Zooplankton online monitor

04.11.21 | Stefan Bruns

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EU Project: Digital intelligence Hub DIH4 CPS

Im Rahmen von DIH4CPS wurde eine Shrimp-Detektion mittels neuronaler Netze implementiert.

Es wurden zwei Basismodelle zur Objekterkennung in Bildern verwendet: YOLOv5 von Ultralytics und Tensorflow Object Detection API (EfficientDet).

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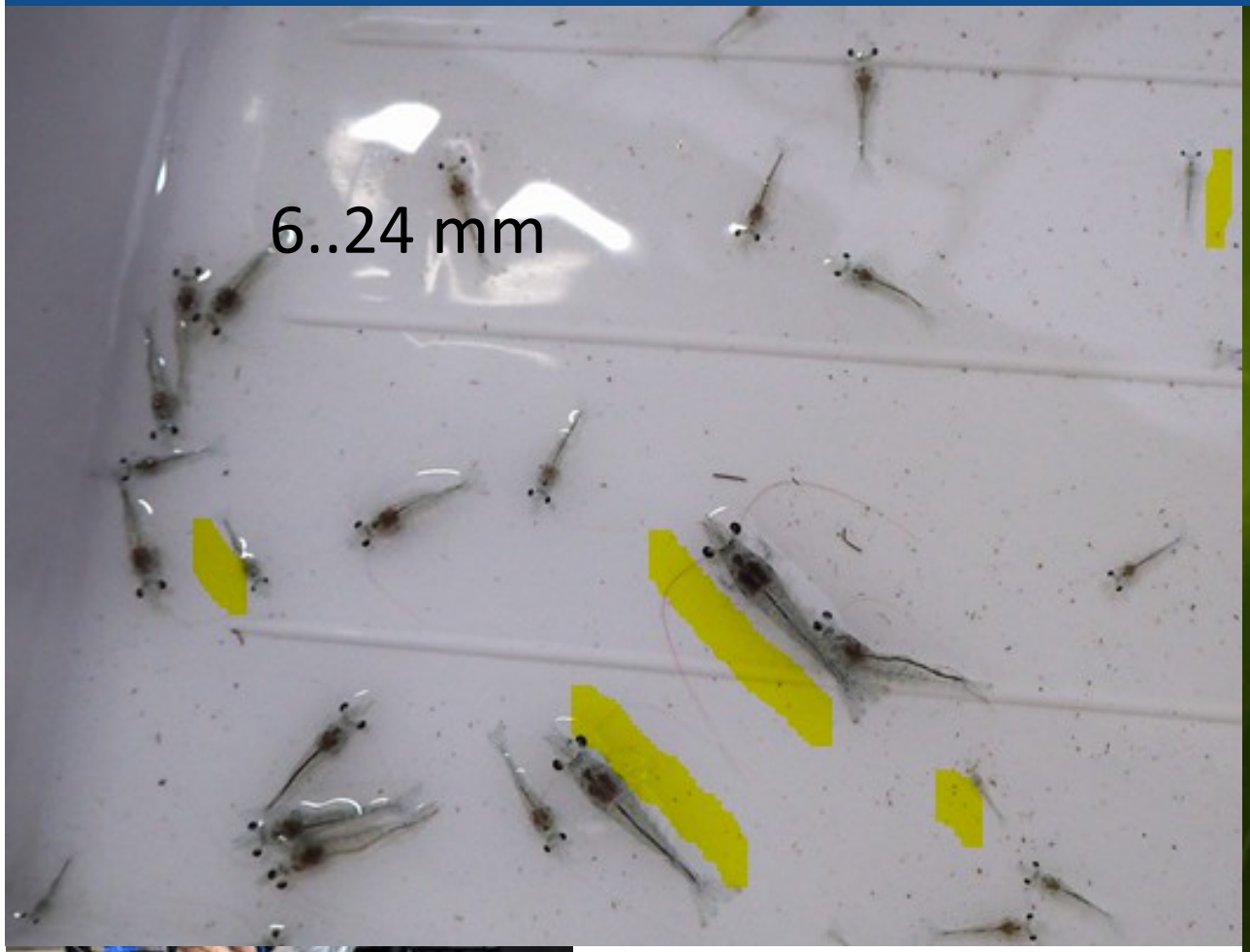
Shrimps counting



