



Figure 2. *Totorilla* (*Schoenoplectus californicus* ssp. *totorilla*). This subspecies differs morphologically from the typical species by its compact inflorescence versus a more open-inflorescence in the latter (Heiser 1978). (Photo: Hernán



Figure 1. Area map showing Lake Titicaca and boundary line between Peru (left) and Bolivia (right). (Map data: ©2014 Google, Mapcity)

## The Uros of Lake Titicaca and their Dependence on *Totorilla* (*Schoenoplectus californicus* ssp. *totorilla*; Cyperaceae)

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Many of us have heard the name “Lake Titicaca” but where is it? Lake Titicaca is the largest freshwater lake in South America and is reportedly the highest navigable lake in the world. It is located at an elevation of 3810 m above sea level along the border of Peru and Bolivia in the northern Andes (Figure 1; whc.unesco.org). It is one of the less than twenty of the world’s ancient lakes and is recognized as a World Heritage Site. The lake is slightly brackish (around 5 ppt) and averages 140-180 m in depth (280 m maximum). Being located in a semi-arid region, lake levels are dynamic both seasonally and cyclically. Seasonal changes may average 70 cm with a peak in late April and minimum in December (Orlove 2002). Over the past 100 years, lake levels have fluctuated by as much as 6.5m (Erickson 2000). The lake contains many endemic species, harboring over half of the known species of the Andean killifish of the genus *Orestias* (23 of 43 species; Parenti 1984). All of the lake’s sponges are endemic as are 90.9% of its amphipods, 88% of its fishes, 61.9% of the mollusks, 32% of the aquatic insects, and 28.6% of its amphibians (UN Development Programme 1995).

Marshes are common along the shores of the lake. These wetlands are dominated by two emergent species: *totorilla* (*Schoenoplectus californicus* ssp. *totorilla*; Figure 2) and *totorilla* (*Juncus arcticus* var. *andicola*) and two aquatics:

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Figure 3. Location of floating islands in Lake Titicaca: (top) 2012 and (bottom) 2002. (Map data: ©2014Google, DigitalGlobe)



Figure 4. Floating platform: a) demonstration of construction of the floating platform showing a 1 m block of rootmass with stems laid on top, and b) platform view from water showing houses and small fish pond. (Photos: a - tillthemoneyrunsout.com and b - familyonbikes.org)

Whitestem pondweed (*Elodea potamogeton*) and Andian watermilfoil (*Myriophyllum quitense*), while muskgrasses or stoneworts (*Chara* spp.) and pondweeds (*Potamogeton* spp.) occupy deeper waters (UN Development Programme 1995). The two emergents are economically important to local people as they are used for mats, mattresses, handicrafts, fodder for livestock, and other purposes (Macia 2001; Macia and Balslev 2000; Heiser 1978). For this article, I will focus on the unique relationship between totora and the Uru people who live in the marshes of Lake Titicaca, recognizing that other peoples in the lake region also make use of this valuable plant.

### Islands of Reed

Perhaps the most interesting aspect of the Uros is that they live on artificial floating islands built from totora. According to historical accounts they fled to the marshes to seek shelter from the invading cultures (e.g., Incas in the 14th and 15th centuries and later from the Spanish in the 16th century). Yet the construction of the floating islands seems to be a more recent event as Orlove (2002) suggests that the first floating islands were built in the 1800s when land-

dwellers from Coata and Huata moved to Lake Titicaca's marshlands. Today about 1200 people live on somewhere around 60 floating islands in the lake – the Uros Islands (Figure 3a). The number of these islands appears to have increased in the past decade (Figure 3b) as booming eco-tourism has probably made it easier for more Uros to make a living in the marshes. The islands were reportedly once located further from the mainland, but with the increase in tourism and desire for better access the city for goods and services and for educating their children, the floating islands are now located closer to the city of Puno.

