



## Research article

# Environmental traditional knowledge in a natural protected area as the basis for management and conservation policies



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## ARTICLE INFO

## Article history:

Received 17 January 2017

Received in revised form

13 June 2017

Accepted 14 June 2017

## Keywords:

Biosphere reserve

Wild edible plants

Management policies

Food significance ethnobotanical index

Sierra la Laguna

## ABSTRACT

Ethnobotany is an adequate tool to identify the most important wild edible plants used by local people and to develop strategies for its sustainable use and policy making. This research records the wild edible plants used by the inhabitants of the Sierra la Laguna Biosphere Reserve, in Mexico, and identified priority species for sustainable development. The employed quantitative approach included the application of a food-oriented index named Food Significance Index (FSI), which integrated cultural, agricultural and food parameters; moreover, it used multivariate analysis to identify priority edible species for use and/or conservation. Fifty taxa were identified as the most important wild edible plants in the reserve, integrated into five priority groups. Foods in priority group 1 had the highest culinary diversity by grouping three fruits (*Ficus petiolaris*, *Stenocereus thurberi*, and *Cyrtocarpa edulis*), one almond-like seed (*Cnidioscolus maculatus*), one vegetable (*Matelea cordifolia*), and one condiment (*Capsicum annuum*). Priority groups 2–5 were selective for one or two types of food, such as fruits, teas, or seeds. Since group 1 was the most diverse, the FSI and the employed strategy permitted to identify the priority wild edible plant species with the highest potential for food security. The selected six species should be included in the future management program of the reserve as the priority wild edible plants to develop strategies for conservation, sustainable use, and improvement of the local population income. General policies to manage the selected six species are outlined.

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## 1. Introduction

In order to improve the functioning of Biosphere Reserves, it is especially important to establish which wild edible plants are used by its inhabitants, to identify priority plant species for sustainable use, and to eliminate the potential loss of ecological/cultural values and natural resources from external threats (e.g. encroachments, inadequate conservations policies) (Armendáriz-Villegas et al., 2015; Hill et al., 2015; Urgenson et al., 2014).

Ethnobotany studies the relationships between men, plants and the environment; it is an ideal tool to identify key species and to develop strategies for sustainable use of plant resources. In recent

decades, ethnobotanical research has used quantitative tools (ethnobotanical indices) to get more objective assessments, provide results with a more experimental basis, or selecting priority species (Joshi et al., 2015; Madeiros et al., 2011).

Although several ethnobotanical indices have been developed to evaluate the importance of wild edible plants, most of them are mainly focused in anthropological/cultural information (e.g. cultural heritage, gender perspective, socioeconomics, differences between ethnic groups, taste, citation index, and cooking of edible species) (da Silva et al., 2006; Ghorbani et al., 2012; Joshi et al., 2015; Kujawska and Łuczaj, 2015; Pieroni, 2001). However, such indices fail in the inclusion of some agricultural and food parameters more related with food security such as role in diet (basic or complementary food), suitability for conversion into processed products, or postharvest life. For example, the Pieroni's index (2001) assign values based on the edible organ (e.g. 1.0 for seeds

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and 1.5 for fruits and leaves); however, for common foods, it is incorrect to assume that human consumption of long shelf-life foods (e.g. maize, wheat, or beans) should be less important than complementary type of perishable foods (e.g. spinach, strawberries). [Alonso-Aguilar et al. \(2014\)](#) modified the [Pieroni's index \(2001\)](#) to eliminate some subjective judgments; they also proposed a set of multivariate statistical methods to classify a high number of species in different groups by similarity. However, some parameters of the new index are not directly related to the specific value of plants as foods; for example, how the item is cooked, transmission of knowledge, and attributed medicinal value. Moreover, the multivariate analysis only groups species based on index similarity, but it does not explain other biological or food advantages.

The aims of this ethnobotanical research were to establish the wild edible plants used by the inhabitants of the Biosphere Reserve Sierra la Laguna, in México, and to identify priority plant edible species for sustainable use. A specially designed ethnobotanical food-oriented index, named Food Significance Index (FSI), combined with multivariate analysis was employed to achieve the objectives. The proposed strategy permitted to choose the priority wild plant edible species with greater impact for food security for the region.

