



Review of the biogeography of *Artemia* Leach, 1819 (Crustacea: Anostraca) in Chile

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Abstract

The *Artemia* genus in Chile is represented by two species: *A. franciscana* and *A. persimilis*. The first species inhabits the Andean saline lakes and coastal ponds in the north of Chile, and salt works in central Chile, whereas the second species inhabits two saline lakes in the southern most part of Chile. The present study consists of a short review about the biogeography and ecology of the genus *Artemia* in Chile. We found that the

Artemia populations in Chile inhabit a wide variety of habitats and exhibit genetic differentiation resulting in various different ecotypes. Many *Artemia* habitats are endangered by changes in the climate and by the actions of humans. The development of management practices for native *Artemia* populations would definitely benefit the conservation of this genus in Chile.

Key Words: *Artemia franciscana*, *A. persimilis*, saline lakes, Patagonia, conservation

Introduction

In Chile, the genus *Artemia* Leach, 1819, is currently represented by two species: *Artemia franciscana* (Kellog, 1906) and *A. persimilis* (Piccinelli & Prosdociami, 1968) (De los Ríos-Escalante & Salgado, 2012). The first studies regarding this genus in Chile, were conducted during the 1990's. The results of some of these studies suggest the existence of *A. persimilis* as an exclusive species of Chile (Gajardo *et al.*, 1995, De los Ríos & Zúñiga, 2000), nevertheless, during the late of 1990's, a population of *Artemia* was reported for the Amarga lagoon (51° S) located on the southernmost part of Chile. This population was later identified as *A. persimilis* (Gajardo *et al.*, 1998, 2004; De los Ríos & Zúñiga, 2000), and few years after this, a second population of *A. persimilis* was found in Tierra del Fuego Island (De los Ríos-Escalante, 2010). The aim of the present study is to provide a short update on the biogeography of *Artemia* in Chile.

Biogeography of *Artemia franciscana* in Chile

The species *A. franciscana* was the first species of the genus *Artemia* reported for Chile (Gajardo *et al.*, 1992, 1993, 1995); it was found in coastal ponds and Andean sulphated saline lakes called "salares" in the north of Chile and salt works in central Chile (Gajardo *et al.*, 2004; Table 1). The coastal ponds are located in upper tidal zone on the rocky coast of the north of Chile (Gajardo *et al.*, 2004; De los Ríos-Escalante & Salgado, 2012) and have a strong marine influence. The populations inhabiting these ponds have ovivaropus reproduction when the salinity increases (Zúñiga *et al.*, 1999). The population of *Artemia* found in sulphated Andean saline lakes reproduces ovoviviparously (this population does not produce cysts in its natural habitat), and have been reported to be significantly affected by an increase in salinity above than 150 g/L (Zúñiga *et al.*, 1999). Nevertheless it has been possible to obtain cysts, from individuals of this population, under laboratory conditions (Zúñiga & Wilson, 1996). Numerous ecological studies have

featured these populations mainly because of the importance of their habitats as feeding and nesting areas for aquatic birds that are important conservation targets. Some of these birds are the Chilean flamingo (*Phoenicopterus chilensis* Molina 1782), Andean flamingo (*Phoenicoparrus andinus* Phillipi, 1854) and Jame's flamingo (*Phoenicoparrus jamesi* Schlater, 1886) (De los Ríos-Escalante, 2010). Also a study on the halophilic copepod *Boeckella poopoensis*, that inhabits brine with salinities ranging from 5-90 g/L, has been conducted and the results suggest that this species does not coexist with *A. franciscana* in this location, probably in De los Cisnes lagoon (53°14' S; 73° 00' W; De los Ríos-Escalante & Gajardo, 2010) because it actively predate on *Artemia* nauplii (Hurlbert *et al.*, 1986). There is a limited number of studies performed on the central Chilean salt works in the literature. One of these studies was conducted at El Convento salt works (El Yali wetland system) and consists of a very basic study on the flora and fauna of this area, and it suggests that this wetland needs protection management because it is being negatively affected by anthropogenic factors (Fariña *et al.*, 2012).

