Federal Agency for Water Management

Federal Ministry for Agriculture, Forestry, Regions and Water Management

DIURNAL VARIATIONS AND DEVELOPMENT OF DISSOLVED OXYGEN CONTENT IN AUSTRIAN CARP PONDS

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Introduction

The amount of dissolved oxygen (DO) available in a waterbody can determine its suitability for Aquaculture. Contrary to Salmonids, carp (*Cyprinus carpio*) are known to survive rather low DO contents. They can survive with DO concentrations of 3 mg L-1 (Steffens 2014, Schäperclaus and Lukowicz 2018) and can withstand levels as low as 0.4 mg L^{-1} for some minutes (Dunham et *al.* 2002). Due to climate change, traditional Austrian carp farming ponds are now experiencing a change in the course of the year in terms of temperature and DO patterns (Böhm and Bauer 2015).

- high water temperatures + high nutrient content→ oxygen deficiencies
- fish losses in summer become more frequent
- pond management needs to be adapted
- knowledge is needed → continuous monitoring of DO and water temperature

Material & Methods

The study site is located at the district Waidhofen an der Thaya in the Waldviertel Region of Lower Austria. This Region is known throughout Austria for its carp production. The high nutrient concentrations found in carp ponds result in high biological activity. A continuous measurement of DO is therefore difficult, because a biofilm forms on the measuring device in continuous use and leads to excessive maintenance work (Fig. 1). Since Mai 2024, we use a fully autonomous oximeter (SmonOX; Galvanic probe; Clark sensor, Fig. 2). This device cleans itself after each measurement and the probe is stored above the water surface, which significantly reduces biofouling. Measurements with this device are conducted 26 times per day at a depth of 0.5 m at a carp farming pond with 41 ha in size.

Fig. 1: Biofouling on devices in continuous use in carp ponds – despite cleaning every two weeks © BAW-ÖKO

