Iranian Journal of Animal Biosystematics (IJAB)
Vol.11, No.2, 183-186, 2015
ISSN: 1735-434X (print); 2423-4222 (online)

First report of the brine shrimp *Artemia* (Branchiopoda: Anostraca) from Bazangan Lake, Iran

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(Received: *13 September 2015*; Accepted: *15 December 2015*)

Artemia has been recorded in thalassohaline and athalassohaline saline habitats from all over the world (Persoone & Sorgeloos, 1980) and is widely used in aquaculture as a food source for crustaceans and fish (Leger et al., 1986). The occurrence of wild *Artemia* populations from 17 hypersaline environments such as saline lakes, lagoons and salty rivers, distributed over 12 provinces in Iran were previously reported (Abatzopoulos et al., 2006) We added parthenogenetic *Artemia* from Bazangan lake as 18th natural habitat in the country (Fig. 1). All Iranian *Artemia* populations are parthenogenetic except one bisexual population namely *Artemia urmiana* from Urmia Lake (Agh, 2006). The historical record of existence of *Artemia* dates back to 982, more than one thousand years ago, from Urmia Lake, by an unknown Iranian geographer (Asem, 2008).The parthenogenesis populations have been reported from Lagoons around Urmia Lake, Urmia and Fesendooz, West Azerbaijan province; Lagoons around Urmia Lake Dasht-E-Tabriz, East Azerbaijan province; Maharlu Lake Shiraz, Bakhtegan Lake Shiraz and Tashk Lake Shiraz, Fars province; Incheh Lake Gonbad and Shor Lake Gonbad, Golestan province; Varmal catchment Zabul, Sistan and Baluchestan province; Mighan Lake Arak, Central province; Qom Salt Lake Qom and Houze Sultan Lake Qom, Qom province; Gaav Khooni Lake Hasan Abad, Isfahan province; Kale Shoor Gonabad, Razavi Khorasan province; Kale Shoor Khorram Abad, Lorestan province; Nough Kerman, Kerman province; Shurabil Lake (extinct) Ardabil, Ardabil province; Kale Shoor Hashtgerd Karaj, Alborz province (Agh, 2006; Abatzopoulos et al., 2006). Several studies have been done about the geology, biology and ecology of Bazangan Lake (Adabi & Mohammadzadeh, 1998; Khoshbakht, 1998 & Gholami et al., 2007). Bazangan Lake is located at N 36°18.48', E 060°28.53' between Mashhad and Sarakhs in north east of Iran (Fig. 1). Its surface area is 690,000 m^2(69 hectare), altitude 860 m and maximum depth 12 m in high water years (Gholami et al., 2007; Behroozi Rad, 2007). Bazangan wetland is an important habitat for birds, especially as a nesting site for some native and migrating species (Behroozi Rad, 2007). *Artemia* is the major food source for these species. During a regularly annual sampling, the brine shrimp *Artemia* was observed for the first time in Bazangan Lake and some water characteristics were also recorded for environmental monitoring. Plankton net (100 μm mesh size) was towed through the water for sampling cyst and adult *Artemia* in November 2015. The presence or absences of males were carefully recorded with visual inspection in *Artemia* population. Physical and chemical water characteristics like temperature, TDS, *p*H and electrical conductivity were determined with HANNA HI 98129 Pocket multimeter-combo

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and total salinity with ATAGO salinometer. Adult animals were preserved in 96% Ethanol and harvested cysts were frozen in -20°C for future studies. In this annual monitoring on Bazangan wetland the following physico-chemical factors were recorded: total area: 300,000 m^2 (30 hectare), *p*H: 7.6, EC to >20 mS/cm, salinity 210 ppt, temperature 15°C.