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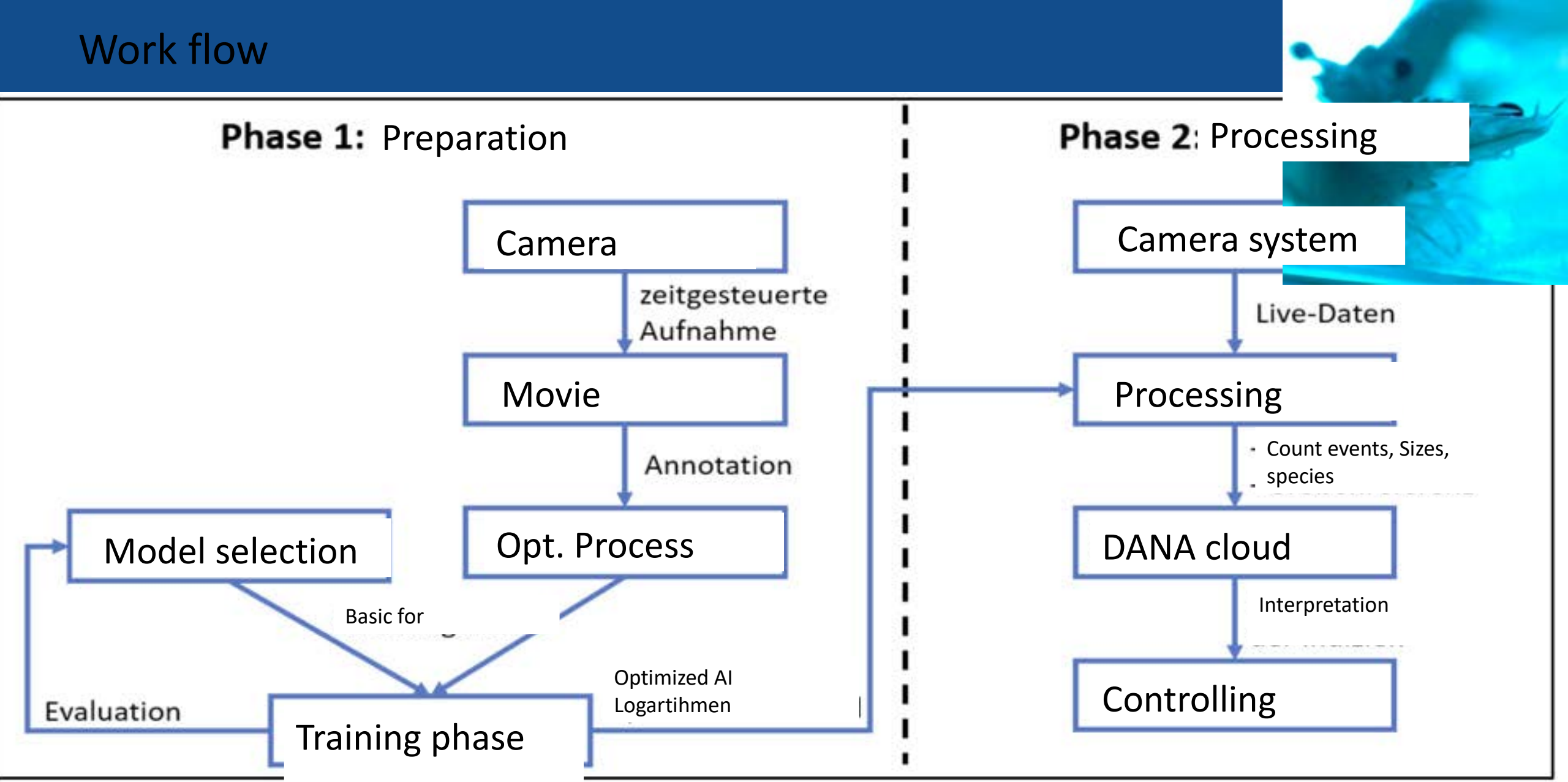
Work flow



Finishing of AI model

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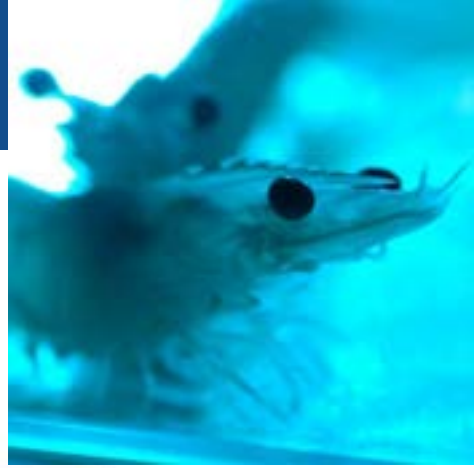
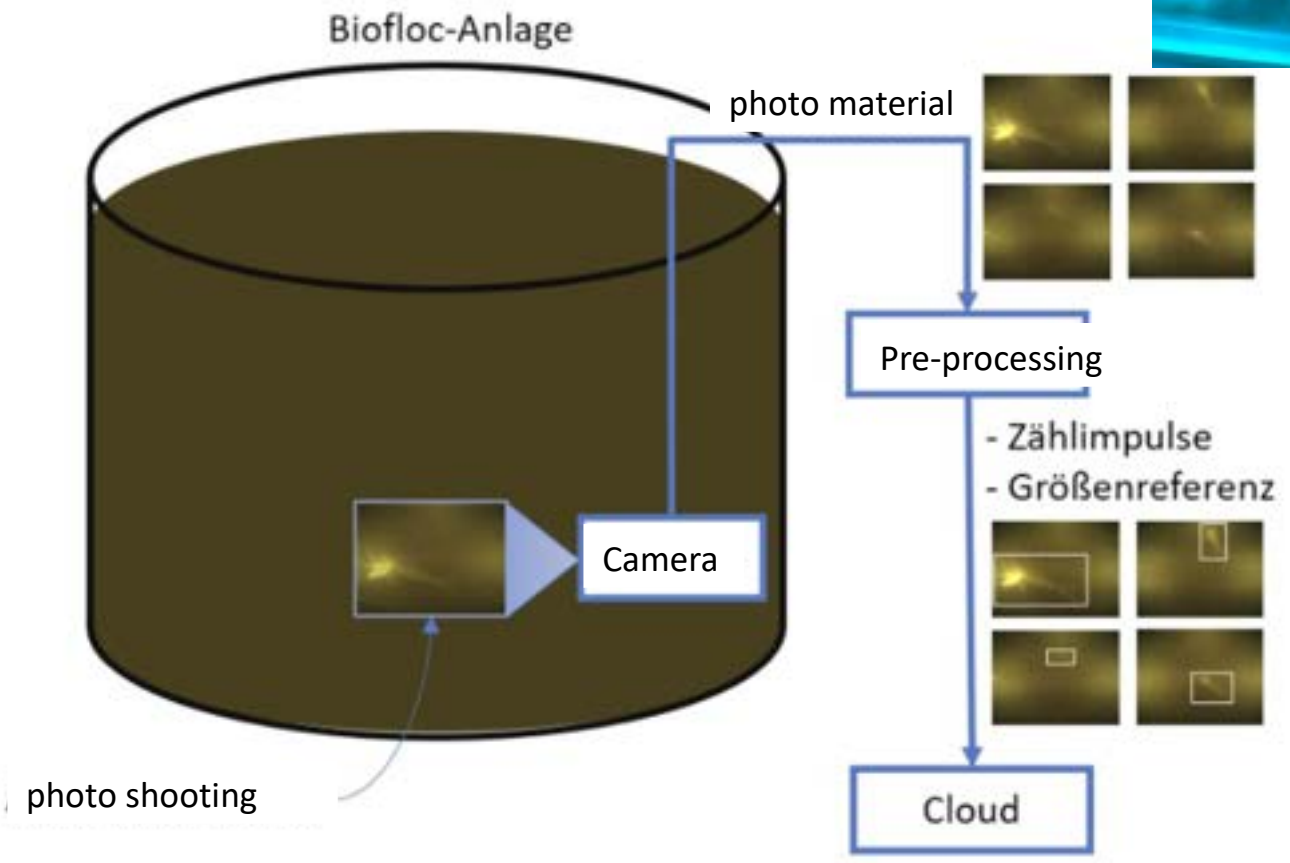
Application



