



FIRST DESCRIPTIONS OF AQUATIC CRUSTACEANS IN COASTAL PLAINS IN NORTHERN CHILE (HUELTELAUQUEN, 31°S, COQUIMBO REGION, CHILE)

BY

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ABSTRACT

The crustacean communities in Chilean seasonal pools have been poorly studied, and much of the existing literature is restricted to southern Patagonian plains, whereas there are no studies available about other sites. The aim of the present study is to describe the aquatic crustaceans in shallow pools in Huentelauquén (31°S, central northern Chile). The species reported upon include *Daphnia ambigua*, *Simocephalus serrulatus*, *Boeckella gracilipes*, Ostracoda, and two unidentified clam shrimps (genera *Lynceus* and *Leptestheria*), which latter ones represent the first record of these taxa for Chile. The ecological results revealed low species numbers and non-structured patterns in the various species associations. The exposed results are markedly different from observations on other Chilean seasonal pools, where no clam shrimps can be found, and where primarily cladocerans, copepods, and amphipods occur in the crustacean communities.

RESUMEN

Las comunidades de crustáceos en las pozas estacionales chilenas están poco estudiadas, y gran parte de la literatura está restringida para las planicies del sur de la Patagonia, pero no existen estudios sobre otros sitios. El objetivo del presente estudio es describir los crustáceos acuáticos en pozas poco profundas en Huentelauquén (31°S, centro norte de Chile). Los informes de especies incluyen *Daphnia ambigua*, *Simocephalus serrulatus*, *Boeckella gracilipes*, Ostracoda y dos camarones de

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almeja indeterminada (*Lynceus* y *Leptestheria*) siendo el primer registro de este taxón para Chile. Los resultados revelaron un bajo número de especies y un patrón no estructurado en las asociaciones de especies. Los resultados expuestos son marcadamente diferentes a las observaciones de otras pozas estacionales chilenas, donde no es posible encontrar camarones almeja y es posible encontrar copépodos, cladóceros y anfípodos.

INTRODUCTION

The crustacean zooplankton in Chilean seasonal pools has been poorly studied, and the main reports published are restricted to Patagonian plains between 46 and 53°S (De los Ríos-Escalante, 2010, 2017; De los Ríos-Escalante & Mansilla, 2014; De los Ríos-Escalante et al., in press), the Araucania region in the Andes Mountains (De los Ríos & Roa, 2010), and coastal dunes (De los Ríos-Escalante et al., 2015; De los Ríos-Escalante & Acevedo, 2016). Those studies revealed the presence of relatively moderate species numbers that include mainly cladocerans, copepods, and amphipods (De los Ríos-Escalante & Mansilla, 2014; De los Ríos et al., 2018), and that sometimes can also include scarce individuals of anostracans (De los Ríos-Escalante, 2010, 2017).

There are not enough studies about seasonal pools in other Chilean regions, and one of these as yet understudied sites are the Huentelauquén plains, in the central northern part of Chile (31°S). The coastal plains of Huentelauquén are located in a transition zone between steppe forest and shrub steppes (Gajardo, 1993; Zuleta et al., in press), with vegetation consisting of species such as *Echinopsis skottsbergii* (Backeb. ex Skottsb.), *Heliotropium stenophyllum* Hook. & Arn., *Senna cumingii* (Hook. & Arn.) Irwin & Barneby, *Chuquiraga ulicina* (Hook. & Arn.), *Frankenia chilensis* Presl. ex Schult. & Schult., *Baccharis macraei* Hook. & Arn., *Bahia ambrosioides* Lag., *Haplopappus foliosus* D.C., *Margyricarpus pinnatus* (Lam.) Kuntze (cf. Zuleta & Piñones, 2015). The dry season lasts approximately nine months (Luebert & Plischoff, 2006). These ephemeral pools (Espejo et al., 2012) have abundant macrophyte populations of *Lepuropetalon spathulatum* Elliot (cf. Alvarez et al., 2012). However, there are no studies about the aquatic crustaceans of this site yet, and in this region in general there are only very few studies about inland water crustaceans (De los Ríos-Escalante, 2010; De los Ríos-Escalante et al., 2013).

