020; Hesami et al., 2018; Hafezieh et al., 2021). Additionally, in 2019, the total yield of *Artemia* eggs and biomass in Mighan Lake was quantitatively assessed, revealing figures of 28.875 t and 23.673 t, respectively (Hafezieh et al., 2021).

Qom Salt Lake

Qom Salt Lake (east of Qom city, Qom Province) is recognized as the largest seasonal hypersaline lake in Iran (Safarpour et al., 2018), encompassing an area of 1806 km^2 (Mirzakani et al., 2017). This lake is also referred to by several names, including "Namak Lake" (with "namak" translating to "salt" in Persian), "Masileh Lake" (Mostofi, 1971; Mirzakani et al., 2017), and "Aran-Bidgol (Salt) Lake" (Babavalian et al., 2009; Makhdoumi-Kakhki et al., 2012; Sedghi et al., 2016; Mirzakani et al., 2017; Safarpour et al., 2018; Nasri et al., 2019). Further studies documented the exclusive presence of parthenogenetic *Artemia* within the lake (Agh et al., 2001, Hafezieh, 2003 a; Van Stappen, 2002; Mohaghegh & Mohamadpor, 2004; Abatzopoulos et al., 2006 a; Khalili et al., 2007; Hajirostamloo et al., 2008 a; Eimanifar et al., 2014, 2020). Additionally, the area surrounding Qom Salt Lake has been the focus of various temporary pilot studies dedicated to *Artemia* farming (Nekoueifard, 2015).

Houze Sultan Lake

Houze Sultan Lake (north of Qom city, Qom Province) is characterized as a seasonal salt lake. Its surface area was recorded at 78.35 km^2 in 2002 and subsequently at 62.65 km^2 in 2013 (Forootan & Alikhah-Asl, 2019). The lake is alternatively known under several names, "Qom Lake" (relating to the nearby city south of the lake) "Saveh Lake" (relating to the city to its west) and "Shahi Lake" (with "shahi" translating to "royal" in Persian) (Shafaroodi, 2009; Forootan & Alikhah-Asl, 2019; Sedghi et al., 2016). The presence of parthenogenetic *Artemia* in Houze Sultan Lake has been well documented in various scientific reports and studies (Hafezieh, 2003 a; Mohaghegh & Mohamadpor, 2004; Abatzopoulos et al., 2006 a; Hajirostamloo et al., 2008 a; Soltanifar et al., 2012).

Bazangan Lake

Bazangan Lake (east of Mashhad city, Razavi Khorasan Province) was initially a brackish water body (Shahnavaz & Ghassemzadeh, 2015). It covered a surface area of 0.69 km^2 and a depth of 13 m (Adabi & Mohammadzadeh, 1998). The lake is also named as Gol Bibi (Gholami et al., 2005). Over the past two decades, Batangan Lake has experienced a significant reduction in size, losing about 55 % of its area, attributed primarily to climate change. By 2015, its surface area had diminished to 0.3 km^2, and the salinity levels had increased to 210 g/l (Mohammadyari et al., 2015). Originally characterized as a hyposaline environment, the lake underwent a transformation into a hypersaline lake. The study conducted by Mohammadyari et al. (2015) reported a parthenogenetic *Artemia* along with a minor presence of rare male individuals in the lake. The findings led to the conclusion that the colonization of *Artemia* in Batangan Lake occurred concomitantly with the increase in salinity levels (Mohammadyari et al., 2015).

Gavkhouni Wetland

Gavkhouni Wetland (southeast of Varzaneh city, Isfahan Province) is also known as Gavkhouni Marsh, with an average surface area of 486 km^2 (Jaberalansar et al., 2021). This ecological site is enlisted in the Ramsar Convention on Wetlands (https://rsis.ramsar.org/). The occurrence of *Artemia* in Gavkhouni Wetland was first documented by Löffler in 1961, referred to "*A. saline*" (Löffler, 1961). In the summer months, the salt concentration of the wetland's water was recorded at 315 ppt, exhibiting a high magnesium content (Löffler, 1961). Abatzopoulos et al. (2006 a) reported the presence of only adult female *Artemia* in the wetland, a finding also supported by Agh et al. (2001). A comprehensive experimental study conducted by Aalamifar et al. (2014) concluded that the samples collected from Gavkhouni Wetland are of a parthenogenetic *Artemia*.

Hamun-e Jaz Murian Wetland

Hamun-e Jaz Murian Wetland (north of Rameshk city, Kerman Province) is characterized as a seasonal wetland, spanning the geographical region between Kerman and Sistan va Baluchestan. It encompasses an area of approximately 3300 km^2, extending over a length of 100 km and a breadth of 45 km (Mirzaei & Zibaei, 2019). Observations and studies within this wetland have confirmed the presence of a parthenogenetic *Artemia* lineage (Hafezieh, 2003a).

Varmal Lake

Varmal Lake, with a surface area fluctuating between 1.3 and 60 km^2 and a salinity range of 18 to 45 ppt, had been reported from Sistan va Baluchestan Province. The lake's average and maximum depths was between 1.5 and 5 m, respectively (Mohammad-Piri & Tehrani, 1997). In a study conducted in November 1996, Mohammad-Piri and Tehrani (1997) identified the presence of *Artemia* in Varmal Lake. Further laboratory investigations confirmed that the *Artemia* from this lake reproduce asexually (Mohammad-Piri & Tehrani, 1997).

Surprisingly, the precise geographical location of Varmal Lake remains ambiguous. Mohammad-Piri and Tehrani (1997) mentioned that the lake is situated west of Zabol city, but did not provide specific coordinates. The village of "Varmal" (30°43'32.4" N 61°20'0.8" E), located approximately 35 km southwest of Zabol city in the Lutak Rural District of Hamun County, does not have any lake or dried water resource in its vicinity matching the reported surface area. Further studies, including those by Abatzopoulos et al. (2006 a) and Hafezieh et al. (2015), have erroneously attributed geographical coordinates to this lake that correspond to a location in Russia. A review of geological and geographical literature yields insufficient information about Varmal Lake. Consequently, the geographic location of "Varmal Lake" is deemed to be an uncertain site in our checklist, warranting further verification and research.

Kal-e Shoor Gonabad

Within the Central Persian Desert basin, a collection of permanent and seasonal saline waterways exists, commonly referred to as "Kal-e Shoor". In the Razavi Khorasan Province, the Kal-e Shoor Gonabad is a notable example of these saline rivers. After a field investigation focused on *Artemia* resources in the saline waters of Gonabad during 2001–2002. Ghassemzadeh et al. (2005) reported the presence of parthenogenetic *Artemia* approximately 35 km north of Gonabad (Banihashemy per. comm. 2022, see also Banihashemy, 2010). The salinity and pH levels in this area ranged from 70.27 to 125.8 g/l and pH 7.5 to 9, respectively, though there are indications that the maximum salinity was alternatively recorded as 155.8 g/l elsewhere in their manuscript. Ghassemzadeh et al. (2005) also identified another habitat of parthenogenetic *Artemia* in the Yunesi District, situated along the Kal-e Shoor Gonabad River, approximately 15 km northwest of the first site (40 km northwest of Gonabad). This location exhibited salinity levels of 101.8 to 322.9 g/l and a pH range of 7 to 8.6. *Artemia* densities varied from 101 to 373 individuals/m^3 in Kal-e Shoor and 2 to 190 individuals/m^3 in the Yunesi District (Ghassemzadeh et al., 2005). Subsequent studies continued to report parthenogenetic *Artemia* from this river (Abatzopoulos et al., 2006 a; Banihashemy, 2010), until the discovery of *A. franciscana* in 2016 (Agh, 2016).

Additionally, a number of smaller natural habitats, both temporary and seasonal, have been identified in the provinces of Karaj, Lorestan, Kerman, Isfahan, Kohgiluyeh va Boyer Ahmad, and Qom, as summarized in table 1.

Farming sites

In the context of aquaculture within Iran, *Artemia* has played a pivotal role as a live feed in larviculture since 1972. This utilization started when Azari Takami pioneered the use of *A. urmiana* nauplii from Urmia Lake for feeding Persian sturgeon larvae at the Sangar hatchery on the southern coast of the Caspian Sea (Fayazi, 1994; see also Javanshir, 1986). This period marked a significant increase in the focus on *Artemia* resources in Iran, emphasizing their application in aquaculture and fisheries.

Kolahi Fishery Farm

At the Kolahi Fishery Farm, an *Artemia* culture project was initiated in 1993. The farm is located 2 km east of Kolahi village and 30 km southeast of Minab city in the Hormozgan Province. *Artemia urmiana* was cultivated over a total area of 5100 m^2, within a salinity range of 80 to 110 ppt. Over a seven-month period, *Artemia* yielded a total biomass of 4,199 kg, translating to an estimated production rate of 1,633 kg per month (Fayazi, 1994).

Nough Lake

Nough Lake (northwest of Rafsanjan city, Kerman Province) was a natural site that underwent development for fish hatchery establishments in the 1990s. Due to climatic change, notably drought, and a rise in water salinity, promoted *Artemia* cultivation in the lake by 1999. As of the year 2020, the lake's surface area has expanded from 0.3 km^2 in 1990 to 2 km^2. Annually, Nough Lake yields approximately 20 t of *Artemia*, both biomass and eggs (www.iranartemia.ir). The project commenced with the introduction of parthenogenetic *Artemia* (Abatzopoulos et al., 2006 a; also see Agh et al., 2001), followed by the subsequent colonization of the non-native *A. franciscana* (Abatzopoulos et al., 2006 a; Hajirostamloo et al., 2008 b; Hajirostamloo & Pourrabbi, 2011; Eimanifar et al., 2014, 2020). Over the past two decades, reports from the lake have exclusively indicated the presence of *A. franciscana* (Hajirostamloo & Pourrabbi, 2011; Eimanifar et al., 2014, 2020).