## 2. Materials and methods

### 2.1. Study area

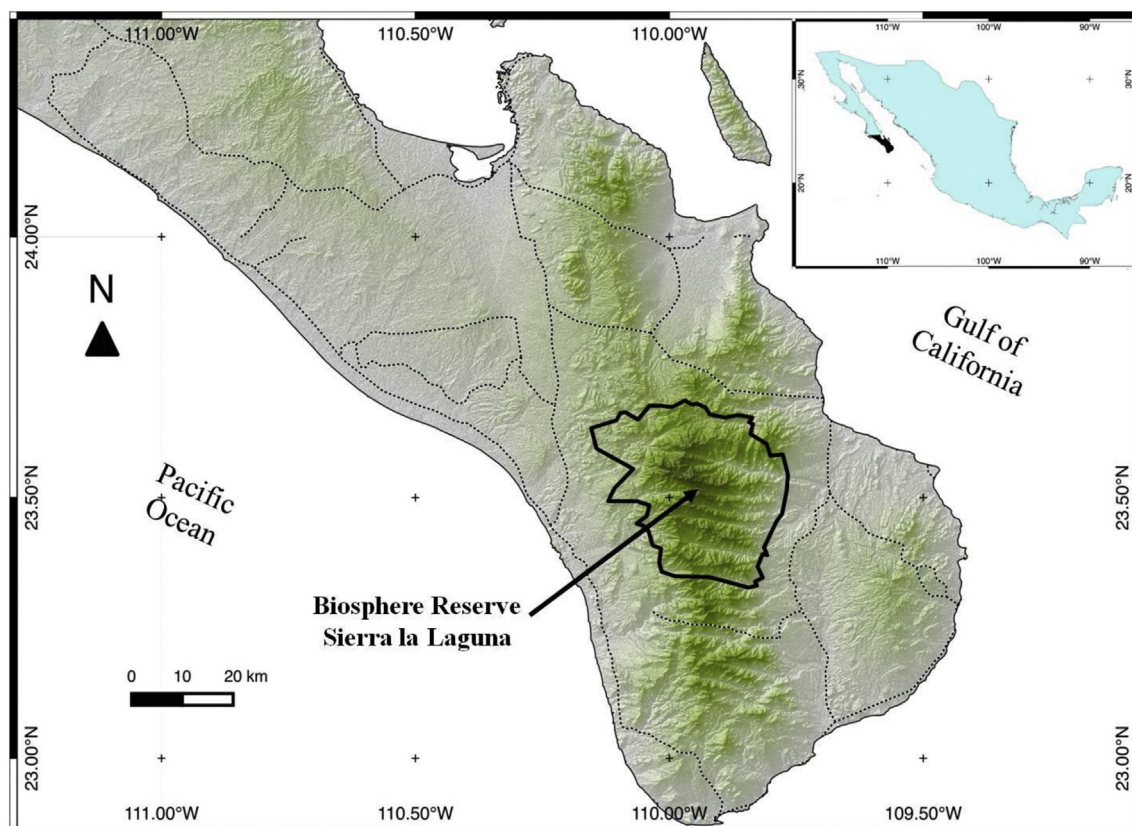
The Biosphere Reserve Sierra la Laguna (hereafter, called the reserve) is located near the southern tip of the Baja California Peninsula ([Fig. 1](#)), between 500 and 2100 m above sea level. It

covers an area of 112,437 ha and has been a reserve since June 6, 1994 ([Conanp, 2003](#)). It consists mainly of dry-deciduous and mixed oak-pine forests. Human settlements are located in the lower parts of the reserve (<1000 m), most within the deciduous forest ([León-de la Luz et al., 2012b](#)). In the reserve, 645 plant species are found in the dry forest and 401 in the more elevated pine-oak forest, including 78 endemic taxa ([León-de la Luz et al., 2012a](#)). The average annual temperature and rainfall at the higher elevations of the reserve is 14.7 °C and 765 mm, respectively ([León-de la Luz and Breceda, 2006](#)); whereas at the lower elevations, they were 22–24 °C and 200–400 mm ([González-Abraham et al., 2010](#)).

The population of the reserve practices subsistence ranching (cows and goats). For example, most of the inhabitants have homegardens for horticulture and/or nwardfruit trees, and making handicrafts from local materials and casually selling the products outside the reserve. The ranches in the reserve originated during the early Jesuit missions period in the 16th century. The pioneers came from the northwest of Mexico and lived among the Pericúe and Guaycura native hunter-gatherers who inhabited the southern peninsula ([Conanp, 2003](#); [Reygadas-Dahl and Landa-Romo, 2013](#)). ([Reygadas-Dahl and Landa-Romo, 2013](#)). There are about 100 ranches and 500 inhabitants in the reserve. Ranches usually include one or two houses with five or less people, except for a small town of approximately 100 inhabitants ([Reygadas-Dahl and Landa-Romo, 2013](#)). There is a local eco-tourist industry that employs some inhabitants as guides and animal handlers.

### 2.2. Collection of information

Ethnobotanical information was collected between September 2013 and June 2015. Initially, semi-structured interviews were used



**Fig. 1.** Geographical location of the Biosphere Reserve Sierra la Laguna.

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