

**THREATS TO AN EXTREME ENDEMIC:  
*CHENOPODIUM FLABELLIFOLIUM* (AMARANTHACEAE)  
ON ISLA SAN MARTÍN.**

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**ABSTRACT:** *Chenopodium flabellifolium* (San Martín goosefoot) is endemic to the small Pacific island of San Martín (Baja California). It is only known to occur on the southeastern side of the island, making its global range less than one square km (~0.5 mi<sup>2</sup>). Four years of observations on this species reveal that its development is not synchronous, and seeds are shed very quickly after they mature. Construction of an abalone farm in occupied *C. flabellifolium* habitat on the eastern coast of the island currently threatens this extreme endemic. Competition from invasive species is a potential concern. Recommendations include restricting expansion of the Abalone farm towards the northern portion of the island, and avoiding expansion of the seasonal fishing village. We recommend this extreme endemic for listing under the Mexican Federal Norma Oficial Mexicana NOM-059-ECOL list of species at risk. Further research into the ecology of this species would inform conservation efforts.

**RESUMEN (español):** *Chenopodium flabellifolium* (San Martín pie de ganso) es endémica de la Isla San Martín, una pequeña isla del Océano Pacífico. Solo se encuentra en el lado sureste de la isla, siendo su rango global en menos de un kilómetro cuadrada (0.5 mi<sup>2</sup>). Cuatro años de observación de esta especie revelan que en su desarrollo no presenta sincronismo y sus semillas se dispersan en cuanto la planta madura. La construcción de una granja de cultivo de abulón en operación en el hábitat de *Chenopodium flabellifolium* sobre la parte este de la costa de la isla actualmente amenaza este endemismo. La competencia por especies invasoras es una preocupación potencial. Para su protección, se recomienda que los futuros desarrollos se realicen a través de la porción norte de la isla y detener la expansión del campo pesquero estacional. Se recomienda que esta endémica extrema sea enlistada bajo la Norma Federal Mexicana NOM-059-ECOL que enlista las especies en riesgo. Una mayor búsqueda en la ecología de esta especie podría proporcionar esfuerzos de conservación.

**KEYWORDS:** Conservation, Baja California, distribution.

## INTRODUCTION

Isla San Martín is the southernmost of the continental shelf islands on the Pacific coast of peninsular California (Junak & Philbrick 1994) with elevation <140 m; it sits three miles (five kilometers) off-shore, near the mainland town of San Quintín, Baja California, Mexico. The island is less than one square mile in area, composed of volcanic bedrock dating from the late Pleistocene (Luhr et al 1995), and has no fresh water other than rainfall and condensation. There is a seasonal fishing village but no permanent human settlement (Vanderplank & Mata 2010). The island has seven endemic vertebrates, including one (*Neotoma martinensis* Goldman) presumed extinct (Samaniego-Herrera et al 2007), but just one endemic plant: *Chenopodium flabellifolium* Standley (Thorne & Junak 1989, Junak & Philbrick 1994).

*Chenopodium flabellifolium* (San Martín goosefoot) is a diminutive herb, with gray foliage and small, more or less triangular (flabelliform) leaves, and is currently classified in the family Amaranthaceae (Stevens 2001). It is not showy and, although collected in 1897 (Brandege, UC 116454), and described in 1916 by Standley, still little is known about its ecology. Originally thought to be conspecific with *C. neomexicanum* Standl. (synonym: *C. hians* Standl., *C. leptophyllum* (Moq.) Nutt. ex S. Watson), studies on seed surface structure and leaf chemistry have shown that *C. flabellifolium* in fact belongs to a different section of the genus and its closest relative is actually the widespread *C. fremontii* S. Watson (Crawford & Evans 1978). Although the San Martín goosefoot is the only native *Chenopodium* on the island, *C. murale* L. (nettleleaf goosefoot) is present in large numbers. Plants of both species can take on a reddish color when under environmental stress, such that they can be difficult to distinguish (Figure 1). Scent is a very useful field character with *C. flabellifolium* having a potent mephetic odor not dissimilar to guano (Vanderplank *et al* personal observation 2008) whereas *C. murale* is relatively odorless.