Hendijan site

In the Hengijan Region of Khuzestan Province, located on the northern coast of the Persian Gulf, a farm was established in the early 2000s with the objective of cultivating

Artemia (Agh et al., 2002). For this purpose, exotic American *A. franciscana*, originally sourced from the Mekong Delta in Vietnam, was introduced. Each pond, spanning an area of 112 hectares, yielded a monthly harvest of approximately 15 kg of eggs (wet weight) (Agh et al., 2002). However, the reported area (each pond with 112 hectares area) does not correspond with the production amounts in this project and pilot studies (see next paragraphs).

Fesendooz site

In 2000, the Iranian Fisheries Science Research Institute established a two-hectare *Artemia* cultivation site for commercial purposes in the Fesendooz District, located in the southeastern region of Urmia Lake, West Azerbaijan Province. This site was initially populated with *A. urmiana* sourced from Urmia Lake (Ahmadi et al., 2012). Subsequent to the filling of certain ponds with saltwater (80 g/l) and fertilization procedures, parthenogenetic *Artemia* emerged spontaneously, without the introduction of nauplii. Additionally, in other ponds where *A. urmiana* nauplii were introduced, parthenogenetic *Artemia* became predominant after a few months (Ahmadi per. comm. 2023). Thus, the Fesendooz District merits recognition as a natural habitat for parthenogenetic *Artemia*.

Throughout the cultivation period, the site yielded monthly harvests of 32.9 kg dry weight per hectare of parthenogenetic *Artemia* eggs and 17.3 kg dry weight per hectare of *A. urmiana* eggs (Ahmadi et al., 2012). Since the early 2000s, the Fesendooz ponds have been intermittently utilized for *Artemia* cultivation (Nekoueifard et al., 2020).

Gobadloo (Ghobadlu) site

Regarding the Gobadloo (Ghobadlu) site, in 2002, an area of 2.3 hectares, divided into eight ponds of 2890 m^2 each, was allocated for the production of *A. urmiana* and parthenogenetic *Artemia* in the Gobadloo District, situated in the eastern part of Urmia Lake, East Azerbaijan Province (Atashbar per. comm. 2023; Manaffar et al., 2004; Agh et al., 2007). During the culture period, which lasted 3 to 4 months, the site reported monthly harvests of 36.9 kg dry weight per hectare of parthenogenetic *Artemia* eggs and 28.8 Kg dry weight per hectare of *A. urmiana* eggs (Manaffar et al., 2004). A notable transition was observed in the Gobadloo District pilot project, where the dominance shifted from *A. urmiana* to parthenogenetic *Artemia* (Agh et al., 2007). Currently, this farming site is not in use for further projects (Atashbar per. comm. 2023).

Shams Abad site

The Shams Abad site, located within the Qanavat Rural District of Qom County in the Qom Province, was developed for the cultivation of both native parthenogenetic *Artemia* (originating from Qom Salt Lake) and the non-native *A. franciscana*. This facility comprised six ponds, collectively covering an area of 600 m^2 (300 m^2 allocated for each treatment), with an average salinity of 50 g/l. A pilot study conducted over 180 days during the summer and autumn of 2013 resulted in the harvesting of 2800 kg of wet biomass of parthenogenetic *Artemia* and 2200 kg of *A. franciscana* (wet weight). The study estimated that the average egg production for parthenogenetic *Artemia* and *A. franciscana* accounted for approximately 182 and 113 eggs/l, respectively (Asadpour, 2016 a).

Ab Shirin site

In the Ab Shirin site, located in the Miyandasht Rural District of Kashan County in the Isfahan Province, a pilot study was conducted to compare the production potential of native parthenogenetic *Artemia* (sourced from Qom Salt Lake) with that of the exotic

American *A. franciscana*. The site consisted of six ponds, each measuring 50 m^2 and maintaining a salinity of 40 to 50 g/l. The study, which lasted for 105 days during the summer of 2009, revealed that the average number of eggs produced by parthenogenetic *Artemia* and *A. franciscana* were 193 and 123.5 egg/l, respectively (Asadpour, 2016 b).

Additionally, the exotic American *A. franciscana* has been introduced for economic exploitation in several artificial ponds located along the northern coast of the Persian Gulf and the Sea of Oman, within the provinces of Khouzestan, Bushehr, and Hormozgan (Jafari & Astani, 2011). Detailed information regarding these introductions is summarized in table 1, although comprehensive data is not readily available.

Discussion

In this study, 59 *Artemia* sites were identified across Iran, including five sites with uncertain status (Agh Gol, Agh-Gala Pond, Aliabad, Massileh, Iaq-Shoar River) for more information see table 1). Notably, two natural lakes, Shurabil Lake and Shor Lake, have witnessed the disappearance of *Artemia* due to ecological shifts from hypersaline to freshwater conditions. Additionally, climate change has transformed Bazangan Lake from a brackish to a hypersaline environment, now hosting parthenogenetic *Artemia*. The source of this colonization remains unclear, but the absence of human intervention in *Artemia* introduction suggests natural dispersal mechanisms, possibly via migratory waterbirds or wind from adjacent areas. Bazangan Lake represents a natural habitat where climate change has altered biodiversity without direct human influence.

Previous checklists (e. g., Vanhaecke et al., 1987; Triantaphyllidis et al., 1998; Van Stappen, 2002) incorrectly listed Athlit, (located on the Mediterranean Sea coast; see Goldschmidt, 1952), as an *Artemia* site in Iran. In another instance, Sahulan (Sahoolan) Cave in the Central District of Mahabad County (West Azerbaijan Province) was mistakenly reported to host *Artemia* in its freshwater lake (Asghari-Mogadam et al., 2006), whereas it was actually *Gammarus komareki* (Crustacea: Amphipoda) (see Alizadeh & Sari, 2008).

The first recorded presence of the American brine shrimp *A. franciscana* in Iran dates back to 2006 in Nough Lake (Abatzopoulos et al., 2006 a). By 2016, the number of *A. franciscana* sites increased to seven localities (Agh, 2016). Our review identified 12 sites with *A. franciscana*, including three natural inland lakes with native parthenogenetic *Artemia*. This introduction poses a significant threat to the biodiversity of native *Artemia* species in natural inland lakes. *A. franciscana* is recognized as a dominant invader in hypersaline ecosystems, attributed to its high reproductive capacity, superior adaptability, and rapid filter-feeding rate compared to other species and parthenogenetic lineages (Amat et al., 2007; Sánchez et al., 2016). However, pilot studies in Iran have yielded contrary findings, indicating that Iranian native parthenogenetic *Artemia* exhibits higher reproductive potential and fitness than the regionally endemic *A. urmiana* and the invasive *A. franciscana*.

Despite the abandonment of most *Artemia* farming sites in Iran, the presence of resistant eggs in soil columns theoretically allow for the establishment of limited populations during rainy seasons. Additionally, these resistant eggs can be dispersed to other habitats by wind or waterbirds during and after the farming period. Therefore, abandoned farms should be conservatively classified as *Artemia* sites.

As a management program to conserve *Artemia* biodiversity, the use of enrichment techniques to increase nutrient value is suggested as a means of exploitation and production of *Artemia* from native sources (parthenogenetic *Artemia*). Parthenogenetic *Artemia* lineages, predominant and widespread in Iran, have been under-researched, particularly in assessing their ploidy levels. Different ploidy levels in parthenogenetic *Artemia* lineages, resulting from diverse evolutionary origins (Maniatsi et al., 2011; Asem et al., 2016 b), which can influence their biological characteristics. Therefore, a thorough investigation into the distribution and nutritional value of parthenogenetic *Artemia*, considering ploidy levels, is imperative to understand the biodiversity and aquacultural potential of these organisms in Iran. Despite the absence of current data on the status of Iranian parthenogenetic *Artemia* communities post-introduction of *A. franciscana*, the latter should be regarded as a potential ecological threat.

Recently, Nekoueifard et al. (2023) reported new locality for *A. sinica* in Behshahr and identified two sites of *A. urmiana* in Doz Daghi and Basharyan from Iran. Their investigation relied solely on individual sequences of the mitochondrial *COI* marker and nuclear *Na^+/K^+ATPase*, without disclosing the sequences or delving into reproductive mode. While they sequenced the *Na^+/K^+ATPase* marker, the results obtained did not provide enough evidence to support whether the studied samples exhibited a homozygous or heterozygous pattern in the valine codon, and thus, whether they were bisexual or parthenogenetic (see Manaffar et al., 2011). However, it is worth noting that the validity of a heterozygote pattern in the valine codon of parthenogenetic *Artemia* has been debated by Maccari et al. (2013). Furthermore, *A. sinica* displayed only a 76.17 % similarity with sequences available in the NCBI database, which suggests a potential issue with low sequence quality and the presence of poly-peak sequences (see Asem et al., 2022). Additionally, *A. urmiana* and the diploid parthenogenetic lineage, as well as, *A. sinica* and tetra-/pentaploid parthenogenetic lineages exhibited close genetic similarities, making it clear that relying solely on the "percentage of homogeneity" is insufficient to establish their taxonomic status. In light of these challenges, the taxonomic status of these localities has been recorded as "unconfirmed" in this checklist. To resolve these uncertainties, future studies should incorporate a larger number of sequences and take into consideration the reproductive mode, which will help confirm their taxonomic status.

