

Monitoring the influence of agroforestry on the microclimate of small watercourses in agricultural landscapes in Saxony and Brandenburg/Germany

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Riparian strips with fast-growing trees provide various ecological benefits alongside small watercourses in agraric environments and contribute to the implementation of the EU Water Framework Directive. They are also an interesting cultivation method for farmers for the production of energy wood. This poster shows the microclimatic impact of two agroforestry systems on adjacent watercourses and their environment in Saxony and Brandenburg (DE).



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Test site Peickwitz, Brandenburg (DE)

Coordinates: 51°27'33.1"N 13°57'39.0"E, watercourse width 0.4-2.5 m, flow speed ca. 0.05-0.15 m/s, 1 ha plantation, 9 rows (poplar, Fritzi Pauley) 2.70 m distant/1 m between trees in a row, 400 m length alongside watercourse, 3 m distance between 1st tree row and watercourse

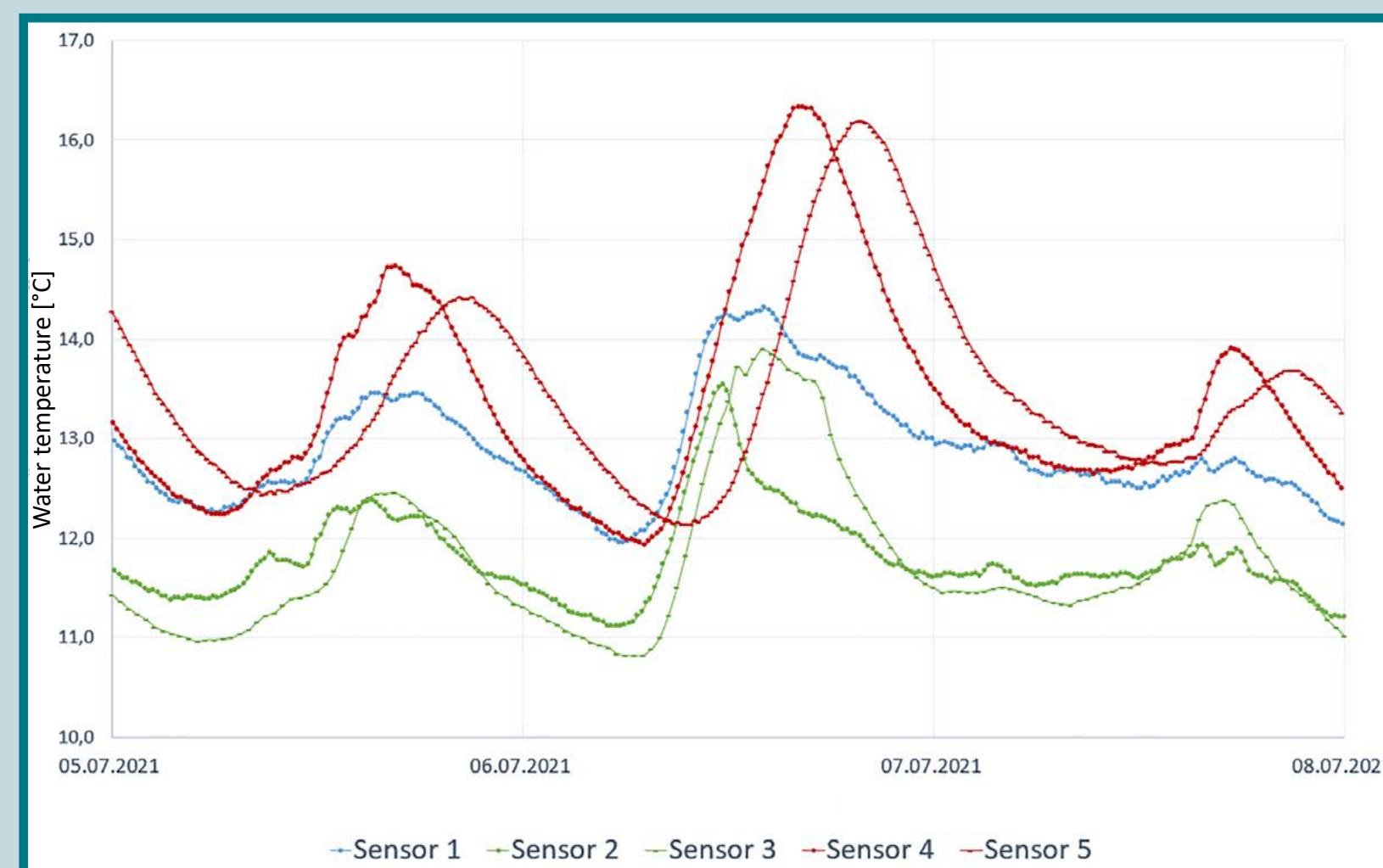
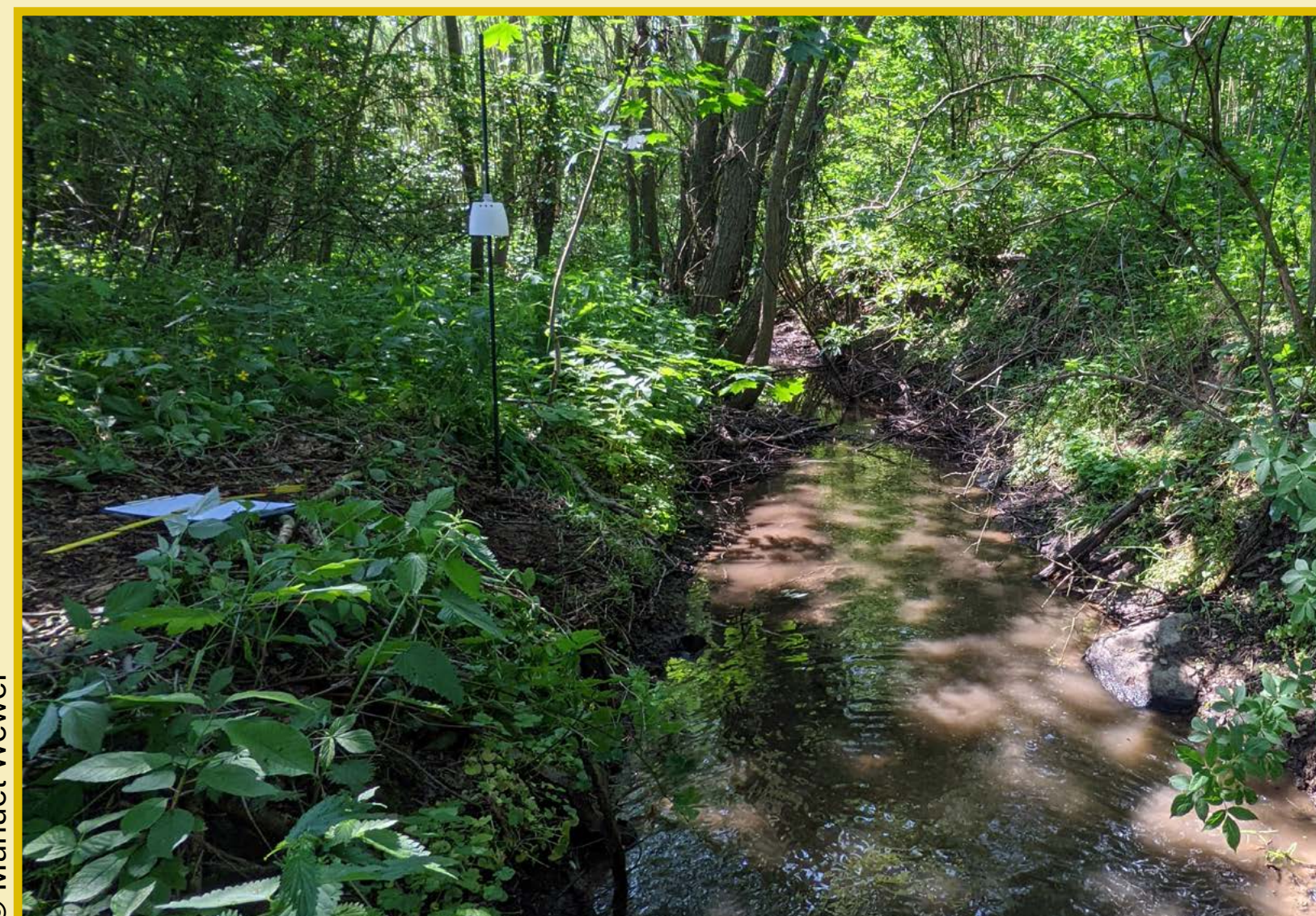