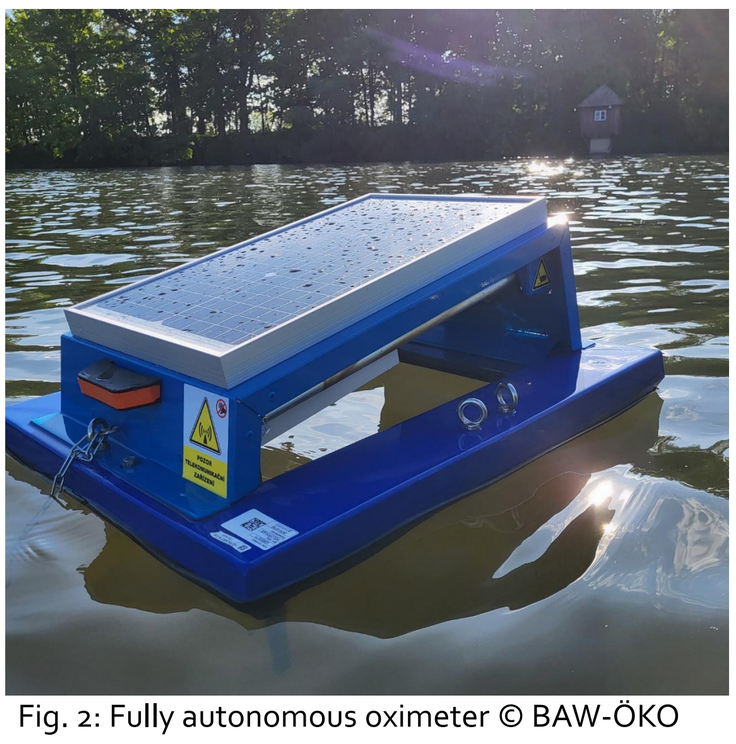


Fig. 2: Fully autonomous oximeter © BAW-ÖKO

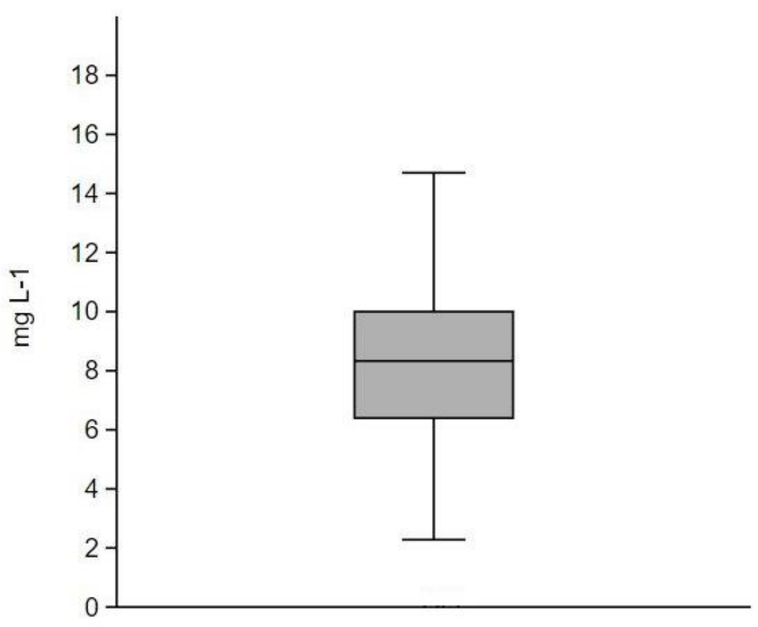


Fig. 3: Variation in DO content in 50 cm depth at a pond in the Waldviertel region in June & July 2024