The aim of the present study thus is to give a first characterization of the aquatic crustaceans in Huentelauquén seasonal pools, considering that this makes the first detailed species description of inland water crustaceans for the Coquimbo region in central northern Chile.

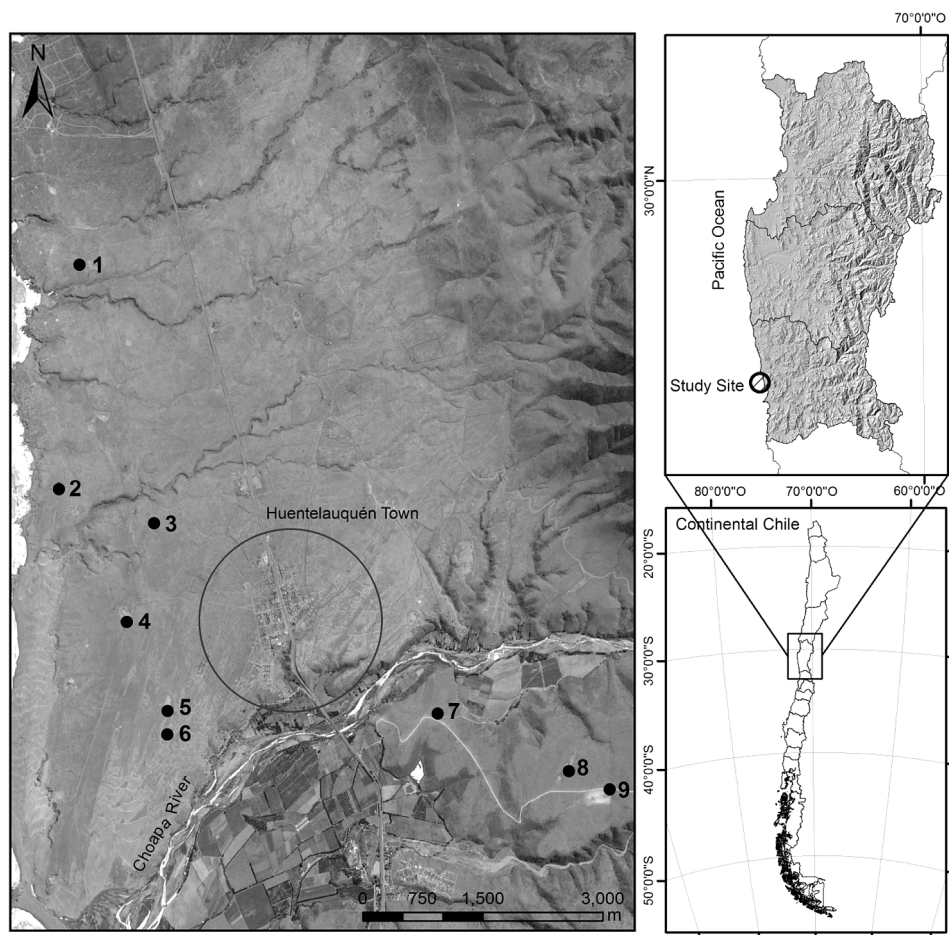


Fig. 1. Map of the studied sites in Huentelauquén (Coquimbo region, Chile); the black circles (1-9) indicate the ponds (sites) studied.

MATERIAL AND METHODS

The studied site was visited during 15-18 October 2015 and 06-08 January 2016 (fig. 1). A map with the sites was made using R software (R Development Core Team, 2009), and the R package Dismo (Hijmans et al., 2011). Zooplankton samples were collected using the protocols of Soto & De los Ríos (2006), based on filtering through 100 μm mesh a known water volume, after which the crustacean specimens were fixed with absolute ethanol, identified in the laboratory with the aid of relevant literature descriptions (Araya & Zúñiga, 1985; Bayly, 1992a, b), and finally quantified considering their relative and absolute abundances.

