

# ECONOMIC USE OF TOTORILLA (*JUNCUS ARCTICUS*, JUNCACEAE) IN ECUADOR<sup>1</sup>

MANUEL J. MACÍA<sup>1</sup>

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**Macía, Manuel J.** (*Real Jardín Botánico, Plaza de Murillo 2, E-28014 Madrid, Spain, e-mail mmacia@ma-rjb.csic.es*). ECONOMIC USE OF TOTORILLA (*JUNCUS ARCTICUS*, JUNCACEAE) IN ECUADOR. *Economic Botany* 55(2):236–242, 2001. *Juncus arcticus* var. *andicola* is native to the Andean region. Its stems are used to make handicrafts by the rural mestizo population of Cotopaxi province in Ecuador. These products are sold at traditional markets along the Andes of Ecuador. The plant is of great economic importance in the modest lives of the artisans. Totorilla has been cultivated by this rural population. It is cultivated in pools and sometimes wild populations are managed. The area of production is 1.5 ha. One woven item can be made from a 0.35 m<sup>2</sup> totorilla stand area. A 100 m<sup>2</sup> yielded 850 woven items annually, bringing in a gross income of U.S. \$1275 per year, corresponding to 66% of the official minimum salary in Ecuador. The plant also provides a good source of cattle fodder during periods of drought.

USO ECONÓMICO DE LA TOTORILLA (*JUNCUS ARCTICUS*, JUNCACEAE) EN EL ECUADOR. *Juncus arcticus* var. *andicola* es nativa de la región andina. Los tallos se usan para confeccionar artesanías por la población rural mestiza de la provincia de Cotopaxi en Ecuador. Estos productos se venden en los mercados tradicionales a lo largo de los Andes en Ecuador. La planta es de gran importancia económica para el modesto modo de vida de los artesanos. La totorilla ha sido cultivada por esta población rural. Se cultiva en piscinas y también se manejan poblaciones silvestres. El área de cultivo en producción es de 1,5 ha. Un producto se puede confeccionar con 0,35 m<sup>2</sup> de superficie de totorilla cultivada. En un área de 100 m<sup>2</sup> se produjeron 850 productos anuales, que supuso un ingreso bruto de U.S. \$1275, lo que corresponde al 66% del salario mínimo oficial de Ecuador. La planta ofrece también un buen recurso como planta forrajera, especialmente durante períodos de sequía.

**Key Words:** *Juncus arcticus* var. *andicola*; totorilla; Juncaceae; fiber; handicrafts; Andes; Ecuador; South America; economic botany.

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The genus *Juncus* L. (Juncaceae) is widespread in all continents except Antarctica. Of the 220 species in the genus, 41 are known in the Neotropics, and 15 of them in Ecuador (Balslev 1979, 1996; Jørgensen and León-Yáñez 1999). *Juncus arcticus* Willd. *sensu lato* is native to western America, from Alaska to Patagonia. According to Balslev (1996), the species can be divided in three varieties: *J. arcticus* var. *mexicanus* (Willd.) Balslev from western United States to Guatemala, and in the Andes, from southern Peru to Patagonia; *J. arcticus* var. *montanus* (Engelm.) Welsh in western North America, from Alaska to Guatemala; and *J. arcticus* var. *andicola* (Hook.) Balslev in the central region of Mexico and Guatemala, and along the

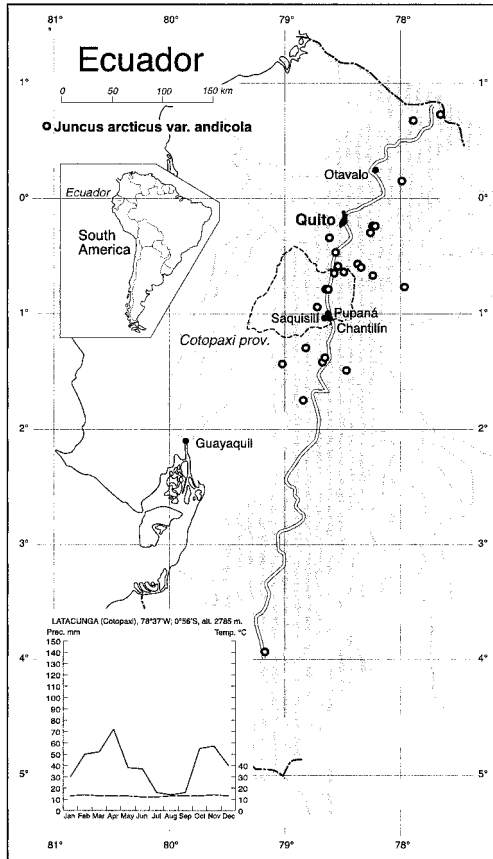
Andes, from southern Colombia to Patagonia. This last taxon is the object of the present study. In Ecuador its common names are *tatora*, *tatora de Castilla*, and *totorilla*. Totorilla will be used in this paper to avoid confusion with *Schoenoplectus californicus* (C. A. Mey.) Sojak (Cyperaceae) a fiber plant in Ecuador, which is also known as *tatora* (e.g., Heiser 1978; Macía and Balslev 2000).