## METHODS

As part of ongoing floristic research in the area, we have made five field trips to Isla San Martín Island in the last four years: February 2006 (5 days); April 2008 (4 days); June 2008 (1 day); July 2009 (5 days) and October 2009 (1 day). In the summer of 2009 during plant surveys on San Martín Island, we took the opportunity to record and map all individuals of *C. flabellifolium* that we encountered. Most of the island was covered on foot during the five days of fieldwork, and the number of individuals at each site was recorded.



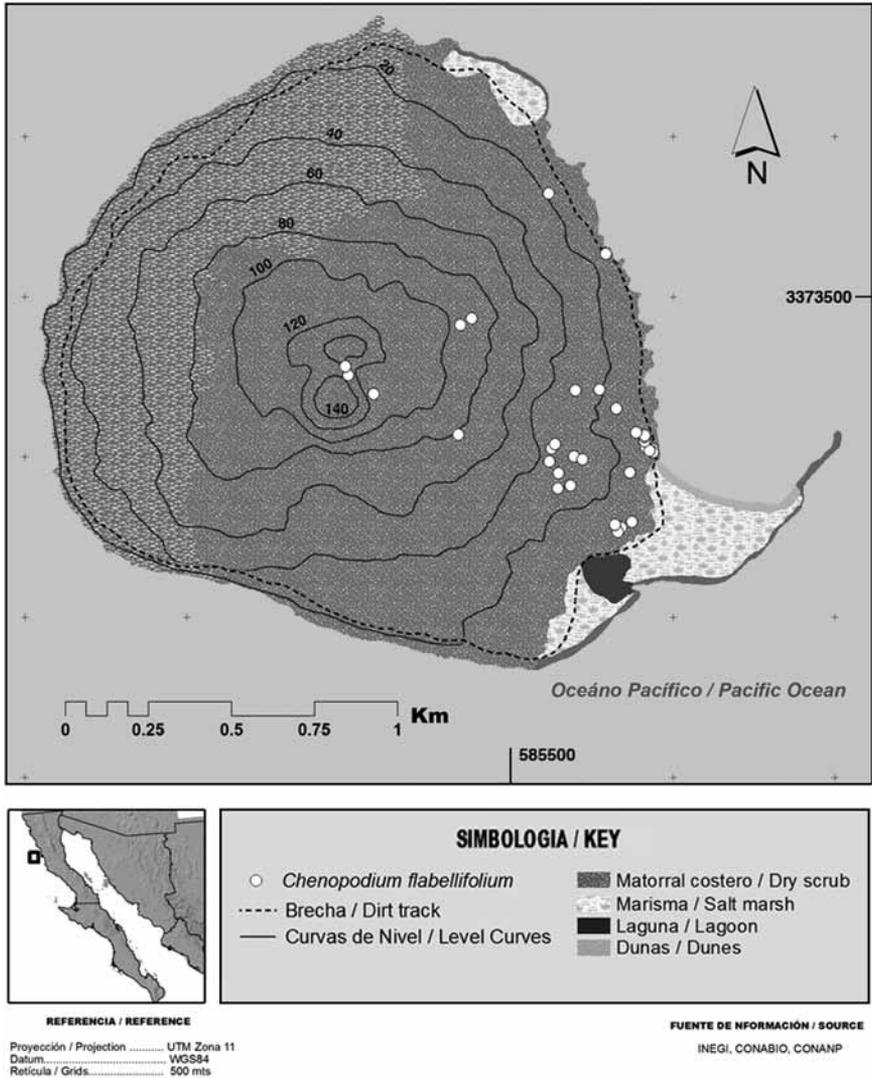
**Figure 1:** *Chenopodium flabellifolium* (left) as compared to the weedy invasive *Chenopodium murale* (right). Photo: S. Vanderplank, 2009.