Exploratory multivariate data analysis.— Data analysis was invariably performed using the software “R” (R Development Core Team, 2009). This calculated

a Checkerboard score (“C-score”), which is a quantitative index of occurrence that measures the extent to which species co-occur less frequently than expected by chance (Gotelli, 2000). A community is structured by competition when the C-score is significantly larger than expected by chance (Gotelli, 2000; Tondoh, 2006; Gotelli & Entsminger, 2007; Tiho & Josens, 2007). It also compared co-occurrence patterns with null expectations via simulation: Gotelli & Ellison (2013) suggested, as the statistically most robust among the null models, to use the model “Fixed-Fixed”: in this model, the sums of both the rows and columns of the matrix are preserved. Thus, each random community contains the same number of species as the original community (fixed column), and each species occurs with the same frequency as in the original community (fixed row). The null model analyses were performed using the software R (R Development Core Team, 2009) and the package EcosimR version 7.0 (Gotelli & Ellison, 2013; Carvajal-Quintero et al., 2015).

As a second step, the data were ordered for applying the species richness estimations considering presence/absence data, using the indices Chao 1, Chao 2, Jackknife 1 and Jackknife 2, using the software R (R Development Core Team, 2009) and the R package Fossil (Vavrek, 2011) with the aim of understanding the properties of the community (Chao, 1984, 1987; Gotelli & Chao, 2013). Finally, as a third step an UPGMA analysis was applied using the R package Phangorn (Schliep, 2018) and the software R (R Development Core Team, 2009).

RESULTS AND DISCUSSION

The results revealed low species numbers, with the presence of *Daphnia ambigua* Scourfield, 1947 that appears at three sites, *Simocephalus serrulatus* (Koch, 1841) that appears at two sites, *Boeckella gracilipes* Daday, 1902 at one site, and Ostracoda at one site. The diplostracan *Lynceus* sp., was collected at eight sites, and one species of the genus *Leptestheria* was recorded at seven sites (table I). The results of null model species associations indicate that these communities are not structured (table II). The result of the Chao 2 index was 6.25, whereas Jack1 and Jack2 were 6.96 and 5.99, respectively, which indicates the presence of low species numbers. The results of UPGMA revealed that sites 3 and 6 are markedly close, and these are joined by site 1, and next by sites 2 and 9, in that order. That cluster then joins sites 7 and 8 plus site 5 at a lower level of similarity; and finally the most different was site 4 (see dendrogram in fig. 2).

This kind of crustacean community, with a marked presence of clam shrimps (*Lynceus* and *Leptestheria*) is different in comparison to other descriptions of crustacean assemblages for ephemeral pools that can have daphniids, calanoid copepods, and sometimes fairy shrimps (*Branchinecta*), such as found in central

TABLE I
Crustacean species reported for studied sites at Huentelauquén in the Coquimbo Region, Chile

	Pool 1	Pool 2	Pool 3	Pool 4	Pool 5	Pool 6	Pool 7	Pool 8	Pool 9
Location	31°35'52.2"S 31°35'52.2"S	31°35'52.2"S 31°34'00.0"S	31°34'00.0"S 31°34'39.9"S	31°35'44.5"S 31°35'44.5"S	31°35'25.8"S 31°35'19.9"S	31°35'19.9"S 31°35'44.5"S	31°35'44.5"S 31°35'52.2"S		
(latitude/longitude)	71°33'56.5"W 71°33'44.2"W	71°33'11.8"W 71°33'25.8"W	71°33'25.8"W 71°33'07.9"W	71°33'07.9"W 71°30'59.6"W	71°30'59.6"W 71°29'58.2"W	71°29'58.2"W 71°29'39.0"W			
Altitude (m a.s.l.)	18	27	48	43	40	43	71	158	157
Branchiopoda									
Cladocera									
<i>Daphnia ambigua</i>				X	X	X	X	X	
Scourfield, 1947									
<i>Simocephalus</i>									
<i>serrulatus</i>									
(Koch, 1841)									
Diplostraca						X	X	X	X
<i>Lyceus</i> sp.	X		X	X	X	X	X	X	
<i>Leptestheria</i> sp.	X	X	X	X					
Copepoda							X		
<i>Boeckella</i>						X		X	X
<i>gracilipes</i>									
Daday, 1902									
Ostracoda		X	X	X	X				