The island platforms are made of the bulrush called “totora” (or “junco”) in South America. Each artificial island is comprised of two layers: one a layer of the natural rootmass about 1 meter thick and the second layer – one of harvested reeds laid in a crisscrossed pattern (Figure 4). According to Poon (2007), the rootmass is excavated from the marshes in large rectangular sections (5 m x 12 m x 1 m thick), then multiple sections are strung together by ropes through holes made in the “slabs” that are joined together to form a floating platform. Layers of freshly cut reeds are



Figure 5. House built of totora reeds. (Photo: tillthemoneyrunsout.com)

then laid on top of the platform in a criss-crossed pattern. The islands are anchored to prevent drifting. Since the vegetation decomposes over time, the Uros need to keep adding more reeds to the surface – every 3 months during the dry season and monthly during the wet season. Eventually the platform becomes thick enough to rest on the lake bottom. At that point, the island is abandoned and a new one built. The islands last for about 15-18 years.

#### **Other Uses of Totora**

Totora not only provides the substrate for living in the marshes but is vital to other aspects of life for the Uru people. They use the bulrush as raw material for homes, boats, mattresses, furniture, and handicrafts (e.g., fans, mats, and toys). The light-weight, water-repellent dried stems provide excellent shelter for living on a floating island (Figure 5). When the island platform is refreshed with new reeds, the reed houses are simply lifted off the ground and moved to the replenished section. Houses are also elevated somewhat above the platform surface to reduce moisture.

In the absence of wood, totora reeds have served as the

material for boat construction since pre-Columbian times (Figure 6). Lake Titicaca reed boats (balsas) have intrigued archeologists and others for many years (Allen 2014). In fact, the renown explorer Thor Heyerdahl (famous for his 1947 trans-Pacific voyage on a balsa boat – Kon-Tiki) had reed boat builders from Lake Titicaca construct RA-II that he used to cross the Atlantic (Morocco to Barbados) in 47 days. A totora boat may last 3-6 months with normal use but if plastic tarps are laid to protect the inside of the boat, its life expectancy is increased to 8-12 months (Banack et al. 2004). For additional information on reed boats consult Vranich et al. (2005) for a description of the boat building process and Allen (2014) for a brief history of reed boat construction.

The white inner portion of the basal shoots of totora (high in iodine) is eaten raw by the Uros. Tea is made from the flowers. The Uros fish and hunt fowl in the marshes, which provide essential breeding and feeding habitat for these species. The Uros also practice aquaculture on a small scale on their islands. Totora has medicinal uses: wrapping the reed around a sore tends to ease pain. Similarly it is

reportedly used to help deal with hang-overs (roll the white part of the lower shoot in one's hand then press the reed to the forehead). Dried totora is used as fuel for fires (Heiser 1978).

Harvest of wild stands of totora appears sufficient to meet the needs of the Uros but the plant is cultivated by other peoples in the lake region. Totora is planted in areas subject to periodic flooding by the lake or in "sunken gardens" – natural wet depressions or hand-dug pits (Banack et al. 2004; Erickson 2000; Heiser 1978). The use of totora as fodder for livestock may be the driving force behind increased cultivation of the species around the lake (Orlove 2002).

Totora is truly a remarkable plant – the foundation of life for the Uru people and widely used by other peoples where it occurs in abundance in South America. To learn more about the Uros and other peoples of the Lake Titicaca region and their uses of totora read "Lines in the Water: Nature and Culture at Lake Titicaca" (Orlove 2002).

### Acknowledgments

Special thanks to Hernán Tolosa, Daniel Heuclin, and the creators of two websites (tillthemoneyrunsout.com and familyonbikes.org) for use of their photos. Additional images can be viewed at these sites.



Figure 6. Reed boats from Lake Titicaca: a) traditional boat – this one built by Aymara people for harvesting totora, and b) fancier boats made by the Uros to carry tourists. (Photos: a – Daniel Heuclin; b – tillthemoneyrunsout.com)

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