Installation



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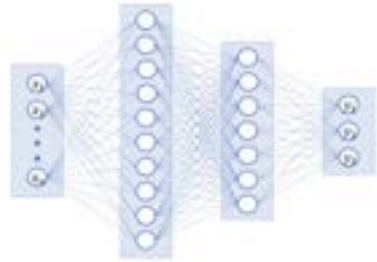
AI-Modell



Artificial Intelligence = Structures not programmed but derived by algorithms = machine learning

The algorithm is trained to derive the relevant structures that are necessary for the solution of given problems. (Deru and Ndiaye 2019, 17)

The distinction between the following three forms of machine learning is established:

Supervised Learning – supervised learning from annotated (data 5000 images marked by hand)

School education

Unsupervised learning – the unsupervised or completely automatic learning from non-annotated data

Fuzzy learning

Reinforcement Learning – the reinforcement learning from situations and experiences that are evaluated positively or negatively

DOG teaching

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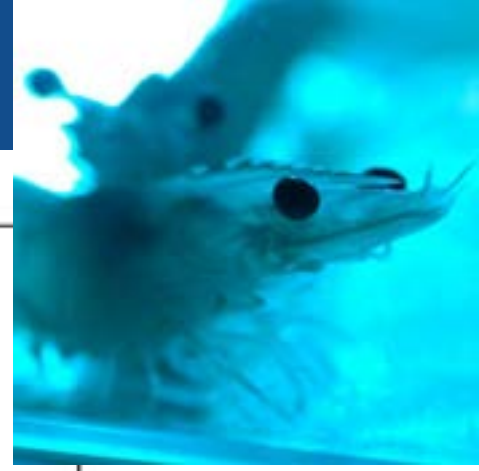
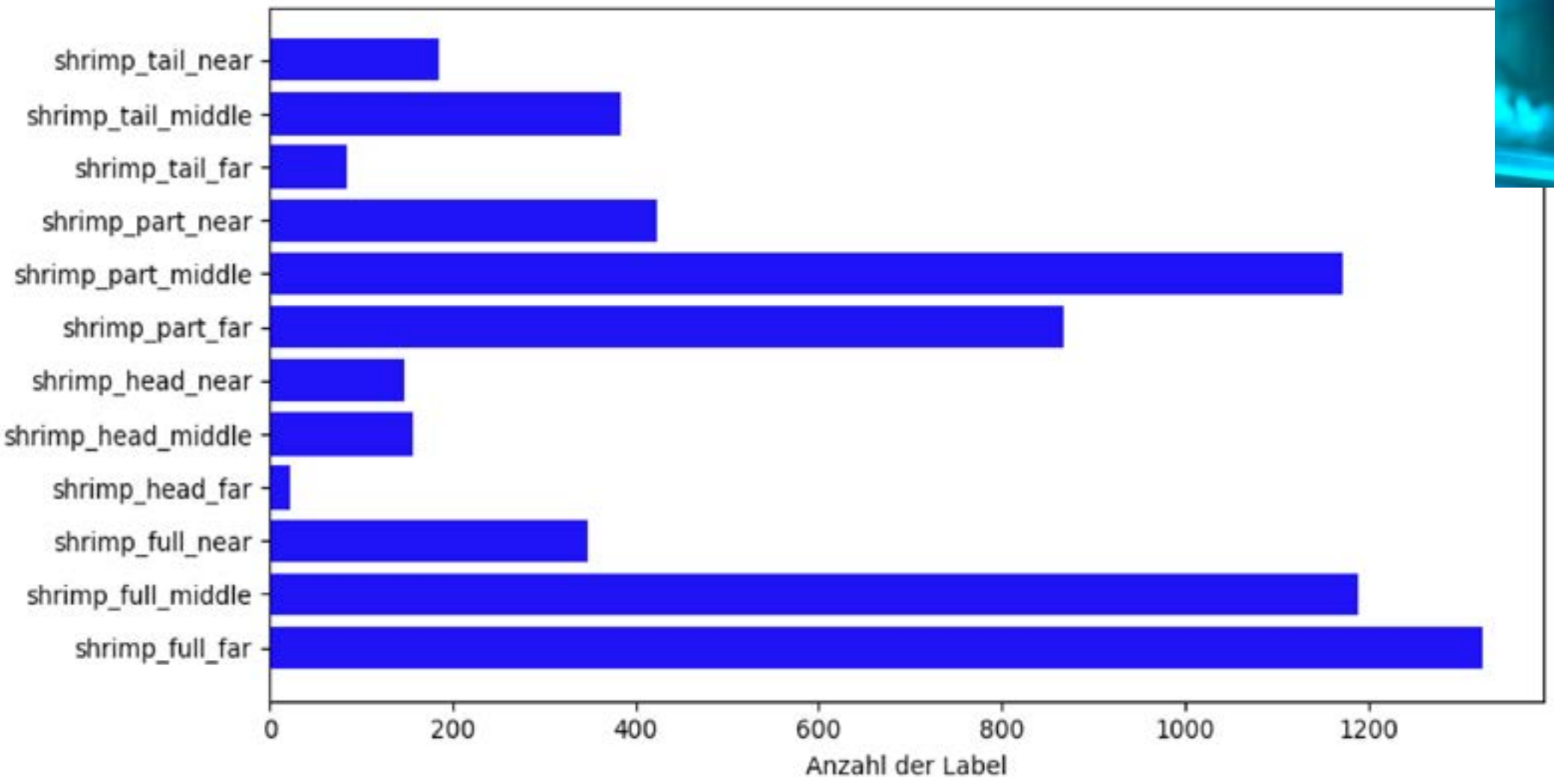
Counting results