TABLE II
Results of null model analysis

Observed index	Mean index	Standard effect size	<i>P</i>
2.200	2.160	0.141	0.504 n.s.

and southern Patagonia at 45-53°S (De los Ríos-Escalante, 2010, 2017; De los Ríos et al., 2018), or in coastal lagoons in the Araucania region (De los Ríos & Carreño, in press). The present record would be the first mention of clam shrimps for Chilean inland waters, and more taxonomic studies would be necessary in order to confirm the correct taxonomic identification of the reported species, because there are no reports for this group in Chile available, yet (Soto, 1990; De los Ríos-Escalante & Kotov, 2015).

The presence of clam shrimps is described mainly for shallow temporary pools (Wang et al., 2017; Medeiros-Fonseca et al., 2018), where, due to their dispersion capacity by means of resting eggs, it is possible to find a metacommunity with dynamics that involve also other crustacean species (Timms, 2017). In this scenario, the reported results would probably indicate that clam shrimps would

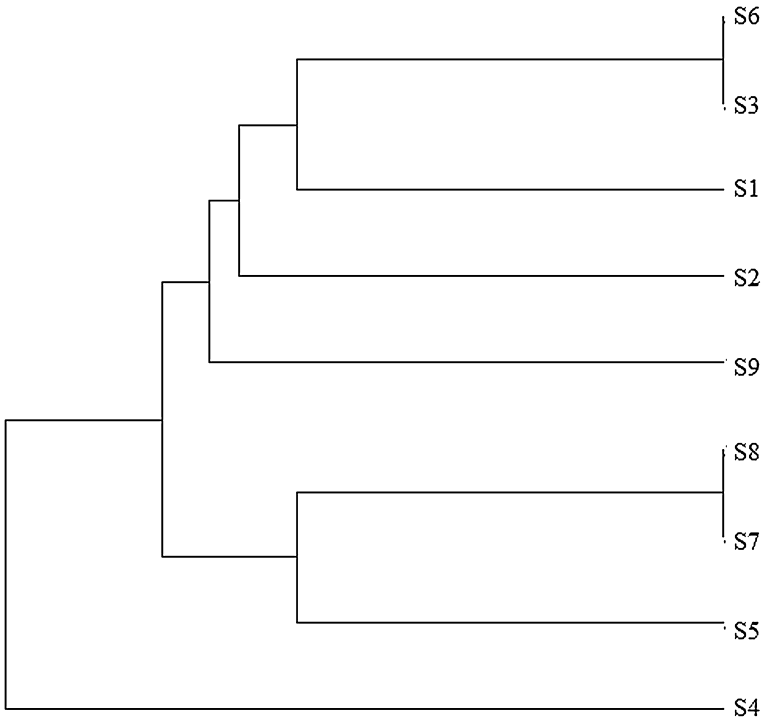


Fig. 2. Results of UPGMA analysis for the studied sites (S1-S9) in Huentelauquén (Coquimbo region, Chile). See text for further explanation.

have a key role in displacing grazers, such as daphniids or copepods, which yields a markedly different situation in comparison with the fairy shrimp, as that group is markedly scarce (De los Ríos-Escalante, 2017).

As a conclusion, the present study would indicate that it is necessary to do more studies on large branchiopods, mainly clam shrimps (Spinicaudata and Laevicaudata), because there are no studies about the species of these taxa potentially present in Chilean inland waters. Such a study would also contribute to understanding the community ecology of this distinctly other kind of shallow coastal pools, which presumably is markedly different in comparison to the southern Chilean shallow pools.

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