In Ecuador totorilla grows between 2700–4000 m (Fig. 1). It is a heliophilous species that occurs frequently in cattle pastures and in other areas under human influence (Balslev 1996). It seems to be a good ecological indicator of near surface subterranean water (Macía pers. obs.).

In the Neotropics, few uses have been reported for Juncaceae in general and *Juncus* in particular: *Juncus effusus* L. is used to make mats and mattresses in Costa Rica and Guatemala (Standley 1937; Standley and Steyermark 1952)

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**Fig. 1.** Distribution of *Juncus arcticus* var. *andicola* in Ecuador. Shaded area indicate  $\geq 2500$  m a.s.l. Climatic diagram based on Cañadas (1983).

and *Juncus ramboi* subsp. *colombianus* Balslev is used for several handicrafts (Balslev 1996). In Ecuador, the main use of totorilla is the manufacture of handicrafts from its stems (Acosta-Solís 1961; Balslev 1996; Cuví 1994). Totorilla is only exploited in the Andean province of Cotopaxi in Ecuador. Its products are sold in several traditional markets along the Andean region and, although a weaver's family may produce only limited amounts, the overall economic importance of the totorilla is substantial because it is often their most important source of income. No previous work describes the use and economic botany of this plant, but its management is similar to that of totora (*Schoenoplectus californicus*), which is also exploited as a fiber plant in Ecuador (Macía and Balslev 2000).

This paper describes the current status of the use and management of totorilla in Ecuador,

quantifying several aspects of its cultivation, stem production, manufacture of products, and their subsequent commercialization.

## METHODS

The study area was the rural village of Pupaná ( $0^{\circ}49' S$ ;  $78^{\circ}38' W$ ) and in the nearby locality of Chantilín ( $0^{\circ}50' S$ ;  $78^{\circ}39' W$ ), both in the province of Cotopaxi in Ecuador. The villages are in the inter-Andean corridor at 2900 m altitude, where the average annual precipitation reaches 477 mm, and the medium annual temperature is  $13^{\circ}C$  (Fig. 1). In this area the soil is mainly sandy and lacks natural vegetation. The area is devoted to cattle pastures and cultivation of several edible crops for autoconsumption. In recent years, new crops are being intensively cultivated for commercial purposes such as broccoli, and the installation of greenhouses for flower cultivation are modifying the area. These localities are the only ones in Ecuador where totorilla is exploited for economic use. The totorilla weavers are generally mestizo communities with deep roots in the Quichua-speaking Andean culture and are self-sufficient in basic needs.

Information on propagation, harvest, and socioeconomic importance was collected from October 1998 to February 1999, based on personal observations and interviews with local residents. The author was lodged at the house of a weaver's family in Pupaná several times, allowing the opportunity to participate in all aspects of totorilla production and fabrication. To quantify stem density under different natural conditions and estimate the overall production, plots of  $1 m^2$  were established, both in pools and in managed wild populations in nonflooded areas. Information on market and products prices was obtained from local markets in the towns of Otavalo, Quito, and Saquisilí.

The distribution map (Fig. 1) was produced from bibliographic references (Balslev 1979; 1996), herbarium collections from AAU, MA, NY, QCA, QCNE (acronyms according to Holmgren, Holmgren, and Barnett 1990), and my own field collections and observations.

## RESULTS

### HARVEST AND PROCESSING

The green stems of totorilla are harvested at regular intervals of four months, when the inflorescence has matured and the plant reaches its



**Fig. 2.** Harvest and use of totorilla (*Juncus arcticus* var. *andicola*) in Ecuador. **A.** Manual harvesting of the stems in Pupaná. **B.** Bundling the harvested stems for carrying to the house. **C.** Plantlet to be planted in a pool. **D.** Detail of a model. **E.** Production of a basket. **F.** Marketed products in the traditional market of Otavalo in Imbabura province.

maximum development. The harvest is done in the pools by pulling out the stems manually from its basal part, to obtain the maximum length from the stems, which is usually 1.3–2.2 m (Fig. 2A). When the plant grows without harvesting for more than four months, the stems become difficult to pull out manually and must be cut with a serrated sickle, resulting in shorter stems. Although the time employed harvesting depends on the density of stems, on one occasion a worker manually harvested 6 m<sup>2</sup> in 66 minutes. Once the harvest is finished, the pool must be cleaned of all plants with the exception of totorilla stems to prevent weeds.