Conclusion

The absence of contemporary biodiversity data presents a significant obstacle in the development and implementation of effective conservation strategies. While resource assessment data from natural habitats are crucial for monitoring biodiversity and the distribution of organisms, much of the research on *Artemia* resources in Iran remains unpublished. Moreover, the extant assessment data are derived from diverse methodologies, encompassing metrics such as the number of individuals, number of eggs, biomass, and both dry and wet weights of eggs. This methodological heterogeneity renders comparative analysis of resource assessment data across different habitats and timeframes challenging. It is imperative to adopt a specific protocol aligned with standardized methodologies for consistent data collection and analysis.

Considering that *A. urmiana* is an endemic species to Urmia Lake in northwest Iran, its cultivation in southern regions of Iran should be treated as the introduction of an alien species. Over the past three decades, Urmia Lake has undergone severe ecological disruptions. Data on population size and reproductive capacity indicate that *A. urmiana* has experienced a dramatic decline of over 90 % between 1994 and 2004 (Asem et al., 2012, 2019). Recent resource assessments in 2018 suggest a further reduction, approximating 99 % (Mohebbi et al., 2023 a). In light of the ongoing critical conditions of Urmia Lake, it is recommended that *A. urmiana* be classified as Critically Endangered (CE) on the Regional

Red List of Iran, following the criteria of the IUCN Red List at both regional and national levels (IUCN, 2012).

Acknowledgement

Authors thank Dr. Markus Braun (Paul-Ehrlich Institute, Germany) for translating Löffler's works into English. The help of Dr. Alireza Amirsadeghi (ACECR, Iran), Dr. Zhichao Wang (Tarim University, China), Dr. Behrooz Atashbat (Urmia University, Iran) and Dr. Feridun Mohebbi (Iranian Fisheries Science Research Institute, Iran) in preparing references for this study is greatly appreciated. The help of Mr. Xia Lidong (Kunming University of Science and Technology, China) is highly appreciated.

Disclosure Statement

No potential conflict of interest was reported by the authors.

References

Aalamifar, H., Agh, N., Malekzadeh, R. & Aalinezhad, M. 2014. Comparative study on effects of different salinities on the reproduction rates of two parthenogenetic species of *Artemia* (Gaav Khooni wetlands of Isfahan and ponds around the Urmia Lake) from Iran. *International Journal of Aquatic Biology*, 2, 91–98.

Abatzopoulos, T. J., Agh, N., Van Stappen, G., Rouhani Razavi, S. M. & Sorgeloos, P. 2006 a. *Artemia* sites in Iran. *Journal of the Marine Biological Association of the UK*, 86, 299–307. http://doi.org/10.1017/S0025315406013154

Abatzopoulos, T. J., Baxevanis, A. D., Triantaphyllidis, G. V., Criel, G., Pador, E. L., Van Stappen, G. & Sorgeloos, P. 2006 b. Quality evaluation of *Artemia urmiana* Günther (Lake Urmia, Iran) with special emphasis on its particular cyst characteristics (International Study on *Artemia* LXIX). *Aquaculture*, 254, 442–454. http://doi.org/10.1016/j.aquaculture.2005.11.007

Abd-Almaleki, S., Ghaninezhad, D., Nahrvar, R., Sayad-Rahim, M., Khedmati, K., Nourouzi, H. A. & Rastin, R. 2009. Population dynamics and reproductive biology of crayfish (*Astacus leptodactylus* Eschscholtz, 1823) in Shorabil Lake (Ardabil province), Northwest of Iran. *Iranian Scientific Fisheries Journal*, 18, 109–118.

Abonyi, A. 1915. Experimenlelle Daten zum Erkennen der *Artemia*-Gattung. *Zeitschrift für wissenschaftliche Zoologie*, 114, 95–168.

Abreu-Grobois, F. A. & Beardmore, J. A. 1991. Genetic characterization and intra-generic relationships of *Artemia monica* Verrill and *A. urmiana* Günther. *Hydrobiologia*, 212, 151–168. http://doi.org/10.1007/BF00025997

Abreu-Grobois, F. A. & Beardmore, J. A. 1982. Genetic differentiation of the brine shrimp *Artemia*. *In*: Barigozzi, C., ed. *Mechanisms of Speciation*. Alan R. Liss, New York, 345–376.

Adabi, M. H. & Mohammadzadeh, H. 1998. Study of origin and hydrogeology of Bazangan Lake, in eastern Kopet-Dagh Basin. *Geographical Research*, 12, 31–43.

Agh, N., Bossier, P., Abatzopoulos, T. J., Beardmore, J. A., Van Stappen, G. V., Mohammadyari, A., Rahimian, H. & Sorgeloos P. 2009. Morphometric and preliminary genetic characteristics of *Artemia* populations from Iran. *International Review of Hydrobiology,* 94, 194–207. http://doi.org/10.1002/iroh.200811077

Agh, N. 2016. *Artemia* resources in Iran, Azerbaijan and Turkmenistan. *FAO Expert Workshop on Sustainable Use and Management of Artemia Resources in Asia, 7–9 November 2016, Tianjin: China*.

Agh, N., Abatzopoulos, T. J., Kappas, I., Van Stappen, G., Razavi-Rouhani, S. M. & Sorgeloos, P. 2007. Coexistence of Sexual and Parthenogenetic *Artemia* Populations in Lake Urmia and Neighbouring Lagoons. *International Review of Hydrobiology*, 92, 48–60 http://doi.org/10.1002/iroh.200610909

Agh, N., Atashbar, B. & Manaffar, R. 2002. Successful inoculation of *Artemia franciscana* (Vietnam Strain) at South of Iran. *World Aquaculture 2002, 24–27 April 2002, Beijing: China.*

Agh, N., Sorgeloos, P., Abatzopoulos, T., Razavi-Ruhani, S. M. & Lotfi, V. G. 2001. *Artemia* resources in Iran. *International Workshop on Artemia, 12–15 May 2001, Urmia: Iran.*

Ahmadi, M. R. 1987. First report of *Artemia* occurrence in Shurabil Lake (Iran). *In*: Sorgeloos, P., Bengston, D. A., Decleir, W., Jaspers, E., eds. *Artemia Research and its Applications. Vol. 3.* Universa Press, Wetteren, 143.

Ahmadi, M. R., Leibovitz, H. & Simpson, K. L. 1990. Characterization of Uromiah Lake *Artemia* (*Artemia uromiana*) by isoelectrofocusing of isozyme patterns. *Comparative Biochemistry and Physiology Part B*, 95, 115–118. http://doi.org/10.1016/0305-0491(90)90256-S

Ahmadi, R. 2005. *Artemia population changes on Orumieh Lake*. Iranian Fisheries Science Research Institute Press, Tehran, 1–59.

Ahmadi, R. 2007. *Evaluation of Artemia population changes on Orumieh Lake*. Iranian Fisheries Science Research Institute Press, Tehran, Ahmadi, R., Esmaili, L., Mohebbi, F. & Ganji, S. 2012. Semi-intensive culture of parthenogenetic population of *Artemia* and *Artemia urmiana* Günther, 1899 (Crustacea: Anostraca) on the fertilized ponds in Fesendooz district (near of Urmia Lake, Iran). *International Journal of Artemia Biology*, 2, 48–51.

Al-e-Dawoud, S. A. 1995. Masalik wa Mamalik. *Nashr-e Danesh*, 89, 41.

Alizadeh, E. H. & Sari, A. R. 2008. Ponto-Caspian and *Gammarus Pulex* species group amphipods (Crustacea: Amphipoda) from Azarbaijan of Iran. *Journal of Science*, 33, 35–47.

Alvandi, A. & Asil, R. H. 2014. Edge detection process of Qom Salt Dome gravity anomalies using hyperbolic tilt angle. *International Journal of Geomatics and Geosciences*, 5, 209–224.

Amat, F., Hontoria, F., Navarro, J. C., Vieira, N. & Mura, G. 2007. Biodiversity loss in the genus *Artemia* in the western Mediterranean region. *Limnetica*, 26, 387–404. http://doi.org/10.23818/limn.26.33

Amat, F., Hontoria, F., Ruiz, O., Green, A., Sanchey, M. I., Figuerola, J. & Hortas, F. 2005. The American brine shrimp as an exotic invasive species in the western Mediterranean. *Biological Invasions*, 7, 37–47. http://doi.org/10.1007/s10530-004-9634-9

Anonymous. 982. *Hadud Al-alam min Al-Mashriq Ilal-Maghrib*. Tehran, Iran.

Anufriieva, E., Kolesnikova, E., Revkova, T., Latushkin, A. & Shadrin, N. 2022. Human-Induced sharp salinity changes in the world's largest hypersaline lagoon Bay Sivash (Crimea) and their effects on the ecosystem. *Water*, 14, 403. http://doi.org/10.3390/w14030403

Artom, E. 1922. Nuovi datti sulla distribuzione geografica e sulla biologia delle due specie (*microperenica* e *macroperenica*) del genere *Artemia*. *Atti della Accademia Nazionale dei Lincei Rendiconti*, 31, 529–532.

Asadpour, Y. 2016 a. Ecological assessment of imported specie *Artemia franciscana* with the local specie *Artemia parthenogenetica* at the southern margin of Namak Lake Qom Province. *Journal of Animal Environment*, 8, 159–164.

Asadpour, Y. 2016 b. *The Comparison of the Culture Operation of Artemia franciscana and Parthenogenetic Species on the Sidelines of Qom Salt Lake*. Iranian Fisheries Science Research Institute Press, Tehran.

Asem, A. 2008. Historical record on brine shrimp *Artemia* more than one thousand years ago from Urmia Lake, Iran. *Journal of Biological Research-Thessaloniki*, 9, 113–114.