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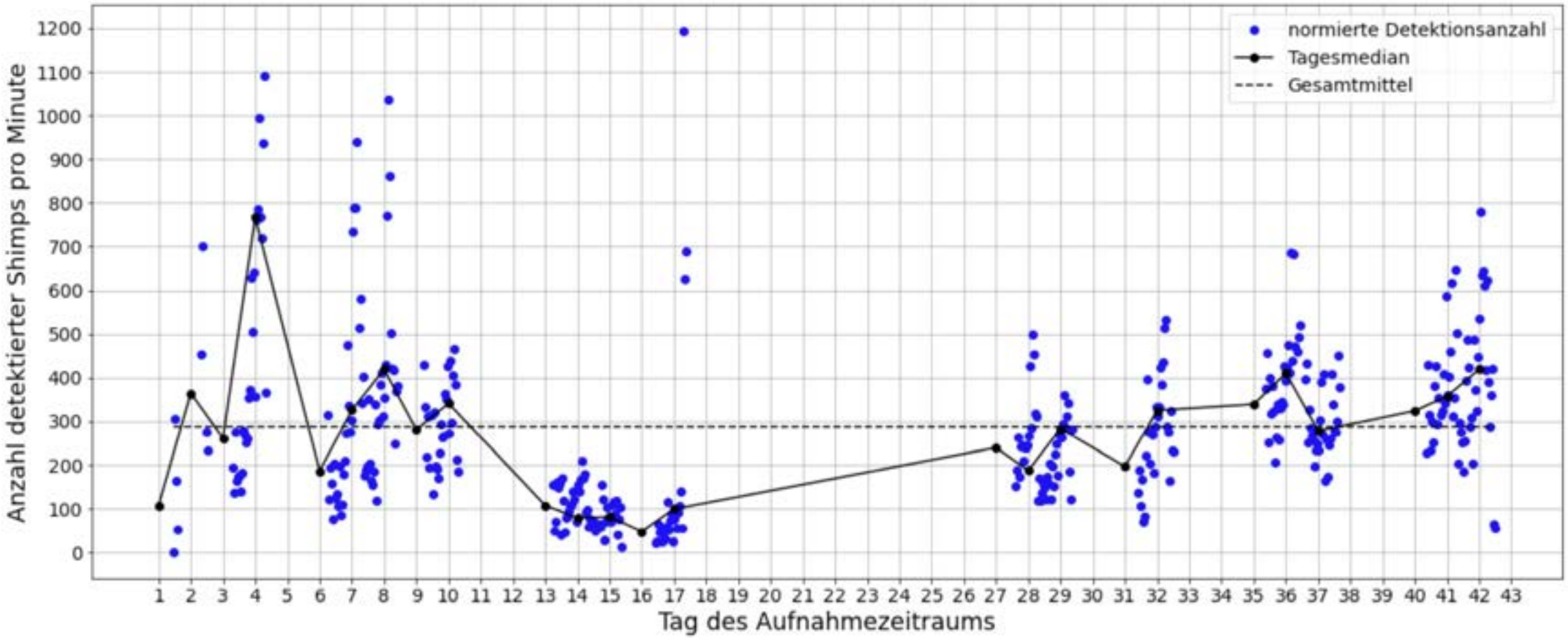
Shrimps counting, Aquaculture Damm, Batch: 18



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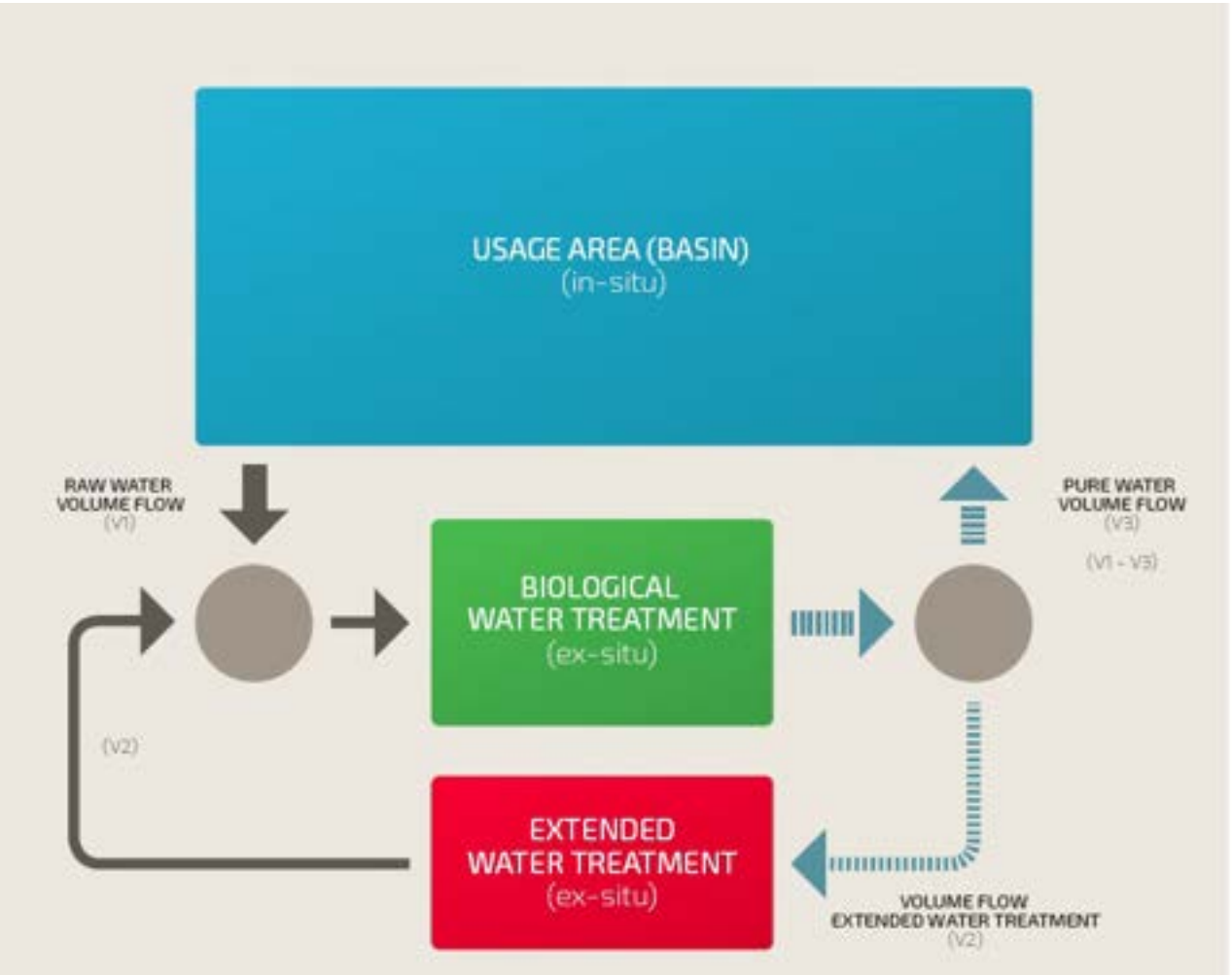
In Situ disinfection