After harvesting, the stems are tied in bundles and carried to the homes to dry (Fig. 2B). To

take advantage of the basal parts, once the stems are dried, the cataphyls are removed and left one more week to dry, until they acquire a color similar to the rest of the stems. Once dried, the fibers can be stored for some years without damage.

A minor part of the totorilla used is harvested from wild managed populations, usually close to the pools, where natural populations are maintained from wind-dispersed seeds. These stems are thinner than the ones from the pools. They are harvested when needed, but always in intervals longer than four months. A worker with a serrated sickle harvested 5 m<sup>2</sup> in 7 min. The length of the stems was 35–80 cm.

The weavers who do not own private land

must harvest the totorilla stems from unmanaged wild populations in cattle pastures, choosing among the bunches those stems suitable for the handicrafts. The number of useful stems per bunch is lower, and the profit therefore less. In one hour, 50–100 stems can be harvested manually.

#### PROPAGATION

Totorilla has been cultivated by the rural population of Pupaná for several decades. Even though it is a terrestrial species, totorilla is cultivated as an aquatic plant and, in this environment, the stem growth is faster, longer, and thicker than in nonflooded areas.

The plant is cultivated in pools excavated in the ground, where subterranean water flows at 1.5–3 m below the surface. Plantlets obtained from the areas close to the pools or from the pastures, without much stem development, 40–50 cm maximum height, are planted without letting them dry in permanently wet areas at a depth of about 5 cm, and 10–15 cm apart (Fig. 2C). The rate of success is generally high. According to the informants, the only limiting factor is the absence of water during some seasons. The first harvest can be done one year after planting, whereas the second and subsequent cuts may be every four months. The plants remain in production up to 15 years. Then it is necessary to completely remove the rhizomes, clear all the organic matter from the pools, and then, new plantlets can be planted without fal-low.

#### PRODUCTS AND APPLICATIONS

The main use of totorilla in Ecuador is in the manufacture of handicrafts. To produce them, the fibers are soaked in water for 5–10 min, which makes them more pliable and keeps them from breaking during weaving. The handicrafts are made inside of the houses to prevent the sun from drying and hardening the fibers. The stems are classified according to their thickness to get a better uniformity of the final product. The stems are made flexible by passing them through a split stick. The products are manufactured by intercrossing pairs of stems, adding as many series as needed, depending on the final size of the product (Fig. 2D).

All members of the family work to produce the totorilla products. The weavers devote most of the day to this activity. Two kinds of products

are made: traditional baskets made only with totorilla fibers, and the modern products in which the fiber covers different kinds of pottery (Fig. 2E). The latter were first produced 15 years ago and sell better as souvenirs for domestic and foreign tourists. Table 1 shows the sizes, number of stems, and time devoted to each product. Depending on the thickness of the stems—thicker ones harvested at pools, thinner ones coming from nonflooded areas—the size of the final product will be long or short. The products from nonflooded areas are of secondary importance because the stems are shorter. The maximum dimensions of the products are limited by the fiber length, which may not exceed 15 pairs, equal to 120 fibers.

Totorilla is also used as cattle fodder. The crops are protected from the uncontrolled livestock, and only when a pool is severely affected by weeds, will they be given up for pasture. Other domestic uses of totorilla are: the apical parts from the dried stems are burnt and the ashes obtained are used for healing the cut umbilical cord in newborn children; and dried apical parts are also used as fire-starters for the kitchens.

#### MARKET

The products are usually sold by the families in traditional markets along the Andean region (Fig. 2F). Totorilla products are well accepted by domestic and foreign tourists. Prices are highest in cities with large populations (Table 2). However, they are occasionally distributed through small shops in Quito where the final price is at least twice of that obtained at traditional markets. The products are not distributed in the coastal provinces, because the fibers decay quickly due to the high moisture. Other products, such as the ones used to cover glass bottles and other kind of vessels, are made on order. The price of this work normally reaches U.S. \$1.5 just for the weaving.