Asem, A. & Aliabadian, M. 2008. The culture of the invasive *Artemia franciscana*: A serious threat to endemic parthenogenetic *Artemia* population of Maharlu lake, Iran. *20th International Congress of Zoology, 26–29 August 2008, Paris: Frence*.

Asem, A., Atashbar, B., Rastegar-Pouyani, N. & Agh, N. 2009. Biometric comparison of two parthenogenetic populations of *Artemia* Leach, 1819 from the Urmia Lake basin, Iran (Anostraca: Artemiidae). *Zoology in the Middle East*, 47, 117–120. http://doi.org/10.1080/09397140.2009.10638358

Asem, A., Atashbar, B., Rastegar-Pouyani, N. & Agh, N. 2010 b. Morphological and biometric characterization of rare male and sexual dimorphism in parthenogenetic *Artemia* (Crustacea: Anostraca). *Zoology in the Middle East*, 49, 115–117. http://doi.org/10.1080/09397140.2010.10638402

Asem, A. & Eimanifar, A. 2016. Updating historical record on brine shrimp *Artemia* (Crustacea: Anostraca) from Urmia Lake (Iran) in the first half of the 10th century AD. *International Journal of Aquatic Science*, 7, 3–5.

Asem, A., Eimanifar, A., Djamali, M., De los Rios, P. & Wink, M. 2014. Biodiversity of the Hypersaline Urmia Lake National Park (NW Iran). *Diversity,* 6, 102–132. http://doi.org/10.3390/d6010102

Asem, A., Eimanifar, A., Li, W., Shen, C., Shikhsarmast, F. M., Dan, Y., Lu, H., Zhou, Y., Chen, Y., Wang, P. & Wink, M. 2021 b. Reanalysis and Revision of the Complete Mitochondrial Genome of *Artemia urmiana* Günther, 1899 (Crustacea: Anostraca). *Diversity*, 13, 14. http://doi.org/10.3390/d13010014

Asem, A., Eimanifar, A., Li, W., Wang, P., Brooks, S. A. & Wink, M. 2018. Phylogeography and population genetic structure of an exotic invasive brine shrimp *Artemia* Leach, 1819 (Crustacea: Anostraca) in Australia. *Australian Journal of Zoology*, 66, 307–316. http://doi.org/http://doi.org/10.1071/ZO18077

Asem, A., Eimanifar, A. & Sun, S. C. 2016 b. Genetic variation and evolutionary origins of parthenogenetic *Artemia* (Crustacea: Anostraca) with different ploidies. *Zoologica Scripta*, 45, 421–436. http://doi.org/10.1111/zsc.12162

Asem, A., Eimanifar, A., Van Stappen, G. & Sun, S. C. 2019. The impact of one-decade ecological disturbance on genetic changes: a study on the brine shrimp *Artemia urmiana* from Urmia Lake, Iran. *PeerJ*, 7, e7190. http://doi.org/10.7717/peerj.7190

Asem, A., Eimanifar, A. & Wink, M. 2016 a. Update of "Biodiversity of the Hypersaline Urmia Lake National Park (NW Iran)". *Diversity,* 8, 6. http://doi.org/10.3390/d8010006

Asem, A., Fu, C., Yang, N., Eimanifar, A., Cao, Y., Wang, P. & Shen, C. 2022. Validation of two novel primers for the promising amplification of the mitogenomic Cytochrome c Oxidase subunit I (COI) barcoding region in *Artemia* aff. *sinica* (Branchiopoda, Anostraca). *Crustaceana*, 95, 585–592. http://doi.org/10.1163/15685403-bja10207

Asem, A., Gajardo, G., Hontoria, F., Yang, C., Shen, C., Rastegar-Pouyani, N, Padhye, S. M. & Sorgeloos, P. 2024 b. The species problem in *Artemia* Leach, 1819 (Crustacea: Anostraca), a genus with sexual species and obligate parthenogenetic lineages. *Zoological Journal of the Linnean Society*, zlad192. doi: 10.1093/zoolinnean/zlad192

Asem, A., Gajardo, G., Rogers, D. C. & Sorgeloos, P. 2024 c. The taxonomic status of *Artemia monica* Verrill, 1869 (Crustacea: Anostraca), *Zoological Journal of the Linnean Society*, zlae088. doi: 10.1093/zoolinnean/zlae088

Asem, A., Mohebbi, F. & Ahmadi, R. 2012. Drought in Urmia Lake, the largest natural habitat of brine shrimp *Artemia*. *World Aquaculture*, 43, 36–38.

Asem, A. & Rastegar-Pouyani, N. 2008 a. Sexual dimorphism in *Artemia urmiana* Günther, 1899 (Anostraca: Artemiidae) from the Urmia Lake (West Azerbaijan, Iran). *Journal of Animal and Veterinary Advances*, 6, 1409–1415.

Asem, A. & Rastegar-Pouyani, N. 2008 b. Morphological differentiation of *Artemia urmiana* Günther, 1899 (Crustacea: Anostraca) in different geographical stations from the Urmia Lake-Iran. *Research Journal of Biological Sciences*, 3, 222–228.

Asem, A. & Rastegar-Pouyani, N. 2010. Different salinities effect on biometry of nauplii and meta-nauplii of two *Artemia* (Crustacea; Anostraca) populations from Urmia Lake basin. *International Journal of Aquatic Science*, 1, 10–13.

Asem, A., Rastegar-Pouyani, N. & Agh, N. 2007. Biometrical Study of *Artemia urmiana* (Anostraca: Artemiidae) Cysts Harvested from Lake Urmia (West Azerbaijan, Iran). *Turkish Journal of Zoology*, 31, 171–180.

Asem, A., Rastegar-Pouyani, N. & De los Rios, P. 2010 a. The genus *Artemia* Leach, 1819 (Crustacea: Branchiopoda): true and false taxonomical descriptions. *Latin American Journal of Aquatic Research*, 38, 501–506. http://doi.org/10.3856/vol38-issue3-fulltext-14

Asem, A. & Rogers, D. C. 2012. Clarification of the publication date for *Artemia urmiana* Günther (Crustacea: Anostraca): 1890, 1899 or 1900? *International Journal of Artemia Biology*, 2, 3–6.

Asem, A., Schuster, R., Eimanifar, A., Lu, H., Liu, C., Wu, X., Yao, L., Meng, X., Li, W. & Wang, P. 2021 a. Impact of colonization of an invasive species on genetic differentiation in new environments: A study on American *Artemia franciscana* (Crustacea: Anostraca) in the United Arab Emirates. *Journal of Ocean University of China*, 20, 911–920. http://doi.org/10.1007/s11802-021-4675-6

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. & 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, 1–25. http://doi.org/10.1093/jcbiol/ruad002

Asem, A., Yang, C., Mahmoudi, F., Chen, S., Long, B., Wang, B., Fu, C., Hontoria, F., Rogers, D. C. & Gajardo, G. 2024 a. Tibetan *Artemia* (Crustacea: Anostraca) mitogenomic biodiversity and population demographics. *Zoological Journal of the Linnean Society*, 201 (1), 32–56. http://doi.org/10.1093/zoolinnean/zlad114

Asghari-Mogadam, A., Movaied, M. & Nadiri, A. 2006. Study on geomorphology, geology and genesis of Sahulan Cave, northwest Iran. *Humanities and Social Sciences Tabriz University*, 22, 59–91.

Atashbar, B., Agh, N., Van Stappen, G. & Beladjal, L. 2014. Diversity and distribution patterns of large branchiopods (Crustacea: Branchiopoda) in temporary pools (Iran). *Journal of Arid Environments*, 111, 27–34. http://doi.org/10.1016/j.jaridenv.2014.07.005

Azareh, A., Rafiei-Sardooi, E., Gholami, H., Mosavi, A., Shahdadi, A. & Barkhori, S. 2021. Detection and prediction of lake degradation using landscape metrics and remote sensing dataset. *Environmental Science and Pollution Research*, 28, 27283–27298. http://doi.org/10.1007/s11356-021-12522-8

Azari Takami, G. 1989. Two strains of *Artemia* in Urmia Lake (Iran). *Artemia Newsletter*, 13, 5.

Azarnia, M., Agh, N. & Bayramzadeh, Z. 2002. Comparative study on growth of parthenogenetic *Artemia* from lagoons around Urmia Lake and Inche Lake.*1st Iranian Conference on Animal Science and Biodiversity. 20–22 August 2002, Kerman: Iran.*

Babavalian, H., Amoozegar, M. A. & Pourbabaee, A. A. 2009. Isolation, identification and characterization of moderately halophilic bacteria producing hydrolytic enzymes from Aran-Bidgol Salt Lake. *Iranian Journal of Biology*, 22, 24–45.

Banihashemy, S. A. 2010. Morphometric comparison of Urmia Lake *Artemia* with Gonabad Kale-Shour. *Iranian Journal of Biology*, 23, 179–189.

Barigozzi, C. 1974. *Artemia*: A Survey of Its Significance in Genetic Problems. *In*: Dobzhansky, T., Hecht, M. K., Steere, W. C., eds. *Evolutionary Biology*. Springer, Boston, 221–252.

Barigozzi, C. 1980. Genus *Artemia*: problems of systematics. *In*: Persoone, G., Sorgeloos, P., Roels, O., Jaspers, E., eds. *The Brine Shrimp Artemia, Vol 1*. Universa Press, Wetteren, 147–153.

Barigozzi, C. & Baratelli, L. 1989 The problem of *Artemia urmiana*. *Artemia Newsletter*, 14, 14.