Internal disinfection

- Zooplanker

=>the intelligent chlorine of the natural pools ?

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In Situ disinfection

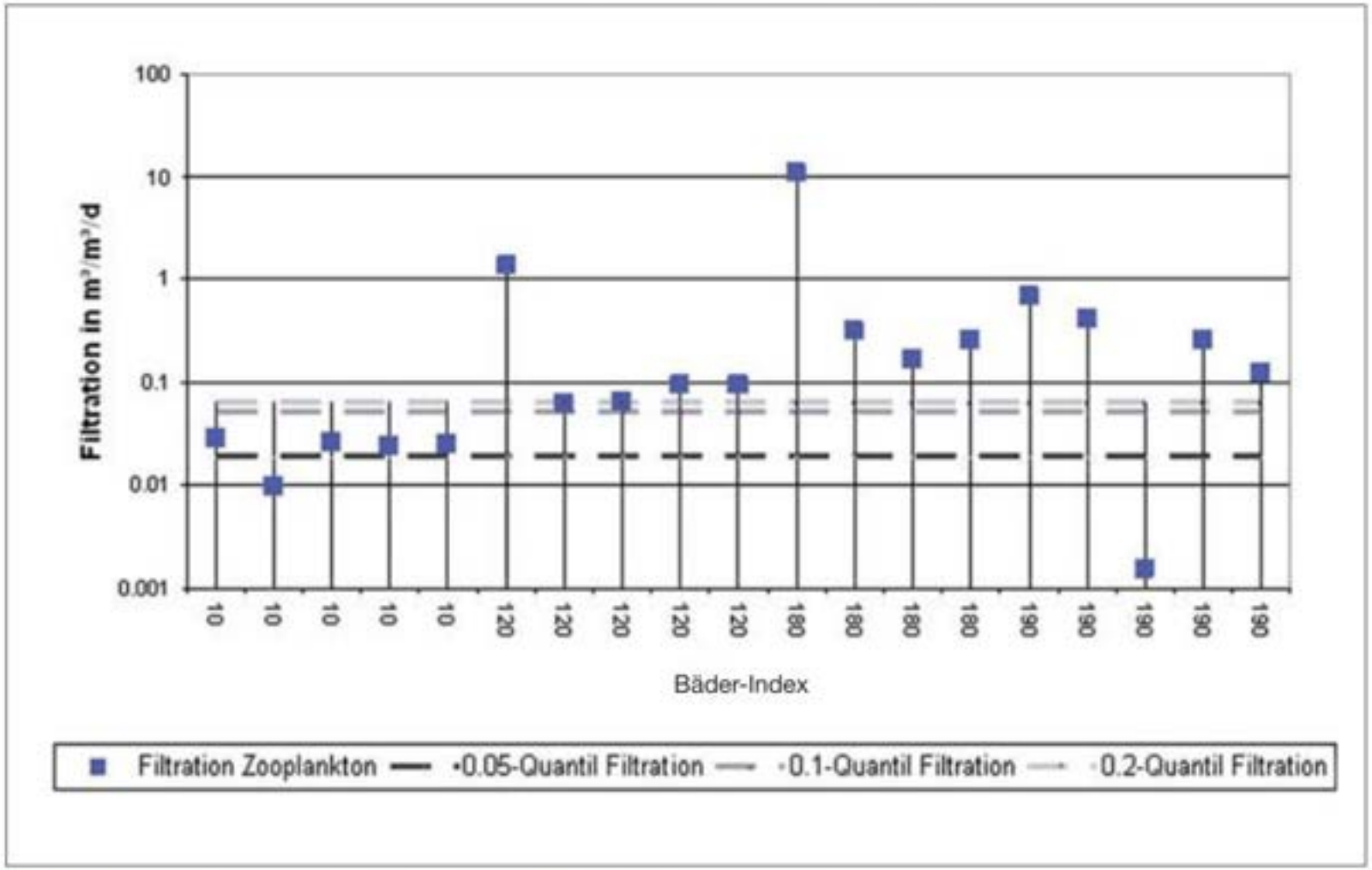

Abbildung 9: Gruppe 2, Darstellung der Filtrationsraten

Published in:

285 AB Archiv des Badewesens 05/2010 | Bädertechnik · Wasseraufbereitung

Author: Stefan Bruns

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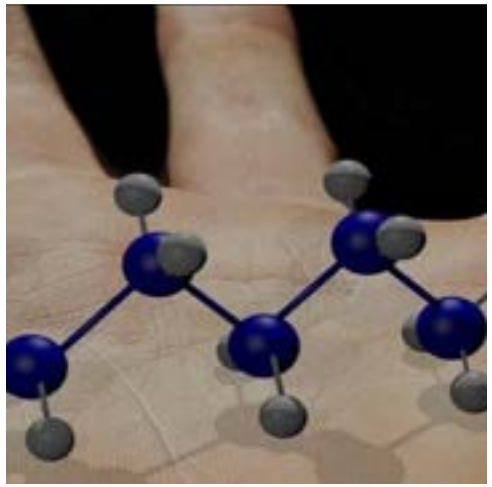

Internal disinfection in baths with biological

Internal disinfection in chlorine pool

- Disinfection with Chror is effective against many viruses and bacteria within minutes.
- It has almost no effect on protozoa and viruses with a stable shell. With regard to the latter, there is little research.