Biogeography of *A. persimilis* in Chile

The species *A. persimilis* was reported first as being endemic for Argentina (Triantaphyllidis *et al.*, 1998), nevertheless during the last two decades it has also been recorded for southern Chile. The first population reported was found in Amarga lagoon in Torres del Paine National Park (Gajardo *et al.*, 1998), whereas the second species was reported for Cisnes lagoon in Tierra del Fuego island, close to Porvenir (the main town on the island) (De los Ríos-Escalante, 2010) and probably in a salt work in central Chile (Table 1). Both of these saline lakes are feeding areas for Chilean flamingo (Campos *et al.*, 1996) and for black necked and coscoroba swans (Gibbons *et al.*, 2007) which are being actively managed for their conservation (Victoriano *et al.*, 2006).

Interestingly enough the seasonal coexistence between *B. poopoensis* with *A. persimilis* was

reported for Southern Chilean saline lakes, that is a markedly opposite scenario in comparison to the situation for northern saline lakes where *B. poapoensis* does not coexist with *A. franciscana* (De los Ríos-Escalante & Gajardo, 2010). Nevertheless,

additional studies are required in order to better understand the ecology and interactions of the Chilean *A. persimilis* populations with other species of animals.

Tab. 1: List and geographical location of *Artemia* populations in Chile

| Locality | Specie | Geographical localization | Ref. |
|--------------------------------------|-----------------------|---------------------------|------|
| Salar de Surire | <i>A. franciscana</i> | 18°48' S; 69°04' W | 1 |
| Salar de Llamara | <i>A. franciscana</i> | 21°18' S; 69°37' W | 1 |
| Plata Yape (Iquique) pools | <i>A. franciscana</i> | 20°40' S; 70°15' W | 2 |
| Salar de Atacama: Cejas Lagoon | <i>A. franciscana</i> | 23°02' S; 68°13' W | 1 |
| Salar de Atacama: Tebenquiche Lagoon | <i>A. franciscana</i> | 23°07' S; 68°16' W | 1 |
| La Rinconada lagoon | <i>A. franciscana</i> | 23°26' S; 70°30' W | 3 |
| Pampilla Pools | <i>A. franciscana</i> | 29°58' S; 71°22' W | 1 |
| Palo Colorado (Los Vilos) Pools | <i>A. franciscana</i> | 31°58' S; 71°35' W | 2 |
| El Convento salt work | <i>A. franciscana</i> | 33°52' S; 71°48' W | 3 |
| Pichilemu salt work | <i>A. persimilis</i> | 34°48' S; 72°10' W | 2 |
| Amarga lagoon (Torres del Paine) | <i>A. persimilis</i> | 50°29' S; 72°45' W | 2 |
| De los Cisnes lagoon | <i>A. persimilis</i> | 53°14' S; 70°00' W | 3 |

Ref.: 1. Zúñiga *et al.* (1999); 2. Gajardo *et al.* (1998); 3. De los Ríos-Escalante & Salgado (2012)

Conservation management of Chilean *Artemia* populations

The inland hypersaline waters of Northern Chile are susceptible to climate changes that could alter hydrological patterns. These areas are also being affected by human intervention (e.g. water extraction for domestic and industrial use) (Keller & Soto, 1998) that could result in the drying-up of *Artemia* habitats (Zúñiga *et al.*, 1999). The Magallanes region, where two *A. persimilis* populations are currently found, has been affected by climate changes. De los Ríos *et al.* (1998) found dramatic changes in aquatic ecosystems, mainly wetlands drying. This situation could result in lower salinities in the ponds and displacement of *Artemia* by copepods in this system (De los Ríos, personal observations, May 2007).

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