Barigozzi, C., Varotto, V., Baratelli, L. & Giarrizzo, R. 1987. The *Artemia* of Urmia Lake (Iran): Mode of reproduction and chromosome numbers. *Atti della Accademia Nazionale dei Lincei*, 81, 87–90.

Barzegar, R., Moghaddam, A. A. & Baghban, H. 2016. A supervised committee machine artificial intelligent for improving DRASTIC method to assess groundwater contamination risk: a case study from Tabriz plain aquifer, Iran. *Stochastic Environmental Research and Risk Assessment*, 30, 883–899. http://doi.org/10.1007/s00477-015-1088-3

Barzegar, R., Moghaddam, A. A. & Tziritis, E. 2017. Hydrogeochemical features of groundwater resources in Tabriz plain, northwest of Iran. *Applied Water Science*, 7, 3997–4011. http://doi.org/10.1007/s13201-017-0550-4

Beardmore, J. A. & Abreu-Grobois, F. A. 1983. Taxonomy and evolution in the brine shrimp *Artemia*. *In*: Oxford, G. S., Rollinson, D., eds. *Protein Polymorphism: Adaptive and Taxonomic Significance.* Academic Press, London, 153–64.

Browne, R. A. & Bowen, S. T. 1991. Taxonomy and population genetics of *Artemia*. *In*: Brown, R. A., Sorgeloos, P., Trotan, C. N. A., eds. *Artemia Biology*. CRC Press, Florida, 221–235.

Browne, R. A. & MacDonald, G. H. 1982. Biogeography of the brine shrimp, *Artemia*: distribution of parthenogenetic and sexual populations. *Journal of Biogeography*, 9, 331–338. http://doi.org/10.2307/2844719

Clark, L. S. & Bowen, S. T. 1976. The genetics of *Artemia salina*: VII. Reproductive isolation. Journal of Heredity, 67, 385–388. http://doi.org/10.1093/oxfordjournals.jhered.a108758

Collins, N. C. 1977. Ecological studies of terminal lakes-their relevance to problems in limnology and population biology. *In*: Greer, D. C., ed. *Desertic Terminal Lakes*. Utah Water Resources Laboratory, Utah, 411–420.

Curzon, G. N. 1892. *Persia and the Persian Question (Vol. 1)*. Longmans, Green & Company, London.

Daneshgar, M. 1975. *The study of Urmia Lake water in Sharaf Khaneh region*. D.M.S. Thesis, University of Tabriz.

Daneshi, A., Najafinejad, A., Maghsoudi, F. & Panahi, M. 2017. Estimating the protection values of Ardebil's Shorabil Lake using contingent valuation method (CVM). *Iranian Journal of Agricultural Economics*, 11, 135–155.

De los Ríos, P. D. & Asem, A. 2008. Comparison of the diameter of the frontal knobs in *Artemia urmiana* Günther, 1899 (Anostraca). *Crustaceana,* 81, 1281–1288.

de Morgan, J. J. M. 1894. Mission Scientifique en Perse. E. Leroux, Paris.

Eimanifar, A., Asem, A., Djamali, M. & Wink, M. 2016. A note on the biogeographical origin of the brine shrimp *Artemia urmiana* Günther, 1899 from Urmia Lake, Iran. *Zootaxa*, 4097 (2), 294–300. http://doi.org/10.11646/zootaxa.4097.2.12

Eimanifar, A., Asem, A., Wang, P., Li, W. & Wink, M. 2020. Using ISSR genomic fingerprinting to study the genetic differentiation of *Artemia* Leach, 1819 (Crustacea: Anostraca) from Iran and neighbor regions with the focus on the invasive American *Artemia franciscana*. *Diversity*, 12, 132. http://doi.org/10.3390/d12040132

Eimanifar, A. & Mohebbi, F. 2007. Urmia Lake (Northwest Iran): a brief review. *Saline Systems*, 3, 5. http://doi.org/10.1186/1746-1448-3-5

Eimanifar, A., Rezvani, S. & Carapetian, J. 2006 a. Genetic differentiation of *Artemia urmiana* from various ecological populations of Urmia Lake assessed by PCR amplified RFLP analysis. *Journal of Experimental Marine Biology and Ecology*, 333, 275–285. http://doi.org/10.1016/j.jembe.2006.01.002

Eimanifar, A., Rezvani, S. & Carapetian, J. 2006 b. Application of RFLP analysis to identify cyst populations of *Artemia urmiana* Günther, 1899 (Branchiopoda, Anostraca) from Urmia Lake, Iran. *Crustaceana,* 78, 1311–1323.

Eimanifar, A., Rezvani, S. & Dehnad, A. 2007. Molecular population study on *Artemia urmiana* and parthenogenetic *Artemia* from the around Urmia Lake shown by RAPD markers. *The 5th National Biotechnology Congress of Iran, 22–25 November 2007, Tehran: Iran.*

Eimanifar, A., Van Stappen, G., Marden, B. & Wink M. 2014. *Artemia* biodiversity in Asia with the focus on the phylogeography of the introduced American species *Artemia franciscana* Kellogg, 1906. *Molecular Phylogenetics and Evolution*, 79, 392–403. http://doi.org/10.1016/j.ympev.2014.06.027

Eimanifar, A. & Wink, M. 2013. Fine-scale population genetic structure in *Artemia urmiana* (Günther, 1890) based on mtDNA sequences and ISSR genomic fingerprinting. *Organisms Diversity & Evolution*, 13, 531–543. http://doi.org/10.1007/s13127-013-0135-5

Eskandari, A. 2001. *Chromosomal study and karyotype on Artemia urmiana taxonomy*. D.V.M Thesis, Islamic Azad University.

Estakhri, A. 930–933. Library of Iran Parliament, Al-Masalik wa Al-Mamalik. Tehran.

Etemad-Alsaltane, M. 1877. Library of Iran Parliament, Merat Al-Boldan. Tehran.

Falahatkar, B & Rafatnezhad, S. 2015. Effects of different levels of vitamin C on hatching efficiency and survival of Maharloo Lake *Artemia* nauplii (*Artemia parthenogenetica*) at different temperatures. *Journal of Marine Science and Technology*, 14, 64–70.

Fayazi, G. R. 1994. *Introducing of Artemia in Hormozgan Province to produce biomass*. M.Sc. Thesis, Tehran University.

Forootan, E. & Alikhah-Asl, M. 2019. Investigation of environmental changes around Hoze Soltan Lake using meteorological data and remote sensing techniques. *Journal of Environmental Science and Technology*, 21, 71–80.

Frankham, R., Briscoe, D. A. & Ballou, J. D. 2002. Introduction to conservation genetics. Cambridge University Press Cambridge, UK, 1–617

Gafurifard, M. R., Mortazavi, R. & Pirsamadi, H. 1977. Study on therapeutic use of Shorabil Lake-Ardabil. *Journal of Engineering Department*, 36, 124–135.

Gajardo, G., Abatzopoulos, T. J., Kappas, I. & Beardmore, J. A. 2002. Evolution and speciation. *In*: Abatzopoulos, T. J., Beardmore, J. A., Clegg, J. S., Sorgeloos, P., eds. *Artemia Basic and Applied Biology.* Kluwer Academic Publishers, Dordrecht, 225–250.

Gajardo, G. & Beardmore, J. A. 2012. The brine shrimp *Artemia*: adapted to critical life conditions. *Frontiers in Physiology*, 3, 185. http://doi.org/10.3389/fphys.2012.00185

Ghassemzadeh, F., Matinfar, A., Shahla, J. & Zareei, A. R. 2005. Study on *Artemia* sp. production in Gonabad salt-waters, Kavir-e-Namak basin, Eastern Iran. *Iranian Scientific Fisheries Journal*, 14, 99–118.

Gholami, A., Ejtehadi, H. & Ghassemzadeh, F. 2005. Species Diversity and ecological status of phytoplankton in the Bazangan Lake. *Iranian Scientific Fisheries Journal*, 14, 73–90.

Golabian, H. 2011 Urumia Lake: Hydro-Ecological Stabilization and Permanence. *In*: Badescu, V., Cathcart, R. B., eds. *Macro-engineering Seawater in Unique Environments*. Springer-Verlag, Berlin, 365–397.

Goldschmidt, E. 1952. Fluctuation in chromosome number in *Artemia salina*. *Journal of Morphology*, 91, 111–131. http://doi.org/10.1002/jmor.1050910106

Goodarzi, E., Ziaei, M. & Hosseinipour, E. Z. 2014. Reservoir Optimization and simulation modeling: A case study. *In*: Goodarzi, E., Ziaei, M., Hosseinipour, E. Z. eds. *Introduction to Optimization Analysis in Hydrosystem Engineering*. Springer, Switzerland, 195–215.

Günther, A. 1898 a. The medusa of Lake Urumiah. *Nature*, 58, 319. http://doi.org/10.1038/058319d0

Günther, R. T. 1898 b. The jelly-fish of Lake Urumiah. *Nature*, 58, 345. http://doi.org/http://doi.org/10.1038/048294c0

Günther, R. T. 1899 a. Contributions to the geography of Lake Urmi and its neighbourhood. *Geographical Journal*, 14, 504–523. http://doi.org/10.2307/1774539

Günther, R. T. 1899 b. Contributions to the Natural History of Lake Urmi, N.W-Persia, and its Neighbourhood. *Zoological Journal of the Linnean Society*, 27, 414–416. http://doi.org/10.1111/j.1096-3642.1899.tb00414.x

Günther, R. T. & Manley J. J. 1899. On the Waters of the Salt Lake of Urmi. *Proceedings of the Royal Society of London*, 65, 312–318. http://doi.org/10.1098/rspl.1899.0040

Hafezieh, M. 2003 a. *Artemia, Brine Shrimp*. Iranian Fisheries Science Research Institute Press, Tehran.