#### PRODUCTION

Based on personal observations, the area of cultivated totorilla in production is 1.5 ha in Ecuador, without taking into account the exploitation of wild populations. The crop is only found in Pupaná and Chantilín in Cotopaxi Province. The productivity of the pools depends on the density of stems. A 1 m<sup>2</sup> plot of cultivated pool yielded an average of 211 stems (range 104–398; n = 30). One product can be made with an

TABLE 1. PRINCIPAL TOTORILLA PRODUCTS SOLD, VARIOUS SIZES, AND TIME EMPLOYED IN ITS MANUFACTURE IN ECUADOR. ( $\emptyset$  DENOTES DIAMETER OF THE PRODUCT.)

Product	Vernacular name	Length $\times$ width $\times$ height (cm)	Stems (#)	Fiber origin	Time (min)
Products with pottery					
Oblong basket	Canasta alargada	37 $\times$ 24 $\times$ 8	72	Pools	55
Oblong basket	Canasta alargada	30 $\times$ 24 $\times$ 6	64	Pools	50
Oblong basket	Canasta alargada	25 $\times$ 17 $\times$ 6	56	Pools	45
Oblong basket	Canasta alargada	16 $\times$ 11.5 $\times$ 4	48	Pools	40
Round basket	Canasta redonda	27 $\emptyset$ $\times$ 8	56	Pools	45
Round basket	Canasta redonda	16.5 $\emptyset$ $\times$ 7	48	Pools	40
Pan basket	Olla	17 $\times$ 18 $\times$ 24	56	Outside the pools	45
Pan basket	Olla	11 $\times$ 9 $\times$ 13	48	Outside the pools	40
Sugar bowl	Azucarero	11.5 $\times$ 8 $\times$ 8.5	56	Outside the pools	45
Teapot	Tetera	17 $\times$ 10 $\times$ 11	56	Outside the pools	45
Products without pottery					
Oblong case <sup>1</sup>	Petaca alargada	38 $\times$ 22 $\times$ 14; 24 $\times$ 21 $\times$ 19	192	Pools	120
Oblong case	Petaca alargada	16 $\times$ 11 $\times$ 6.5; 14 $\times$ 8.5 $\times$ 10	96	Outside the pools	90
Round case	Petaca redonda	23 $\emptyset$ $\times$ 12; 21 $\emptyset$ $\times$ 14	96	Pools	90
Round case	Petaca redonda	8.5 $\emptyset$ $\times$ 6; 9 $\emptyset$ $\times$ 5.5	112	Outside the pools	100
Pot basket	Taza	29 $\times$ 22 $\times$ 23	72	Pools	55
Pot basket	Taza	23 $\times$ 16 $\times$ 19	48	Pools	40
Pot basket	Taza	12 $\times$ 10 $\times$ 18	40	Outside the pools	40
Jewel case <sup>2</sup>	Joyero	6 $\times$ 3.5 $\times$ 5.5-11 $\times$ 7 $\times$ 8.5	112	Outside the pools	180

<sup>1</sup> This product is made by two baskets which fit in one another.

<sup>2</sup> This product is formed by an ensemble of seven baskets which fit one in another as Russian puppets.

TABLE 2. COMPARISON OF PRICES (U.S. \$) FOR TOTORILLA PRODUCTS IN THREE ANDEAN ECUADORIAN MARKETS. POTTERY PRICES ARE INCLUDED IN THE FINAL PRICES. ( $\emptyset$  DENOTES DIAMETER OF THE PRODUCT.)

Product	Length $\times$ width $\times$ height (cm)	Pottery prices	Otavalo	Quito	Saquisilí
Oblong basket	37 $\times$ 24 $\times$ 8	1.5	3.4	3.8	2.3
Oblong basket	30 $\times$ 24 $\times$ 6	1.2	3	3	1.8
Oblong basket	25 $\times$ 17 $\times$ 6	1	2.1	2.6	1.5
Oblong basket	16 $\times$ 11.5 $\times$ 4	0.7	1.8	1.5	1.2
Round basket	27 $\emptyset$ $\times$ 8	1.2	3	3.8	2.3
Round basket	16.5 $\emptyset$ $\times$ 7	0.9	1.8	2.3	1.5
Pan basket	17 $\times$ 18 $\times$ 24	1.5	3.5	3.8	2.3
Pan basket	11 $\times$ 9 $\times$ 13	0.9	2	2.7	1.5
Sugar bowl	11.5 $\times$ 8 $\times$ 8.5	1.2	2.3	3	1.8
Teapot	17 $\times$ 10 $\times$ 11	1.5	3.7	4.1	2.3
Oblong case	38 $\times$ 22 $\times$ 14; 24 $\times$ 21 $\times$ 19	—	3.8	4.6	2.7
Oblong case	16 $\times$ 11 $\times$ 6.5; 14 $\times$ 8.5 $\times$ 10	—	2	2.6	1.5
Round case	23 $\emptyset$ $\times$ 12; 21 $\emptyset$ $\times$ 14	—	2.6	3	1.8
Round case	8.5 $\emptyset$ $\times$ 6; 9 $\emptyset$ $\times$ 5.5	—	0.9	1	0.6
Pot basket	29 $\times$ 22 $\times$ 23	—	1.5	1.8	0.9
Pot basket	23 $\times$ 16 $\times$ 19	—	1.5	1.8	0.9
Pot basket	12 $\times$ 10 $\times$ 18	—	0.9	1.2	0.6
Jewel case	6 $\times$ 3.5 $\times$ 5.5-11 $\times$ 7 $\times$ 8.5	—	3.8	3.4	3