Fig. 1: Water temperature at Peickwitz site over three summer days. Sensor 1 (S1) shows temperature at the beginning of the test area. S2 and S3 are located in the part of the watercourse shaded by the 400 m long agroforestry structure. Here the shading reduces the water temperature, which is rising again at the unshaded sensors S4 and S5.



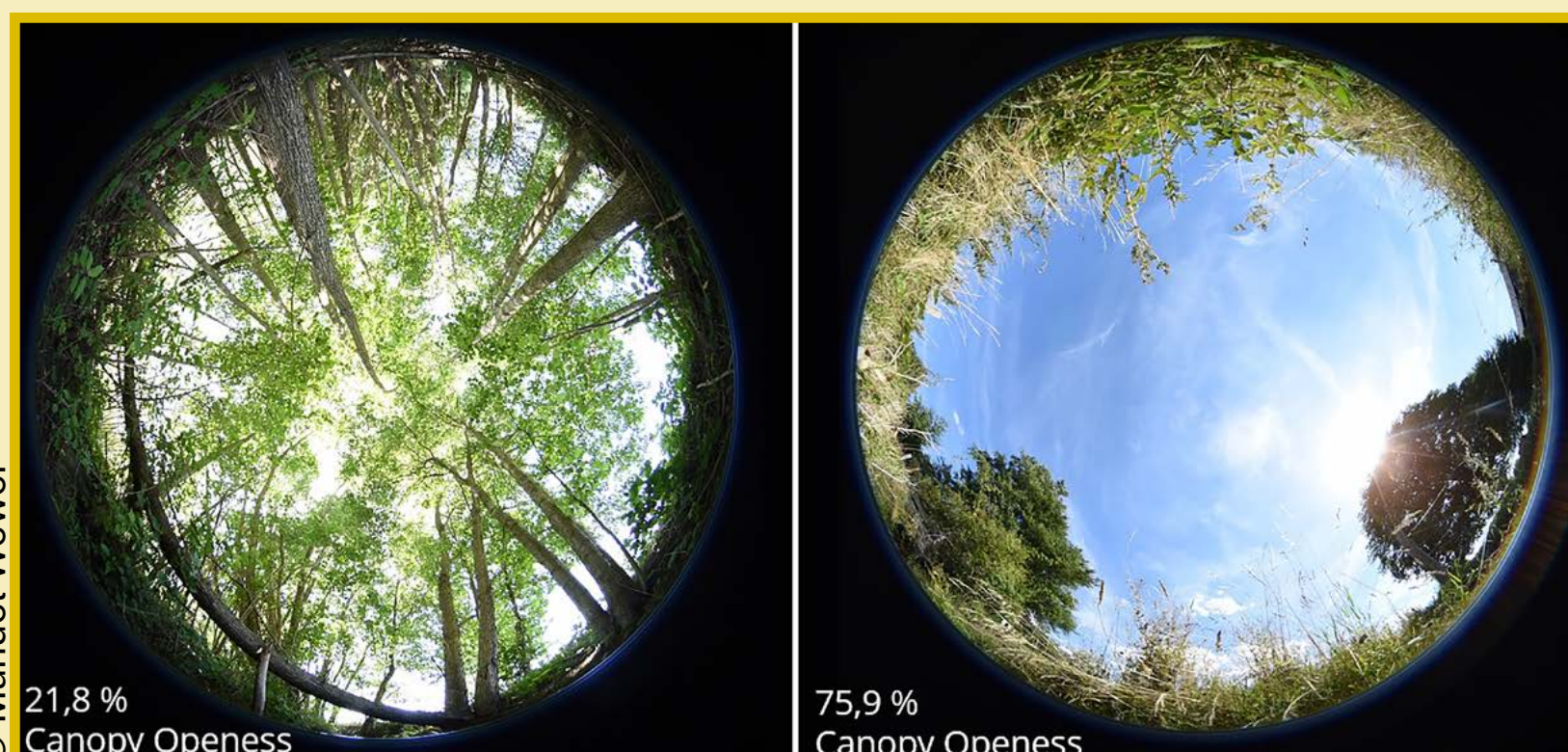
Fig. 2: The detected air temperature on a July day 2022 at the Peickwitz site shows that the agroforestry structure has a cooling effect on the surrounding agricultural landscape.