Hafezieh, M. 2003 b. Some biological aspects and biomass estimation of *Artemia* in Maharloo Lake. *Iranian scientific Fisheries Journal*, 11, 11–28.

Hafezieh, M. 2016. *Evaluation of Artemia Stock in Urmia Lake*. Iranian Fisheries Science Research Institute Press, Tehran.

Hafezieh, M., Nekoueifard A., Mohebbi F., Seidgar M., Cheraghi D., Khezri M. R. & Akbari H. 2021. Evaluation of *Artemia* stocks in Meighan Salt Wetland of Arak. *Iranian Scientific Fisheries Journal*, 30, 175–185.

Hafezieh, M., Sharifian, M. & Hosseinpour, H. 2015. Cysts and nauplius biometrical comparison of Iranian *Artemia*. *Journal of Aquaculture Development*, 9, 11–24.

Hajirostamloo, M. 2019. Investigating the coexistence of *Artemia* and fairy shrimp in the northwest of Iran West and East Azarbaijan. *4th International Congress of Developing Agriculture, 13–15 February 2019, Tabriz: Iran*.

Hajirostamloo, M. & Pourrabbi, R. 2011. Genetic differentiation of *Artemia franciscana* in a New Environment (Iran). *World Journal of Zoology*, 6, 16–21.

Hajirostamloo, M., Rezvani-Gilkolaei, S., Fatemi, M. R., Sadeghizadeh, M. & Kazempour-Osalou, S. 2008 a. Phylogenic study of the bisexual species of *Artemia* in Iran assessed by RFLP analysis of mtDNA. *Iranian Journal of Biology*, 21, 194–205.

Hajirostamloo, M., Rezvani-Gilkolaei, S., Fatemi, M. R., Sadeghizadeh, M. & Laloei, F. 2008 b. Molecular study of the populations of *Artemia parthenogenetica* in Iran using PCR-RFLP method. *Iranian Scientific Fisheries Journal*, 16, 53–67.

Hakupian, E. 1990. Urmia Lake. Nima publisher, Tabriz.

Hami-Tabari, A. 2011. *Identification and Study of Distribution of Local Artemia Population in the Golestan Province; Study on Possible Artificial Propagation and Cultivation*. Iranian Fisheries Science Research Institute Press, Tehran.

Hami-Tabari, A., Shabani, A., Ghadirnejad, H., Shabanpour, B. & Shirangi, S. A. 2013 a. Investigation and determination of population structure of parthenogenetic *Artemia* (Bowen and Sterling, 1978) in the Inche Lake using PCR-RFLP. *Iranian Journal of Biology*, 26, 119–127.

Hami-Tabari, A., Yelghi, S., Porsufi, T., Piri H., Makhdoumi, N. M. & Shirangi, S. A. 2013 b. Experimental investigation of the fecundity and survival rate of *Artemia parthenogenetica* in the Incheh lake in Golestan Province. *New Technologies in Aquaculture Development*, 7, 113–118.

Hesami, H., Zarkami, R. & Agh, N. 2018. Habitat suitability of *Artemia parthenogenetica* in Meighan wetland (Markazi Province) using multivariate analysis. *Animal Researches*, 30, 413–427.

Hontoria, F., Redón, S., Maccari, M., Varó, I., Navarro, J. C., Ballell, L. & Amat, F. 2012. A revision of *Artemia* biodiversity in Macaronesia. *Aquatic Biosystems*, 8, 25. http://doi.org/10.1186/2046-9063-8-25

Horváth, Z., Lejeusne, C., Amat, F., Sánchez-Fontenla, J., Vad, C. F. & Green, A. J. 2018. Eastern spread of the invasive *Artemia franciscana* in the Mediterranean Basin, with the first record from the Balkan Peninsula. *Hydrobiologia*, *822*, 229–235. http://doi.org/10.1007/s10750-018-3683-z

Hoseini, L. & Zare, S. 2012. Molecular Adaptation of *Artemia franciscana*, Kellog 1906, after 10 Years Existence in the New Environment (Maharlu Lake, Fars Province). *Journal of Biotechnology*, 3 (1), 23–35.

Hoveida, R. 1976. *Azerbaijan Natural Geography*. Tabriz University Press, Tabriz, Iran.

IRIB. 2019. Culture *Artemia* in the Khur and Biabanak County. https://www.iribnews.ir/00A9eu (10 April 2024, date last accessed).
IRIB. 2021 a. *Artemia* culture and production in Maranjab (Aran va Bidgol Region) https://www.iribnews.ir/00DDdT (10 April 2024, date last accessed).
IRIB. 2021 b. Culture brine shrimp in desert. https://www.iribnews.ir/00DZvr (10 April 2024, date last accessed).
IUCN. 2012. Guidelines for Application of IUCN Red List Criteria at Regional and National Levels: Version 4.0. Gland: IUCN Species Survival Commission.
IWCSP (Inland Water Crustacean Specialist Group). 1996. *Artemia monica*. The IUCN Red List of Threatened Species. e.T2117A9254479. http://dx.doi.org/10.2305/IUCN.UK.1996.RLTS.T2117A9254479.en
Jaberalansar, Z., Feizi, M. T. & Bahreinninejad, B. 2021. Investigation of vegetation changes using soil moisture index in Gavkhouni wetland. *Journal of Wetland Ecobiology*, 12, 43–56.
Jafari, A. & Vatandoost, S. 2005. Geographical Distribution of *Artemia*. *6th Iranian Congress of Marine Science and Technology, 22 December 2005, Tehran: Iran.*
Jafari, M. & Astani, S. 2011. Studying and investigating the different usages of *Artemia* and its distribution in the country. *The first national conference on economic resolutions in the field of Agriculture and Natural Resources, 15 December 2011, Qom: Iran.*
Javanshir, A. 1986. *Study on Artemia salina from Urmia Lake*. B.Sc. Thesis, Tehran University.
Kargarnejad, E. 1986. *The study of Urmia Lake Water in Rahmanlu region*. D.M.S. Thesis, University of Tabriz.
Karimi, N., Bagheri, M. H., Hooshyaripor, F., Farokhnia, A. & Sheshangosht, S. 2016. Deriving and Evaluating Bathymetry Maps and Stage Curves for Shallow Lakes Using Remote Sensing Data. Water *Resources Management*, 30, 5003–5020. http://doi.org/10.1007/s11269-016-1465-9
Karimian Torghabeh, A. Afzali, SF, Jahandari, A., Mahmudy Gharaie, MH & Al-Khashman, O. A. 2021. Evaluation of trace elements concentration in surface sediments of Parishan International Wetland (Fars Province, SW Iran) by using geochemical and sedimentological analysis. *Toxin Reviews*, 40, 665–675. http://doi.org/10.1080/15569543.2020.1737825
Keramati, E., Armoun, F. & Khatami, S. Y. 2016. Beauty at the edge of the development the encounterment of Ardabil City and the Shorabil Lake. *Manzar*, 37, 30–37.
Khalili, B. N., Emadi, H. & Negarestan, H. 2007. The effect of high salinity on the growth and survival of parthenogenetic *Artemia* surrounding lagoons Urma Lake and Qom Lake. *Journal of Environmental Science and Technology*, 9, 65–70.
Khangholi, E., Naderi, M., Hadipour, M. & Aalipoor-Ardi, M. 2018. An investigation on the water requirement of Mighan desert wetland. *Journal of Wetland Ecobiology*, 10, 91–102.
Khatibi, R. & Nadiri, A. A. 2021. Inclusive Multiple Models (IMM) for predicting groundwater levels and treating heterogeneity. *Geoscience Frontiers*, 12, 713–724. http://doi.org/10.1016/j.gsf.2020.07.011
Löffler, H. 1956. Limnologische beobachtungen an Iranischen binnengewässern. *Hydrobiologia*, 8, 239–278.
Löffler, H. 1959. Beitrage zur Kenntnis Der Iranischen Binnengewässer I Der Niriz-See und Sein Einzugsgebiet. *Internationale Revue der gesamten Hydrobiologie und Hydrographie*, 44, 227–276.
Löffler, H. 1961. Beiträge zur Kenntnis der Iranischen Binnengewässer II Regional-limnologische Studie mit besonderer Berücksichtigung der Crustaceenfauna. *Internationale Revue der gesamten Hydrobiologie und Hydrographie*, 46, 309–406.
Maccari, M., Amat, F. & Gómez, A. 2013. Origin and genetic diversity of diploid parthenogenetic *Artemia* in Eurasia. *PLoS One*, 8, e83348. http://doi.org/10.1371/journal.pone.0083348
Mace, G. M., Possingham, H. P. & Leader-Williams, N. 2006. Prioritizing choices in conservation. *In*: Macdonald, D., Service, K., eds. *Key Topics in Conservation Biology*. Blackwell Publishers, Oxford, 17–34.
Mahabadi, S., Bavani, A. M. & Bgheri, A. 2018. Improving adaptive capacity of social-ecological system of Tashk-Bakhtegan Lake basin to climate change effects — A methodology based on Post-Modern Portfolio Theory. *Ecohydrology & Hydrobiology*, 18, 365–378. http://doi.org/10.1016/j.ecohyd.2018.11.002
Makhdoumi, N. M. 1992. Survey on *Artemia* Distribution from Gonbad Region at Golestan Province. Fishery Company of Iran, Gorgan.
Makhdoumi, N. M. 2000. *Artemia* resources in salt water lakes in Gonbad area. *Iranian Scientific Fisheries Journal*, 9, 61–72.
Makhdoumi, N. M., Hosseini, S. A. & Sharifpour, E. A. 2002. Culture *Artemia* (Inche Lake strain) by feeding green and green-blue algae. *Iranian Scientific Fisheries Journal*, 11, 69–78.
Makhdoumi-Kakhki, A., Amoozegar, M. A., Kazem, B., Pašic, L. & Ventosa, A. 2012. Prokaryotic diversity in Aran-Bidgol Salt Lake, the largest hypersaline playa in Iran. *Microbes and Environment*, 27, 87–93. http://doi.org/10.1264/jsme2.ME11267
Manaffar, R., Taghavi, M., Farokhi, F. & Moosavi-Toomatari, G. 2015. Comparative study on some physiologic, biometrics, nutritional value and molecular characteristics of Mighan Lake's *Artemia* (Arak). *Iranian Scientific Fisheries Journal*, 24, 93–106.
Manaffar, R., Abdilzadeh, R., Akbarialmajough, T., Eskandari, A., Ebrahimi, S. & Saygi, Y. 2018. Population analysis of some of Turkish and Iranian parthenogenetic *Artemia* using biometric components. *Journal of Taxonomy and Biosistematics*, 35, 57–68.

