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Productivity and age structure of riparian forests in a continental-arid climate at the Tarim River (Xinjiang, NW China)

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The Tarim River, as well as the Amu Darya, Syr Darya, and other major river systems in Central Asia, sustain a mosaic of riparian forests (Tugai forests), reeds, and shrub communities. The most frequent and abundant forest building tree along the Tarim River is Populus euphratica Oliv., accompanied by shrubs of the genus Tamarix, and herbaceous plants like Phragmites australis Trin. ex Steud.

The annual precipitation in the continental-arid Tarim Basin (Southern Xinjiang) does not exceed 50 mm. Therefore, the native plant species continuously contact the groundwater and thus adapt to the arid climate. Seed germination, in contrast, depends on flood events and river dynamics. On sites out of the reach of the floods, P. euphratica recruits clonally through root suckers.

The groundwater is refilled by the surface water of the Tarim River and its river branches. The Tarim river's water is supplied by melting water and summer rainfall in the Tianshan Mountains. Therefore, about three quarters of the annual run-off fall in July, August, and September, resulting in annual summer floods. Due to climate change, the river run-off will change and most probably decrease in the future. This will result in lower floods, longer periods during which the river bed and the river branches are dry as well as dropping groundwater levels.

Those riparian forests and the reeds are the most productive natural ecosystems in the desert regions of Central Asia. We follow the hypotheses that 1) their productivity is determined by river run-off and thus the mountain climate rather than the local climate and 2) their age structure reflects the flood event history.

We determined annual increments and tree ages of P. euphratica along two model transects at the Tarim middle and lower reaches, respectively. The Tarim lower reaches had been dry for 30 years, before water was diverted again into the lower reaches in 2000 and the following years. The middle reaches never suffered drought up to now.

The annual increments and thus productivity react positively on increased river run-off and subsequent groundwater level rise. The annual productivity ranges from 1.5 to 2.5 t/ha*a. Seedlings, saplings, and generatively established trees clearly mark areas of river relocation and flood events during the past. The trees established from seedlings form distinct lines reflecting water levels during previous flood events. Root sucker growth reacts positively on groundwater level rise.

Tugai forests from P. euphratica remain to build up biomass even under conditions of prolonged dry river courses. Thus, Tugai forests can act as an important carbon sink in the continental-arid lowlands of Central Asia.