Pine nuts and timber, sustainably yielded from Mediterranean pine woodlands?

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Since Antiquity, stone pine Pinus pinea L. has been an important tree in Mediterranean countries, providing timber, firewood and most notably cones, whose edible Mediterranean pine nut kernels are a gourmet nut that moves about 300 million euros annually. Stone pine woodlands have also high environmental, ecological and cultural value (soil protection, wildlife, landscape).

Cones harvested for Mediterranean pine nuts

Drought-prone Mediterranean stone pine woodlands
- Timber growth is as low (0.5-3 m³/ha/yr) as its value (8-18 €/m³).
- Open stands (150 trees /ha, Crown cover < 20%, Basal Area < 20 m²/ha).
- Mostly even-aged stands (rotation 80-150 yr.), also un-evenaged or mixed forests.
- Regeneration is difficult in poor soils and irregular climate (recurrent droughts).

Timber and wood biomass account for only 33% of revenues for stone pine forest owners, but cone harvest licences make up 43%, the resting 25% being paid for rights of other forest uses such as grazing, hunting or resin tapping (Gordo et al., 2016). Without cone harvesting, forest management would in most cases be unprofitable in these stands (Pasalodos et al., 2016).

Expansion of stone pine since XIX c. by forestation and plantations on farmland has increased its area threefold to nearly 1 million hectares, initially for soil protection and forest restoration, but in the last 30 years also for expected economic benefits from cone yields, not the least by private landowners.

Annual global Mediterranean pine nut production is about 15-20,000 tonnes (t) in shell, i.e. about 4-5,000 t shelled kernels. But production does vary widely both in time (regional masting 1:50 between years) and in space: mean cone yields vary as much as 100 - 5,000 kg/ha/yr depending on site quality, stand age and structure, and on regional climate.

In Portugal, western Turkey and Mount Lebanon, where maritime influence tempers Mediterranean climate extremes, cone production per hectare is highest. These three countries are now competing with Spain for being the main pine-nut producer.

During the last years, the ongoing climate change and an increased prevalence of cone pests have reduced the cone yield harvested per hectare in most Mediterranean countries. Additionally, industries have reported a drop in kernel-per-cone yield in factory, especially since the accidental introduction of the invasive conifer seed bug Leptoglossus occidentalis in Europe. Since a first report in Italy in 1999, this exotic pest has expanded its area to most of the continent, the Maghreb, and Western Asia. It causes everywhere the so called Dry Cone Syndrome, i.e. massive conelet abortion and high percentages of empty seeds within those cones that do ripen (cf. Branco et al. at All Division 7 Meeting---Session 199, Thu. 21/09/17 18:00 K9). Due to the resulting shortage, since 2012 prices for pine nut kernel have nearly doubled, in wholesale to 35-50 €/kg, in retail even 80-100 €/kg. But the benefits for forest owners, cone pickers and processors have plumped, and economical sustainability of the forest system and value chain is seriously jeopardised.

Mediterranean pine nuts collected from the wild – or an orchard crop?

Until few years ago, nearly all pine cones had still been harvested from forests, not orchards. However the excellent prices for pine nuts, and EU afforestation subsidies for farmers, have favoured the private initiative promoting more intensively managed stone pine plantations as nut crop, especially in Portugal. Currently, private landowners are focussing on optimised cone production rather than on multipurpose forestry. Stone pine is hence evolving into an agroforestry system or orchard crop, including grafted plantations that offer higher revenues from annual cone crops, whereas economic relevance of timber is minor.

Since 2009, graft scions from a clone mixture of 64 Portuguese clones selected for cone production have been commercialised as ‘qualified’ forest reproductive materials. Only in 2015, also 10 Spanish elite clones obtained the register as ‘qualified’ basic materials. Other 5 Spanish clones merited the category ‘tested’ basic materials, having demonstrated their superiority by comparative tests for their reproductive material (scions) with 9-15 years cone yields in grafted trials (Guadano & Mutke, 2016).

This improved genetic material for Mediterranean stone pine allows for establishing grafted orchards for a sustained cone production, supplying the regional pine nuts value chains as support for rural development in countries such as Portugal, Spain, Turkey, Lebanon, or Tunisia. Additionally, while in those orchards Integrated Pest Management can be applied for controlling Leptoglossus occidentalis, in pine forest ecosystems no tools are available to mitigate the Dry Cone Syndrome.

Also doubts about climate scenarios call into question the feasibility of traditional pine forest management, sustained only by the now diminished revenues from cones and timber in absence of payments for essential ecosystem services provided, a pending debt of society with forest owners.