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Test site Colmnitz, Saxony (DE)

Coordinates 50°55'14.6"N 13°28'36.8"E, watercourse width 0.4-1.5 m, flow speed ca. 0.1-0.4 m/s, plantation 0.8 ha, 45 double rows (poplar, willow) at a distance of 2.25 m/0.65 m between trees in a row, 170 m length alongside watercourse



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Fig. 3: 22 % (left) and 76 % canopy opening rates of watercourse at Colmnitz test site due to different riparian vegetation (agroforestry & natural)

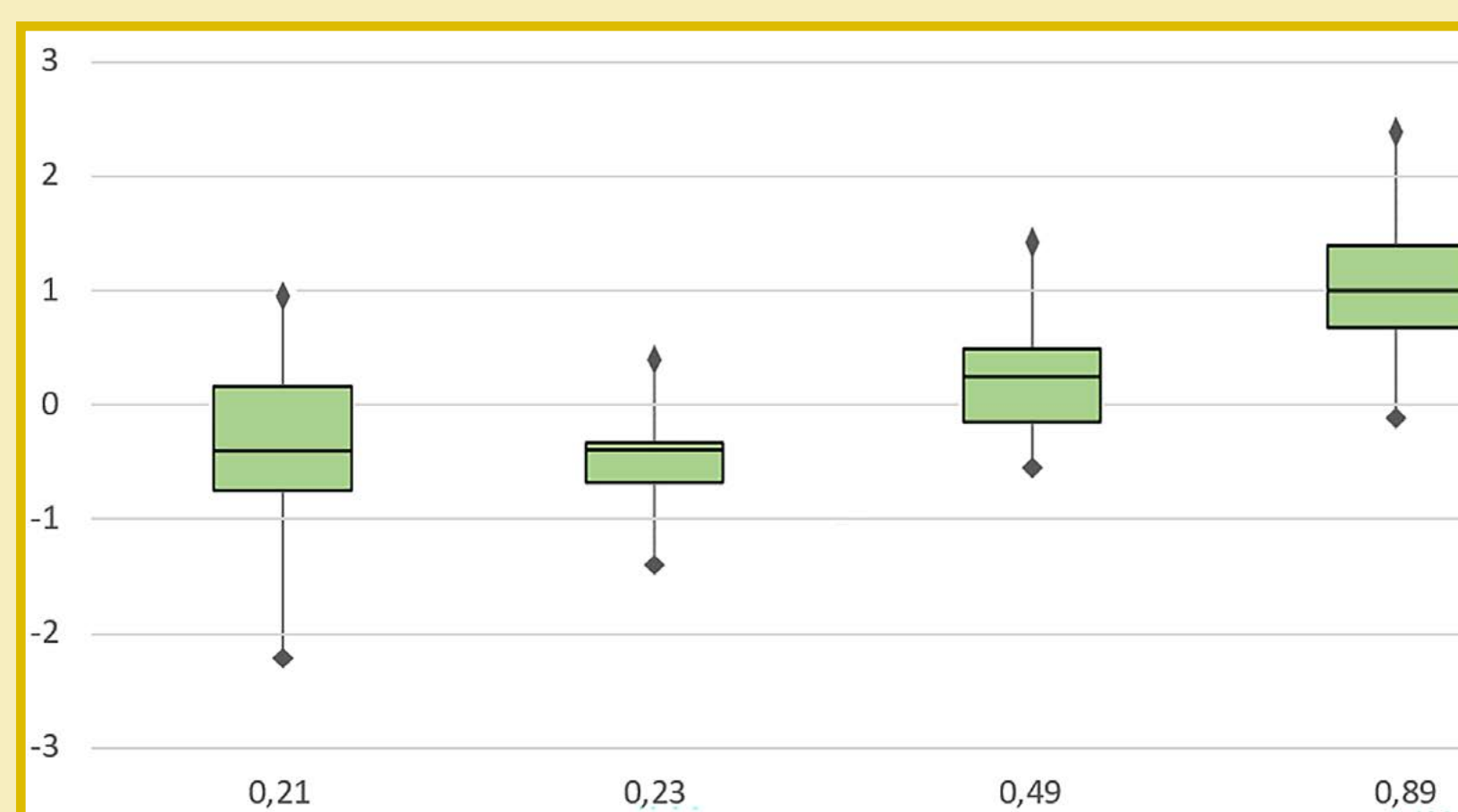


Fig. 4: Influence of different canopy openings (cop) (x-axis in %) on water temperature over 100 m flow length (y-axis in °C): cop 20 % or cop 23 % leads to an Ø temperature reduction of ca. 0.3 °C. Cop 50 % and cop 90 % raise the water temperature by 0.2 °C respectively 1 °C.

Results

of measuring campaigns at both test sites during the vegetation periods 2021 and 2022

Tree shade reduces water temperature (Fig. 1)

Shading of 400 m bank areas can generate a temperature reduction of over 4 °C at low water discharge, Ø flow velocity ca. 0.08 m/s.

Agroforestry structure has cooling effect on the surrounding agraric landscape (Fig. 2)

- air temperature measured by globe thermometer (considers globe radiation to the surroundings & convection from the air to the globe)
