Title: The dwarf's houses in the forest of Central Chile

Before starting my field trip to Chile (my home country), I was thinking how to explains to my family the beauty of studying mosses in nature. One of my little nieces told me that these small plants were places where the dwarfs can live and get food from them. This is totally makes sense! These plants can create fascinating miniature landscapes that host multiple organisms.

Mosses, along with two other lineages (liverworts and hornworts), form a group called bryophytes, which represent early divergent lineages of plants that shared some ancestral structural and ecological characters. These plants, commonly called 'lower plants', are characterized by small size and a life cycle of alternating free-living haploid gametophyte and a single unbranched sporophyte. Because of their phylogenetic position in the tree of life they represent models for the evolutionary origin of fundamental plant characters (alternation of generations, multicellular organization, and high sensibility and dependence to the environment). In fact, ancestors of these living plants were able to live and colonize into the land for first time!!! (the reader can imagine the new traits that evolved to survive in a drying environment).

While much attention has been focused on studying vascular plants (sister to bryophytes where are the most economically important plant species) or 'higher plants' in most areas of science, bryophytes have been largely brushed aside. This is an especially glaring omission in view of the fact that the global diversity of these plants (around 25,000 known species) is higher than many other groups of vascular plants such as ferns (~10,500 known species) or gymnosperms (~1,000 known species). Although this diverse group of small plants occur in practically all terrestrial ecosystem in the world, commonly have been associated to tropical and temperate areas of the world where can be easily recognized. Though, it's known that Mediterranean-type ecosystems are areas of high levels of endemism. Over 20% of known vascular plants worldwide occur in Mediterranean-climate ecosystems, many of which are extremely rare and localized endemics. However, little or none is known about the diversity, abundance and what kind of niches bryophytes will occupy in a seasonal area like the Mediterranean ecosystem, characterized with dry and hot summers and wet and cold winters.

In this exploratory trip to Central Chile I met Juan Larrain, a postdoctoral researcher at the Universidad Católica de Valparaíso, who was willing to help me with his bryological expertise. For that reason, we spent several days in the fields trying to identify any bryophytes that showed up in Central Chile. We went to the coast range (Limache, Region de Valparaíso), the central valley (Rinconada de Maipú and Quebrada de Ramón, Region Metropolitana) and the Andes mountain (Altos de Lircay and Achibueno, Region del Maule) for making an initial survey of bryophytes in those locations. A great variation of native forest and/or plant communities we found in these locations. For instance, the coast ranges is usually dominated by a sclerophyllous forest, where Peumo (*Cryptocarya alba*), Litre (*Lithrea caustica*), Quillay (*Quillaja saponaria*), Canelo (*Drimys winteri*) and Boldo (*Peumus boldus*) are the main native species. Some pristine places of the coast are dominated by palm forest (*Jubaea chilensis*), an endemic

palm species. Going to the valley, open areas of grasses and scattered espino tree (Acacia caven) are more frequent. Toward the Andes mountain the elevation play a role in the distribution of plant communities. In the Region del Maule, the sclerophyllous forest appears again at low elevation, but it becomes mixed with a dense deciduous forest of a classic Nothofagus, which dominate the landscape up to 2,000 m. At high elevation, the tree vegetation is infrequent, but el Ciprés de la Cordillera (*Austrocedrus chilensis*) and low vegetation appear scattered in the land.

Interestingly, we found a huge diversity of mosses and liverworts on the soil, rocks or even on trees of the different forest types (they really are miniature forests in a bigger forest). In just a few days I collected around 20 species of mosses and liverworts associated to the Mediterranean area. It seems that the distribution of bryophytes also were associated to each forest-type since they provide different microenvironment for these small plants. Each forest has different rates of hydratation/dehydratation, duration of hydratation/dehydratation and intensity of hydratation, which are important ecological parameters that influence the distribution of bryophytes. For instance, we found several bryophytes that have ephemeral behavior. In other words, these plants are only alive for short period of time when favorable conditions are available (wet and cold wheather) and later they disappear when adverse conditions become more frequent (hot and dry weather). However, they become dormant using different strategies to survive next season. A seasonal environment, like we found in Central Chile, promotes these changes of habit types in some vascular plants too (i.e. deciduous trees).

It seems that some mosses and liverworts associated with open areas of spiny shrubs and small grasses have this type of habit in Central Chile. *Costesia macrocarpa* is an endemic moss that is only found on soil of open areas of the spiny and sclerophyllous forest in Central Chile. Other examples were associated to *C. macrocarpa are Riccia nigrella, Ephemerum serratum, Lorenziella imbricata, Sphaerocarpos stipitapos, Fossombronia sp., Acaulon sp.,* among others. Interestingly, these plants are characterized by small sizes (even smaller than a common moss), big spores, short sporophyte that's commonly enclosed by leaves. Are these traits adaptations for living in the Mediterranean climate? Do these traits evolved before or after the establishment of Mediterranean climate? Are only related species that exhibit such traits? These questions remain to be tested, but I hypothesized that there are some adaptations of these small plants as we found in other groups of plants in the Mediterranean ecosystem.

As I do usually at any project that involves fieldwork, all the collections need to be identified and incorporated into a herbarium. For that reason, the collections will be shipped to UC Berkeley between herbaria transactions (Universidad de Concepcion) for further identification.

Thanks to this grant, I realized the hidden forest of bryophytes inside the 'true' forest in the Mediterranean area of Central Chile. Although they occur in five scattered areas of the world (Mediterranean Basin, Southern Australia, South Africa, Central Chile, and California), these regions only cover 2% of the Earth's land surface and are highly vulnerable due to the increasing human impact. This project not only will help to inform

scientist and society to conserve the pristine forest of bryophytes in Central Chile, but also will encourage to people to carry their hand lenses to enjoy the beauty of a miniature forests.

Fig 1. An endemic palm forest (*Jubaea chilensis*) in the coast range of Region de Valparaïso. An especial niche for bryophytes.

Fig 2. Local people (Jose and Roberto Guerrero) in Quilpué, Region de Valparaíso, showing us the classic matorral forest. Surprinsingly, they also were interested in bryophytes.

Fig 3. A mixed forest of *Nothofagus dombeyi* with sclerophyllous forest in Altos de Lircay, Region del Maule.

Fig. 4 A: *Syntrichia sp.* B: *Costesia macrocarpa*. C: *Acaulon sp*. D: Liverwort that needs identification. E: *Eurhynchiella acanthophylla*. F: Observing mosses through a hand lens.