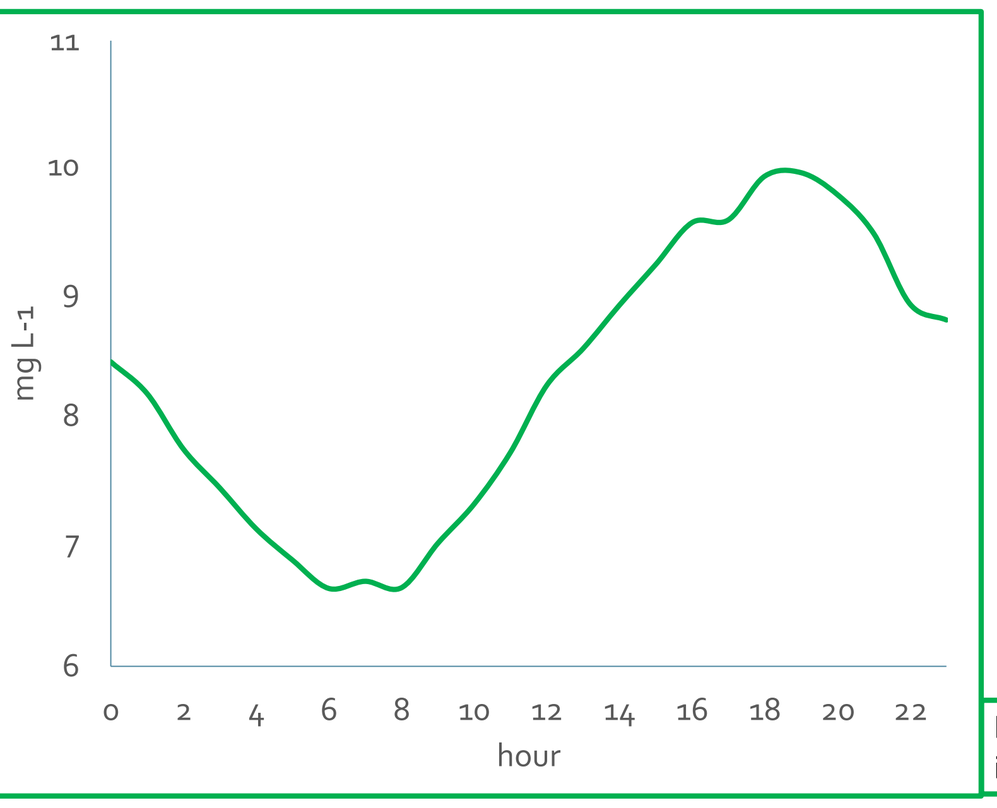


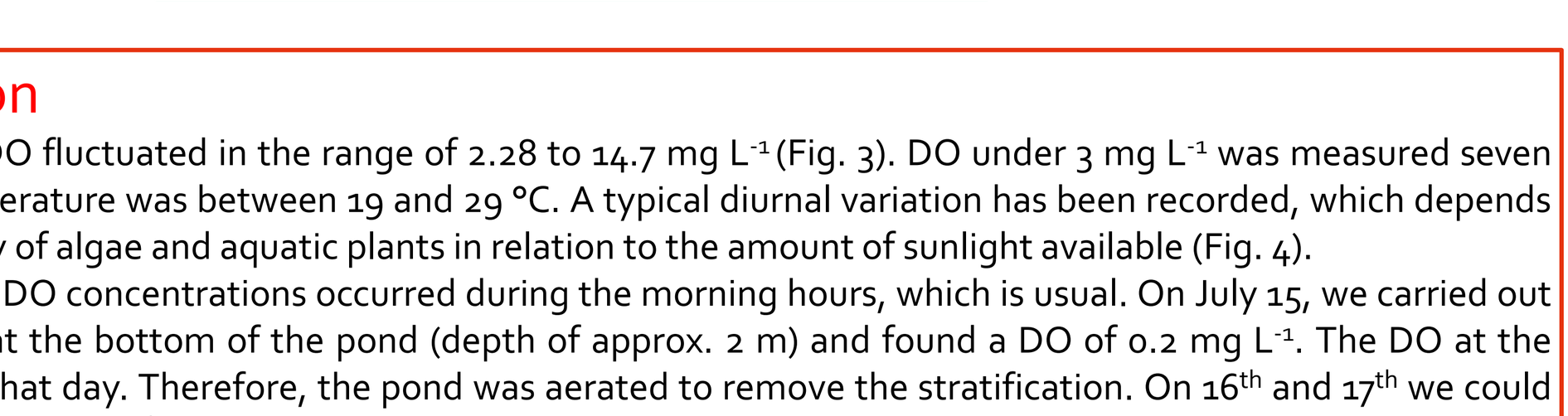
Fig. 4: Average diurnal variation in DO content in June & July 2024

Results & Discussion

Between 1.6. and 31.7.2024 DO fluctuated in the range of 2.28 to 14.7 mg L^{-1} (Fig. 3). DO under 3 mg L^{-1} was measured seven times. During that time temperature was between 19 and 29 °C. A typical diurnal variation has been recorded, which depends on the photosynthetic activity of algae and aquatic plants in relation to the amount of sunlight available (Fig. 4).

On July 14 and 18, the lowest DO concentrations occurred during the morning hours, which is usual. On July 15, we carried out an additional measurement at the bottom of the pond (depth of approx. 2 m) and found a DO of 0.2 mg L^{-1}. The DO at the surface was in a good range that day. Therefore, the pond was aerated to remove the stratification. On 16th and 17th we could not find signs of stratification. On 19th July we measured DO under 0.2 mg L^{-1} at the bottom. The data of our continuous measuring device indicates that, aeration of the pond successfully removes stratification, but lowers the DO of the surface. Consequently, due to aeration, DO levels at the surface can also drop around lunchtime or in the afternoon (Fig.5). When aerating a carp pond, it is important to keep this in mind and aerate at times when high surface DO levels can compensate low or even oxygen-free zones.

Fig. 5: Shows the DO between 14.7. – 19.7.2024. Red arrows mark the lowest concentrations in the early morning hours, which is common due to photosynthetic activity of algae and plants. Purple arrows mark the effect of the aeration (mixing the layers lowers the DO at the surface, if there is an extreme low DO content in deep layers).



Literature

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