- 4 points of measurement: in stock (26.6 °C), plantation edge next to the watercourse (28.5 °C), open field (37.6 °C) and plantation southern edge (44.2 °C)

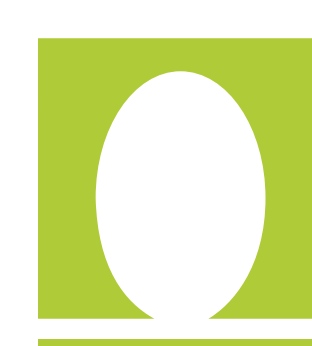
Shading capacity of riparian vegetation and impact on water temperature (Fig. 3 and 4)

- hemispheric photos show canopy opening of riparian vegetation with full sunlight
- direct and diffuse global radiation of the sun reduced from May to Sept 2022 from Ø 200 watts/m² (unshaded) to ca. 48 watts/m² (shaded by bank vegetation)
- reduced water temperature over 100 m flow length with low canopy opening, increase by 1 °C/100 m and Ø flow velocity 0.2 m/s.

Conclusion

- The shading of agroforestry structures with fast-growing trees combined with natural vegetation along small watercourses improves the local microclimate of structurally poor agricultural landscapes.
- Those structures can reduce the water temperature by 4 °C, air temperature by 11 °C (open field <-> in stock) and the global sun radiation by Ø 152 watts/m² especially during hot summer days.
- Last but not least this cultivation method creates regional value, as the farmer can use the wood as a heating or building material.

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Project partners