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Regelwerke

Adaption of the results to Zooplankton

Water treatment in the area of use (in situ) includes:

1. **Natural filtration by zooplankton**;
2. Reduction of microorganisms by solar radiation;
3. Preservation of nutrients by sedimentation.

For the dimensioning of the water treatment, only the filtration by the zooplankton is considered below. The daily cleaning capacity is estimated here with 0.04 m³ per m³ of pool water:

If higher values are used by the planner, the zooplankton populations must be determined quantitatively and qualitatively at least 1 time per month (FLL 6.1.2 for the procedure). The results shall be divided according to the following groups:

- Flagellata (Geißeltierchen); (0,002 ... 0,02 mm)
- Ciliata (ciliate); (0,01… 0,3 mm)
- Rotifera (Rädertierchen); (0,1 … 0,5 mm)
- Cladocera (water fleas); (3 … 4 mm)
- Copepoda (copepods, bouncy ones). (0,2… 2,0 mm)

Red= problem of scaling with the AI Proc.

I. Eydeler, Dr. J. Spieker: Germ elimination by zooplankton. Published in: Archiv des Badewesens March 2010, pp. 167 - 175

S. Bruns: Derivation of a new calculation method for determining the nominal number of visitors water purification in swimming and bathing ponds, taking into account the input sizes and the elimination performances; B Archives of bathing 05/2010 | Bathing water technology · Water treatment

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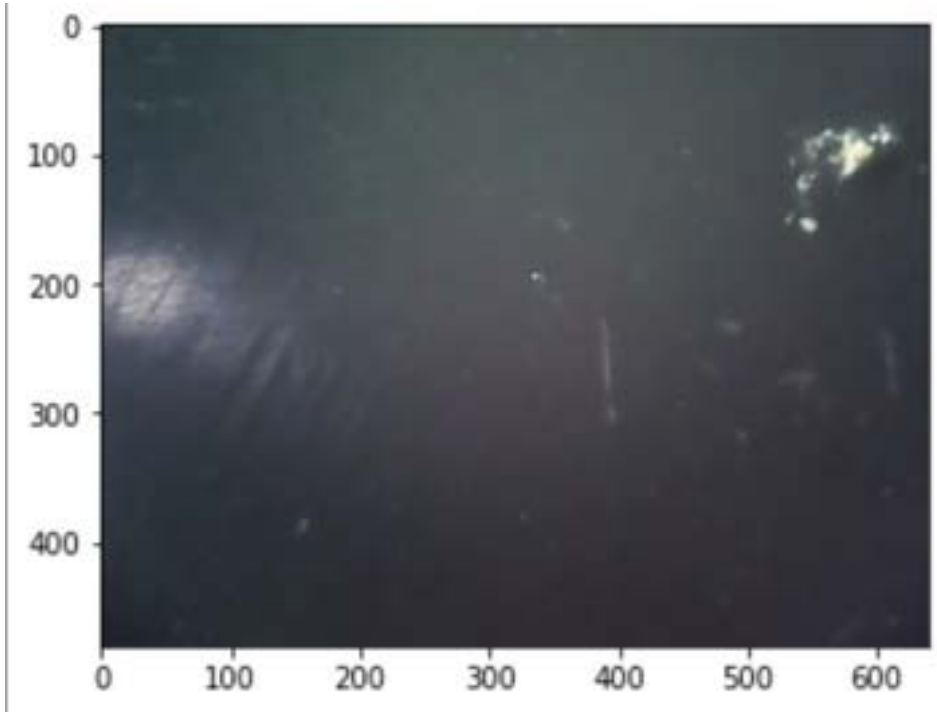
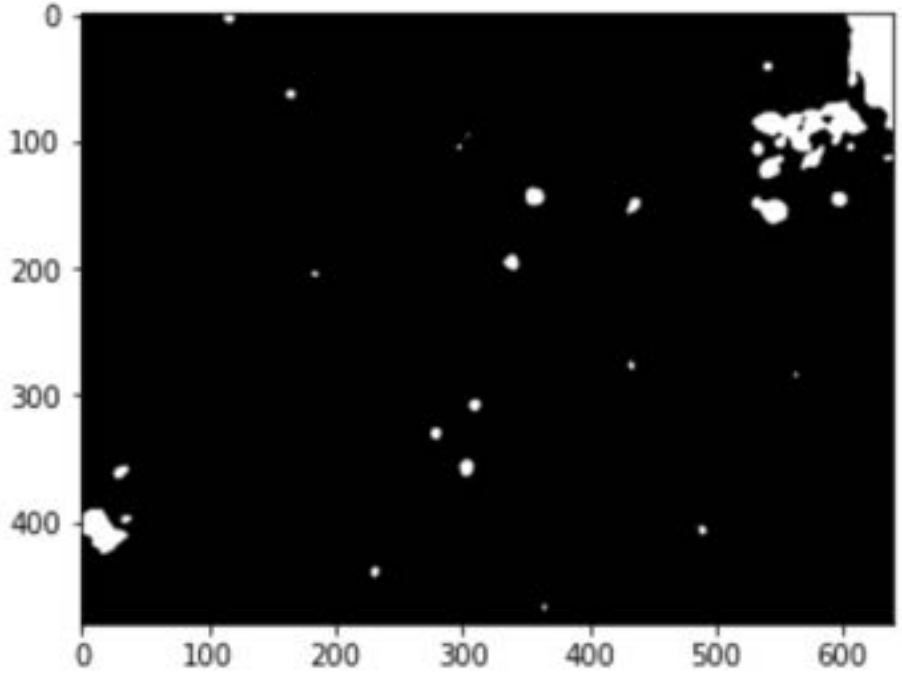
Adaption of the results to Zooplankton identification Pro-processing



Background calculated by the median of 30 sample frames, (one pixel = 80 µm).