## RESULTS

Our results indicate that *C. flabellifolium* is restricted to the southeast portion of the island (Figure 2). The population extends from a sheltered plateau just south of the peak, ca. 180 m (600 ft) elevation, down the southeastern flank, to the edge of the coastal strand vegetation. The plants were usually found growing in protected areas amongst the lava rocks, and most frequently on south-facing

slopes. Although distribution may vary from year to year, we hypothesize that climatic factors limit the distribution of this narrowly endemic species, and that the southeastern corner of the island provides a moister and more sheltered habitat than the exposed windward northern and western portions of the island, where this species is not found.

The available literature, including the type description (Standley 1917), does not



**Figure 2:** Map of Isla San Martín, showing occurrences of *Chenopodium flabellifolium*.

indicate whether *C. flabellifolium* is annual or perennial. Mature plant size varies considerably, raising the possibility that it may have a facultative biennial life history. The population size of *C. flabellifolium* appears to fluctuate with rainfall. We found no plants during 2006 (a comparatively dry year).

Individual *C. flabellifolium* plants do not appear to develop and mature simultaneously, thus plants are often found in different phenological stages (e.g., some are still seedlings while other may have already dropped the majority of their seeds). Additionally, once seed matures it is shed very rapidly, making seed collection difficult even if plants are fairly abundant. Notably, a visit in September found the immature plants documented in June had already dropped their seed and many of them had dried up completely. Three attempts have been made to contribute to a long-term conservation seed bank for *C. flabellifolium*, but success was limited to just one of the trips owing to this asynchronous phenology and the brief period of mature seed availability on the plants.

## THREATS

Although often seen co-occurring, the non-native *C. murale* does not appear to be out-competing the endemic *C. flabellifolium* at the time of writing. Isla San Martín is relatively young geologically and has a very patchy and thin soil profile. We believe the island is still undergoing an active process of floristic change owing to succession (Vanderplank & Mata 2010). It is possible that soil development over time may give a competitive edge to invasive species on the island, which could pose a future threat to the endemic population.

Isla San Martín is under consideration for inclusion in a Federal Biosphere Natural Protected Area that would include all the Pacific islands in Mexico (SEMARNAT 2009). However, the seasonal fishing village is located in the area with the highest *C. flabellifolium* density, and in 2009, for the first time, the 15 year concession of the federal maritime terrestrial zone was awarded by the Mexican government, allowing the development 43,000 m<sup>2</sup> (4.3 ha, or 10.6 acres). The concession was authorized for aquiculture and fish farming by the Secretary of Environment and Natural Resource [SEMARNAT] and, under the terms of the concession, an abalone farm is being constructed on the east coast of the island. Site preparation recently began near the northern edge of the documented *C. flabellifolium* population. Any construction-related loss of occupied habitat would significantly impact this species, given that it is currently found within an area of less than 1 square km (half a square mile) globally. Future impacts of the village and abalone farm could include trampling *C. flabellifolium* plants or altering soil conditions; introduction of additional invasive species; changes to natural drainage patterns;

or other effects. Any of these would further significantly affect *C. flabellifolium* and its habitat.

## CONSERVATION RECOMMENDATIONS

To reduce impacts to the range and genetic diversity of this plant, our conservation recommendations center on avoiding direct impacts and habitat disturbance throughout its known range. *Chenopodium flabellifolium* is one of the narrowest endemic plants in Baja California and we recommend it for listing under the Mexican Federal NORMA Oficial Mexicana NOM-059-ECOL list of species at risk. We recommend that further construction and vegetation clearance for the abalone farm cease or expand only to the north, and avoid expansion to the south and west where *C. flabellifolium* is more abundant. The existing seasonal fishing village should not be expanded, particularly not inland. Care should be taken to avoid habitat disturbance in the south-east section of the island whenever possible, and the impacts of invasive species should be monitored and their populations controlled if necessary. Long-term monitoring on the phenology and distribution of this extreme endemic would inform future conservation efforts on the island.

We also recommend further study of *C. flabellifolium*'s life history, soil and habitat affiliations, interactions with non-native species (in particular *C. murale*), and responses to weather patterns which could inform further conservation management.

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