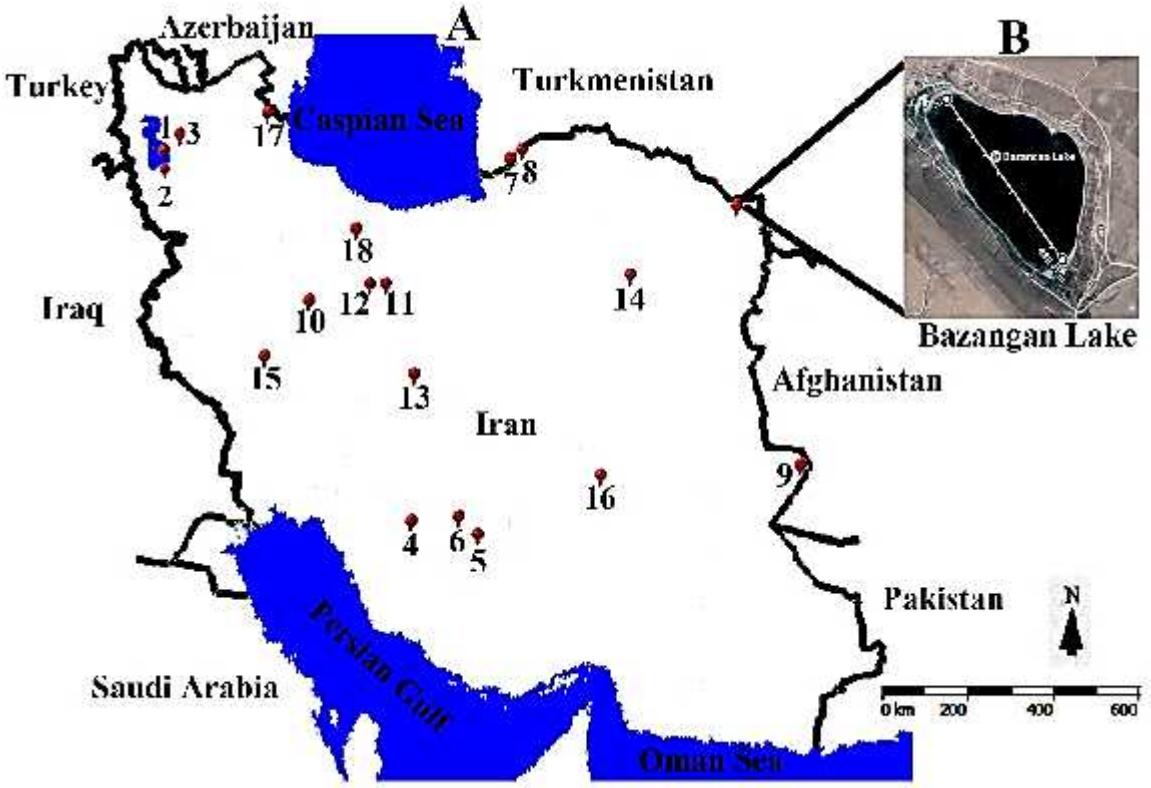

FIGURE 1. A. Distribution of *Artemia* in Iran. The Numbers indicate the *Artemia* Habitats. 1. Urmia Lake; 2. Lagoons West Azerbaijan; 3. Lagoons East Azerbaijan; 4. Maharlu Lake; 5. Bakhtegan Lake; 6. Tashk Lake; 7. Incheh Lake; 8. Shor Lake; 9. Varmal catchment; 10. Mighan Lake; 11. Qom Salt Lake; 12. Houze Sultan Lake; 13. Gaav Khooni Lake; 14. Kale Shoor-Gonabad; 15. Kale Shoor-Khorram Abad; 16. Nough catchment Kerman; 17. Shurabil Lake; 18. Kale Shoor Hashtgerd (Fig. from Agh 2006). B. Satellite view of Bazangan Lake.

FIGURE 2. A. Current status of Bazangan Lake B. Female *Artemia* of Bazangan Lake.

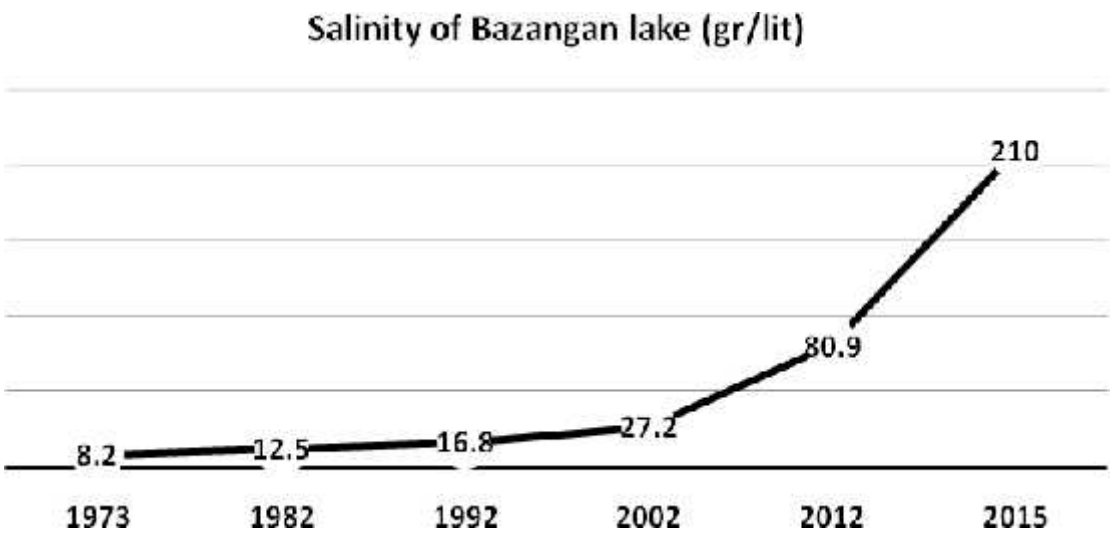

FIGURE 3. Salinity change in Bazangan Lake during four previous decades. All data recorded in spring except 2015 that recorded in November.

A parthenogenetic population of *Artemia* is reported in this study for the first time from the habitat. The density of *Artemia* population in the lake was high but male individuals were rarely observed. Parthenogenesis is common in Old World populations of *Artemia*, whereas in the New World, only sexual reproduction has been reported (Persoone & Sorgeloos, 1980). Since the ecological condition of Bazangan lake has been monitored by Ecology Research Laboratory annually since 1973 (unpublished data), we hypothesize that this parthenogenetic *Artemia* population was stablished in the lake in the recent years; because of its tolerance to high salinity. As shown in Figure 3, the salinity of Bazangan Lake has been increasing exponentially since the early 2000's.

During the recent year's climate has changed and severe drought has caused salinity increase in the aquatic ecosystems, which could affect a dramatic reduction of population sizes and species replacement in most of the natural habitats of the country. Wetland systems are vulnerable to changes in quantity and quality of their water supply. Therefore, successful long term restoration and management of these systems will depend on how we choose to respond to the effects of climate change and choose priorities for restoration and research (Erwin, 2009). Bazangan Lake was a hyposaline water catchment that currently has changed to a hypersaline type. *Artemia* populations are good indicators for these sever change in the inland water. Mean depth of Bazangan Lake is less than one meter, causing huge changes in salinity and temperature across a year. Currently, this ecological and environmentally important lake is facing the danger of drying like many other hypersaline lakes in the country and all over the world; hence, an important mission for scientists, local and national officials to save it.

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