Binary mask of subtractive motion detection

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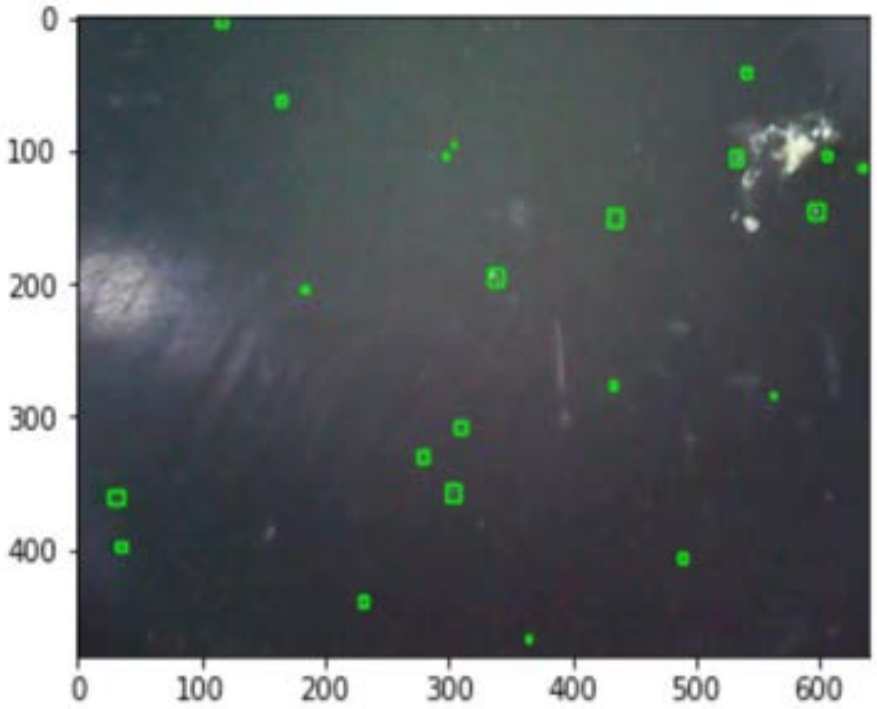
Adaption of the results to the Zooplankton application



Final result of the subtrativ movement indicator (max. Size of the objects smaller than 150 Pixel).

Detection of partikles in sizes beetween 80 µm upt to 10 mm legth

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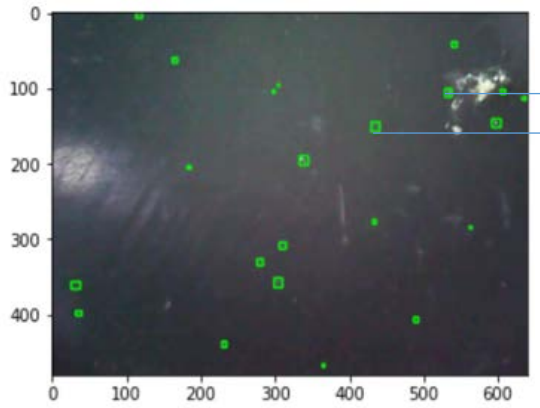
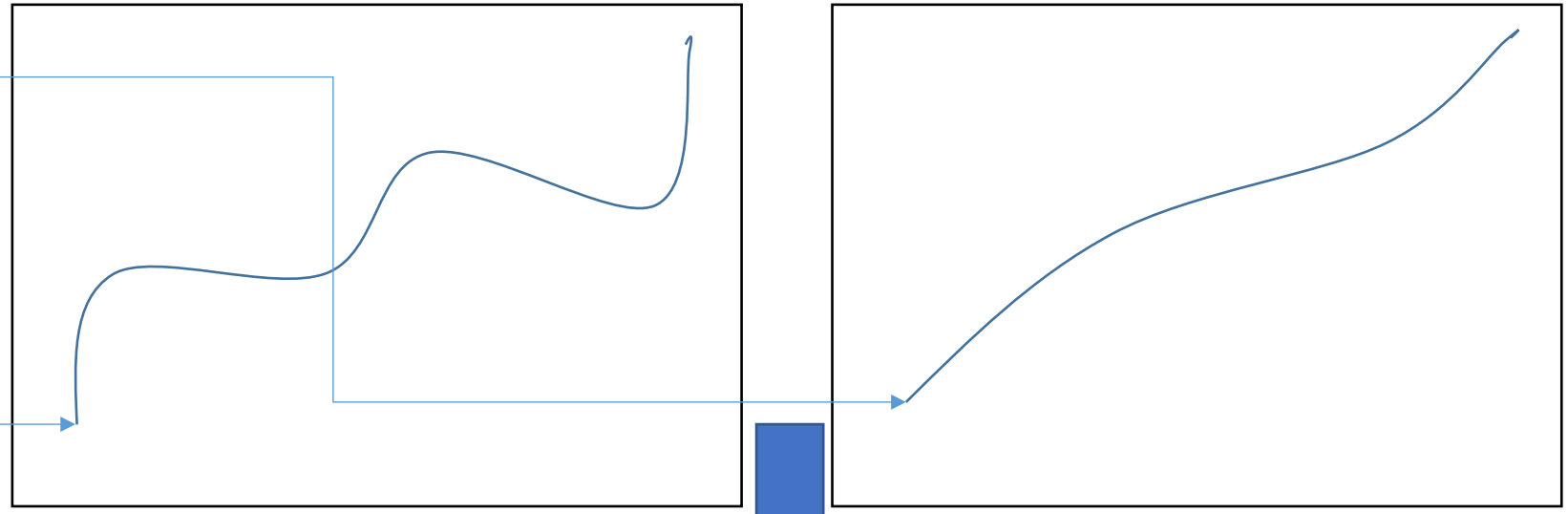
Adaption of the results to Zooplankton



Endergebnis der subtraktiven Bewegungserkennung (maximale Größe der Objekte von 150 Pixel).