average of 76 stems (see Table 1), amounting to a totorilla stand of 0.35 m<sup>2</sup>.

In nonflooded areas a 1 m<sup>2</sup> plot yielded an average of 982 stems (range 517–1560; n = 30). Despite its high production only half of the stems can be used for manufacturing according to the artisans. One product can be made of 70 stems, so we estimate that a 0.15–0.2 m<sup>2</sup> plot is needed from wild managed populations.

#### SOCIOECONOMIC IMPORTANCE

The manufacture of totorilla products is the main source of income for the 30 families who live and exploit the plant intensively in Pupaná. Otherwise, it can be an extra source of income for others peasants who work on it sporadically. A 100 m<sup>2</sup> plot of totorilla stand can produce 850 products annually in the three harvests. The average benefit is U.S. \$1.5 per product, bringing in a gross income of U.S. \$1275 per year, which corresponds to 66% of the official minimum salary in Ecuador. The only expenses for this work are the costs of the pottery vessels (Table 2) and the rent for the places in the markets of Otavalo (U.S. \$15), and in Quito (U.S. \$26–31 per year).

The Pupaná artisans weave their own production as well as buying the traditional totorilla products made by the artisans of Chantilín to sell in the markets. Sometimes if the owner of the totorilla stand does not harvest his portion, it is rented out for cutting. For one such harvest a 90 m<sup>2</sup> pool was rented for U.S. \$77.

#### DISCUSSION

The exploitation of totorilla is a local resource of great economic importance for the modest lifestyle of a few rural Andean people from the province of Cotopaxi in Ecuador. The plant provides the main source of income for those families and also represents an important source of income for a few other people who work temporarily with the plant. Nevertheless, the economic benefit obtained is small and does not reach the minimum monthly salary in Ecuador, although the whole process of exploitation, from cultivation to sale of the final products in several markets along the Andean region, require participation of all family members.

The cultivation of totorilla is a significant advantage to its exploitation because propagation is simple, requiring neither special attention nor high production costs, and the production is high. The density of stems in pools is lower

compared to the nonflooded areas. To promote a higher density of stems, the harvest could be done with a serrate sickle instead of pulling out manually, even though the stems are shorter. This suggestion is based on my personal observations during the totorilla harvest in nonflooded areas as well as in the exploitation and cultivation of totora (*Schoenoplectus californicus*), in neighboring areas (Macía and Balslev 2000).

The harvest of the totorilla stems in pools and in nonflooded areas at regular intervals is a good combination. All the stems harvested are sorted into different lengths and thickness, and these variable sizes may be used alternatively, depending on the kind and final size of the products to be manufactured.

Few weavers are devoted solely to the manufacture of totorilla products. Its manufacture requires a certain skill from the artisans. This is probably the reason for the small number of weavers working with totorilla, whereas in the same area there are a great number of people exploiting totora (*Schoenoplectus californicus*), which is managed under similar condition (Macía and Balslev 2000).

According to informants, sales are increasing as the handicrafts are accepted by domestic and foreign tourists. In the future, this use of totorilla may become important by grouping weavers in a cooperative. The totorilla stand would be therefore increased, new artisans could learn the techniques of weaving, and the handicrafts could be sold directly to the souvenir shops in the big cities. This could be done with limited economic funding and would mean an increasing source of economic resources for the region.

Totorilla stems are also used as a forage species. They provide a pasture that can be important in all the seasons but particularly so, as an alternative in dry seasons or periods of drought.

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