Manaffar, R., Atashbar, B., Mahini, S., Hasani, A. & Agh N. 2004. Successful pond culture of *Artemia parthenogenetica* and *Artemia urmiana* at the vicinity of the Lake Urmia. *INCO-DEV project on Artemia Biodiversity, 21–25 September 2004, Urmia, Iran.*
Manaffar, R., Falahati, A., Moshtagiyan, A., Mosavi, S. M., Atashbar, B. & Asem, A. 2008. First report for existence of *Artemia franciscana* coexistence with endemic parthenogenetic *Artemia* population in inside of the Lake Maharlu, Iran. *World Aquaculture*, 19 –23 May 2008, Busan: Korea.
Manaffar, R., Zare, S., Agh, N., Abdolahzadeh, N., Soltanian, S., Sorgeloos, P., Bossier, P. & Van Stappen, G. 2011. SNP detection in Na/K ATP-ase gene a1 subunit of bisexual and parthenogenetic *Artemia* strains by RFLP screening. *Molecular Ecology Resources*, 11, 211–214. http://doi.org/10.1111/j.1755-0998.2010.02908.x
Maniatsi, S., Baxevanis, A.D., Kappas, I., Deligiannidis, P., Triantafyllidis, A., Papakostas, S., Bougiouklis, D. & Abatzopoulos, T. J. 2011. Is polyploidy a persevering accident or an adaptive evolutionary pattern? The case of the brine shrimp *Artemia*. *Molecular Phylogenetics and Evolution*, 58, 353–364. http://doi.org/10.1016/j.ympev.2010.11.029
McCarraher, D. B. 1972. *A Preliminary Bibliography and Lake Index of the Inland Mineral Waters of the World*. Roma: FAO Fisheries Circular.
Melikian, H. 1940. *Pharmaceutical Value of Urmia Lake Salt and Mud*. Berlin University, Berlin.
Mirzaei, A. & Zibaei, M. 2019. Estimating the economic benefits of Jazmourian Wetland restoration and preservation programs. *Journal of Agricultural Economics Research*, 11, 53–79.
Mirzakani, B., Asgari, A. & Ebrahimi, O. 2017. Geomorphologic elevations of Namak Lake after the last glacier courses. *Journal of Geographical Sciences*, 26, 123–138.
MNA. 2014. The occurrence of endangered aquatic in Lut Desert. www.mehrnews.com/xpW6j (10 April 2024, date last accessed).
Mohaghegh, M. R. 2014. Using of saline surface water and agricultural waste water for aquaculture. *The First National Conference on Water Crises and Challenges in the Salt Lake Basin papers, 10 June 2014, Qom: Iran.*
Mohaghegh, M. R. & Mohamadpor, A. 2004. Recognition of natural habitats of *Artemia* in Namak Lake basin in Iran (Qom region). *INCO-DEV project on Artemia Biodiversity, 21–25 September 2004, Urmia: Iran.*
Mohammad-Piri, S. M. & Tehrani, M. R. 1997. First report on observation and identification of *Artemia* in Sistan. *Scientific Journal of Padjuhesh va Sazandegi*, 8, 47–49.
Mohammadyari, A., Ghassemzadeh, F., Molavi, F., Mohammadzadeh, M. & Fooladi, A. 2015. First report of the brine shrimp *Artemia* (Branchiopoda: Anostraca) from Bazangan Lake, Iran. *Iranian Journal of Animal Biosystematics*, 11, 183–186.
Mohammadyari, A., Rahimian, H. & Agh, N. 2001. Biometry of cyst and nauplii of *Artemia* strains from different geographical origin of Iran. *International Workshop on Artemia, 12–15 May 2001, Urmia: Iran.*
Mohebbi, F., Dadashpour, B., Seidgar, M., Alizadeh Osalou, Z. & Rouhdad Golmankhaneh, Y. 2022. The effect of Urmia Lake water withdrawal on *Artemia urmiana* population structure. *Journal of Animal Environment,* 13, 329–336. http://doi.org/10.22034/AEJ.2020.252122.2373
Mohebbi, F., Seidgar, M., Hafezieh, M., Dadashpour, B.A., Alizadeh & Osaloo, Z. 2023 a. A review on the *Artemia* stocks in Lake Urmia (1277-1400). *Iranian Scientific Fisheries Journal*, 31, 95–110.
Mohebbi, F., Seidgar, M., Dadashpour, B. A. & Alizadeh, Z. 2023 b. The effect of severe drought on the disappearance of the brine shrimp *Artemia* from Urmia Lake. *Environmental Resources Research*, 11, 295–308. http://doi.org/10.22069/ijerr.2024.21754.1413
MOI 2021. http://moi.ir/ (10 April 2024, date last accessed).
Mostofi, A. 1971. *Geographical Reports, Masile-Basin*. Tehran University Press, Tehran.
Mura, G. & Azari Takami, G. A. 2000. Contribution to the knowledge of the anostracan fauna of Iran. *Hydrobiologia*, 441, 117–121. http://doi.org/10.1023/A:1017506506055
Nasri, M. R., Baserisalehi, M. & Kurd-Tabar, M. 2019. Characterization of Antimicrobial Metabolites Produced by Halophilic Actinomyces Isolated from Aran-Bidgol and Maharloo lakes. *Armaghan Danesh*, 24, 373–387.
Nekoueifard, A. 2015. *Study of Economic and Social Effects of Parthenogenetic Artemia (native Qom) Cultivation in the Eastern Edge of Qom Salt Lake*. Iranian Fisheries Science Research Institute Press, Tehran.
Nekoueifard, A., Hafezieh, M., Manaffar, R. & Khezri, M. 2023. New geographic site records for *Artemia* in Iran. *International Journal of Aquatic Research and Environmental Studies*, 3, 117–127.
Nekoueifard, A., Seyedgar, M., Ghanji, S., Hafezieh, M., Mohebbi, F. & Abbaspour, A. 2020. Production of *Artemia urmiana* cyst and biomass in Fesandoz pools surrounding Urmia Lake. *2nd International Conference on Haloculture, 19 February 2020, Yazd: Iran.*
Nezami, S., Nazariha, M., Moridi, A. & Baghvand, A. 2013. Environmentally sound water resources management in catchment level using DPSIR model and scenario analysis. *International Journal of Environmental Research*, 7, 569–580. http://doi.org/10.22059/IJER.2013.637
Noori, F., 1995. *Study morphology, reproduction and life cycle of Artemia urmiana of Urmia Lake*. Urmia University.
Nougué, O., Flaven, E., Jabbour-Zahab, R., Rode, N. O., Dubois, M. & Lenormand, T. 2015. Characterization of nine new polymorphic microsatellite markers in *Artemia parthenogenetica*. *Biochemical Systematics and Ecology*, 58, 59–63. http://doi.org/10.1016/j.bse.2014.10.014

Pakzad, S., Keshtkar, A. R., Keshtkar, H., Atashi, H. & Afzali, A. 2021. Impact of lake surface changes on climate fluctuation within a lake–affected region. *Environmental Earth Sciences*, 80, 160. http://doi.org/10.1007/s12665-021-09425-9

Persoone, G. & Sorgeloos, P. 1980. General aspects of the ecology and biogeography of *Artemia*. *In*: Persoone, G., Sorgeloos, P., RoeIs, O., Jaspers, E., eds. *The Brine Shrimp Artemia, Vol. 3*. Universa Press, Wetteren, 3–24.

Pilla, E. J. S. & Beardmore, J.A. 1994. Genetic and morphometric differentiation in Old World bisexual species of *Artemia* (the brine shrimp). *Heredity*, 73, 47–56. http://doi.org/10.1038/hdy.1994.97

Pirsamadi, H. 1975. *Study on water and mud of Shorabil Lake-Ardabil*. D.M.S. Thesis, Tehran University.

Plattner, F. 1955. Der osmotische Druck von *Artemia salina*. *Pflügers Archiv*, 261, 172–182. http://doi.org/10.1007/BF00369788

Rahmatizadeh, A. & Jafari, M. 2014. Construction of Fifthin-Khordad and Ghadir dams and its effect on desertification trend of Masileh plain at Qom province. *Iranian Journal of Range and Desert Research*, 21, 494–506.

Rode, N.O., Jabbour-Zahab, R., Boyer, L., Flaven, É., Hontoria, F., Van Stappen, G. & Lenormand, T. 2022. The origin of asexual brine shrimps. *The American Naturalist*, 200, E52–E76. http://doi.org/10.1086/720268

Rogers, D. C. 2015. A conceptual model for anostracan biogeography. *Journal of Crustacean Biology*, 35, 686–99. http://doi.org/10.1163/1937240X-00002369

Saberi, A. 1978. *A survey on the physical, chemical, biological and pharmaceutical characteristics of Urmia Lake water and mud*. D.M.S. Thesis, Tehran University.

Sabkara, J. & Makaremi, M. 2011. Surveying the density and distribution of plankton and their role in Shorabil (Ardabil) Lake. *Journal of Biology Science*, 5, 31–46.

Safarpour, A., Amoozegar M. A. & Ventosa, A. 2018. Hypersaline Environments of Iran: Prokaryotic biodiversity and their potentials in microbial biotechnology. *In*: Egamberdieva, D., Birkeland, N. K., Panosyan, H., Li, W. J., eds. *Extremophiles in Eurasian Ecosystems: Ecology, Diversity, and Applications. Microorganisms for Sustainability, Vol. 8*. Springer, Singapore, 265–298.

Saji, A., Eimanifar, A., Soorae, P. S., Al Dhaheri, S., Li, W., Wang, P. & Asem, A. 2019. Phylogenetic analysis of exotic invasive species of Brine Shrimp *Artemia* Leach, 1819 (Branchiopoda, Anostraca) in Al Wathba Wetland Reserve (UAE; Abu Dhabi). *Crustaceana*, 92, 495–503. http://dx.doi.org/10.1163/15685403-00003884

Saleem, C.M., Asem, A. & Sun, S. C. 2019. Morphological abnormality in *Artemia* Leach, 1819 (Crustacea: Anostraca): a specimen with three compound eyes. *Acta Zoologica Bulgarica*, 71, 143–144.

Samiei, M., Ghazavi, R., Pakparvar, M. & Vali, A. A. 2017. The effect of climate change on Maharlo Lake level change using satellite image processing. *RS & GIS for Natural Resources*, 8, 1–18.

Sánchez, M. I., Paredes, I., Lebouvier, M. & Green, A. J. 2016. Functional role of native and invasive filter-feeders, and the effect of parasites: learning from hypersaline ecosystems. *PloS One*, 11, e0161478. http://doi.org/10.1371/journal.pone.0161478

Scalone, R. & Rabet, N. 2013. Presence of *Artemia franciscana* (Branchiopoda, Anostraca) in France: morphological, genetic, and biometric evidence. *Aquatic Invasions*, 8, 67–76. http://dx.doi.org/10.3391/ai.2013.8.1.08

Schulz, S., Darehshouri, S., Hassanzadeh, E., Tajrishy, M. & Schüth, C. 2020. Climate change or irrigated agriculture – what drives the water level decline of Lake Urmia. *Scientific Report*, 10, 236. http://doi.org/10.1038/s41598-019-57150-y

Sclater, P. L. 1893. The jelly-fish of Lake Urumiah. *Nature*, 48, 294. http://doi.org/10.1038/048294c0

Sedghi, M., Saba, F., Noroozi, M., Amoozegar, M. A. & Shahzadeh Fazeli, S. A. 2016. Isolation, morphological and molecular identification of *Dunaliella* species in Hoz-e Soltan and Aran-va-Bidgol Salt lakes (Iran). *Rostaniha*, 17, 70–77. http://doi.org/10.22092/botany.2016.107004

Shadrin, N., Anufriieva, E. & Gajardo, G. 2023. Ecosystems of inland saline waters in the world of change. *Water*, 15, 52. http://doi.org/10.3390/w15010052

Shafaie, S., Zare, S., Manaffar, R. & Falahati, A. 2012 b. The First Report for the invasion of *Artemia franciscana* Kellogg 1906in Tashk and Bakhtegan Lakes, Iran. *Life Science Journal*, 9, 3020–3024.

Shafaie, S., Zare, S., Manaffar, R. & Falahati, A. 2012 a. Report for the Occurrence of *Artemia franciscana* Kellogg 1906 in Tashk Lake, Iran. *Journal of Natural Environment*, 65, 393–401.

Shafaroodi, M. 2009. Hoze-Soltan. *In*: Haddad-Adel, G., ed. *Encyclopedia of The Islamic World, Vol 14*. Encyclopedia Islamica Foundation Tehran, 454–456.

Shahnavaz, B. & Ghassemzade, F. 2015. Phylogenetic diversity of cultivable bacteria in Lake Bazangan and their ecological role. *Journal of Molecular and Cellular Research*, 28, 360–370.

Shen, C., Liu, C., Wu, X., Yao, L., Meng, X., Xia, L., Wang, P., Li, W., Eimanifar, A. & Asem, A. 2021. First record of the invasive American *Artemia franciscana* Kellogg, 1906 (Branchiopoda, Anostraca) at the South China Sea coast of China. *Crustaceana*, 94, 647–650. http://dx.doi.org/10.1163/15685403-bja10113

Sima, S., Rosenberg, D. E, Wurtsbaugh, W. A., Null, S. E. & Kettenring, K. M. 2021. Managing Lake Urmia, Iran for diverse restoration objectives: Moving beyond a uniform target lake level. *Journal of Hydrology: Regional Studies*, 35, 100812. http://doi.org/10.1016/j.ejrh.2021.100812

Soltanifar, Z., Hoseini, S. A. Ghorbani, R. & Mohaghegh, M. R. 2012. Comparison of morphological differentiation of *Artemia parthenogenetica* in three habitats of Qom Province. *First Conference on the Fisheries and Aquatic Animals in Iran. 12–13 December 2012, Bandar Abbas, Iran.*

Sorgeloos, P. 1980. The use of the brine shrimp *Artemia* in aquaculture. *In*: Persoone, G., Sorgeloos, P., Roels, O., Jaspers, E., eds. *The Brine Shrimp Artemia, Vol. 3.* Universa Press, Wetteren, 25–46.

Sorgeloos, P. 1997. *Lake Urmia cooperation project – contract item A, Report on the 'Resource assessment of Urmiah Lake Artemia cysts and biomass*. Ghent University, Ghent.

Stella, E. 1933. Phenotypical characteristics and geographical distribution of several biotypes of *Artemia salina* L. *Zeitschriftfur Induktive Abstammungs und Vererbungslehre*, 65, 412–446.

Triantaphyllidis, G. V., Abatzopoulos, T. J. & Sorgeloos, P., 1998. Review of the biogeography of the genus *Artemia* (Crustacea, Anostraca). *Journal of Biogeography*, 25, 213–226. http://doi.org/10.1046/j.1365-2699.1998.252190.x

Van Stappen, G. 2002. Zoogeography. *In*: Abatzopoulos, T. J., Beardmore, J. A., Clegg, J. S., Sorgeloos, P., eds. *Artemia Basic and Applied Biology*. Kluwer Academic Publishers, Dordrecht, 171–224.

Van Stappen, G., Fayazi, G. & Sorgeloos, P. 2001. International study on *Artemia* LXIII. Field study of the *Artemia urmiana* (Günther, 1890) population in Lake Urmiah, Iran. *Hydrobiologia*, 466, 133–143. http://doi.org/10.1007/978-94-017-2934-5_12

Vanhaecke, P., Tackaert, W. & Sorgeloos, P. 1987. The biogeography of *Artemia*: an updated review. *In*: Sorgeloos, P., Bengtson, D. A., Decleir, W., Jaspers, E., eds. *Artemia Research and its Applications, Vol. 1.* Universa Press, Wetteren, 129–155.

Wu, X., Shen, C., Fu, C., Yang, N., Wang, P., Eimanifar, A. & Asem, A. 2022. Cyst size variability in invasive American *Artemia franciscana* Kellogg, 1906 (Branchiopoda: Anostraca) in Asia: a commercial approach. *Crustaceana*, 94, 573–584. http://dx.doi.org/10.1101/2022.05.07.491002

Wurtsbaugh, W. A., Miller, C., Null, S. E., DeRose, R. J., Wilcock, P., Hahnenberger, M., Howe, F. & Moore, J. 2017. Decline of the world's saline lakes. *Nature Geoscience*, 10, 816–821. http://doi.org/10.1038/ngeo3052

Yar-Mohamadi, M., Pourkazemi, M. & Kamali, A. 2002. Cytogenetic study on *Artemia* from Urmiyah Lake. *Iranian Scientific Fisheries Journal*, 11, 85–100.

Zakariya-Qazwini, A. 1275. *Asar Al-Beldan wa Akhbar Al-Ebad*. The National Library of Iran, Tehran.

Zeynalpour, R., Mirhosseini, S. Z., Dalirsefat, S. B. & Zare, J. 2015. Genetic identification and classification of Iranian *Artemia* using microsatellite markers. *Agricultural Biotechnology Journal*, 7, 149–162.

Zheng, B., Sun, C. S. & Ma, L. 2004. The occurrence of an exotic bisexual *Artemia* species, *Artemia franciscana*, in two coastal salterns of Shandong Province, China. *Journal of Ocean University of China*, 3, 171–174. http://doi.org/10.1007/s11802-004-0030-y

Zheng, B. & Sun, S. C. 2013. Review of the biogeography of *Artemia* Leach, 1819 (Crustacea: Anostraca) in China. *International Journal of Artemia biology*, 3, 20–50.

Zsuga, K., Inelova, Z. & Boros, E. 2021. Zooplankton community structure in shallow saline steppe inland waters. *Water*, 13, 1164. http://doi.org/10.3390/w13091164

Received 12 April 2024
Accepted 01 August 2024