5: Hypothetische Beispiele für getrackte Bewegungen.

Neuronal network
Number of Zooplankton / 100 µm

Field Analysis in Ind./m³

Regressions model

Result in Ind./ m³

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Next task for optimizing

Background
The background is not sufficiently homogeneous, which increases noise and false detections, the background reflects and has impurities that can also move and worsen the detection Housing, which allows you to choose different backgrounds

Reflections
Positioning of the light source perpendicular to the camera to prevent reflection

Current
The movement of the water in the natural pool is highly variable, both in direction and intensity Housing reduces flow, or allows only certain flow Light source

Light wave length
For further analysis, different light sources will be used to take advantage of possible advantages of these light sources, possibly fluorescing zooplankton at a certain wavelength, allowing the color to be incorporated as another filter and thus for noise reduction.

Camera

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Thanks

Thanks to:

1. **The EU Government for funding and collaboration**
2. **BIBA Institute of artificial Intelligence for Collaboration in terms of artificial intelligence and Neurologic networks**
3. **SWMS For the collaboration in the Mathematic modeling**
4. **The DANA Team for implementing the Data to the DANA platform**

DBU

DiH4CPS

Fostering DIHs for Embedding Interoperability in Cyber-Physical Systems of European SMEs

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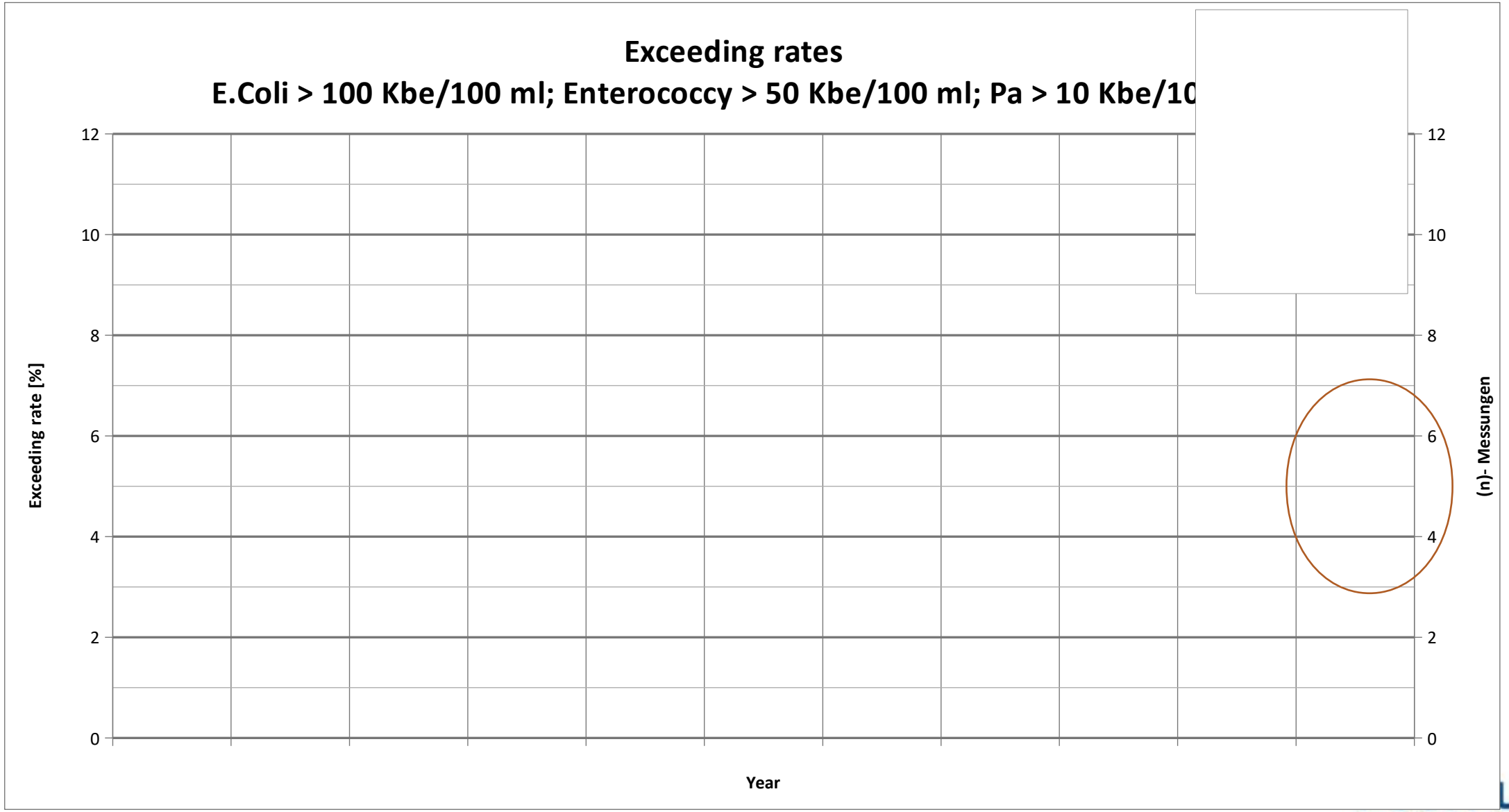
Results


Exceeding rates
E.Coli > 100 Kbe/100 ml; Enterococcy > 50 Kbe/100 ml; Pa > 10 Kbe/10
Exceeding rate [%]
(n)- Messungen
Year
0
2
4
6
8
10
12

?

Conciderations for the relative high exeeding rate regaring E.coli

I. Approx. 30 % lower bather frequencies 2021

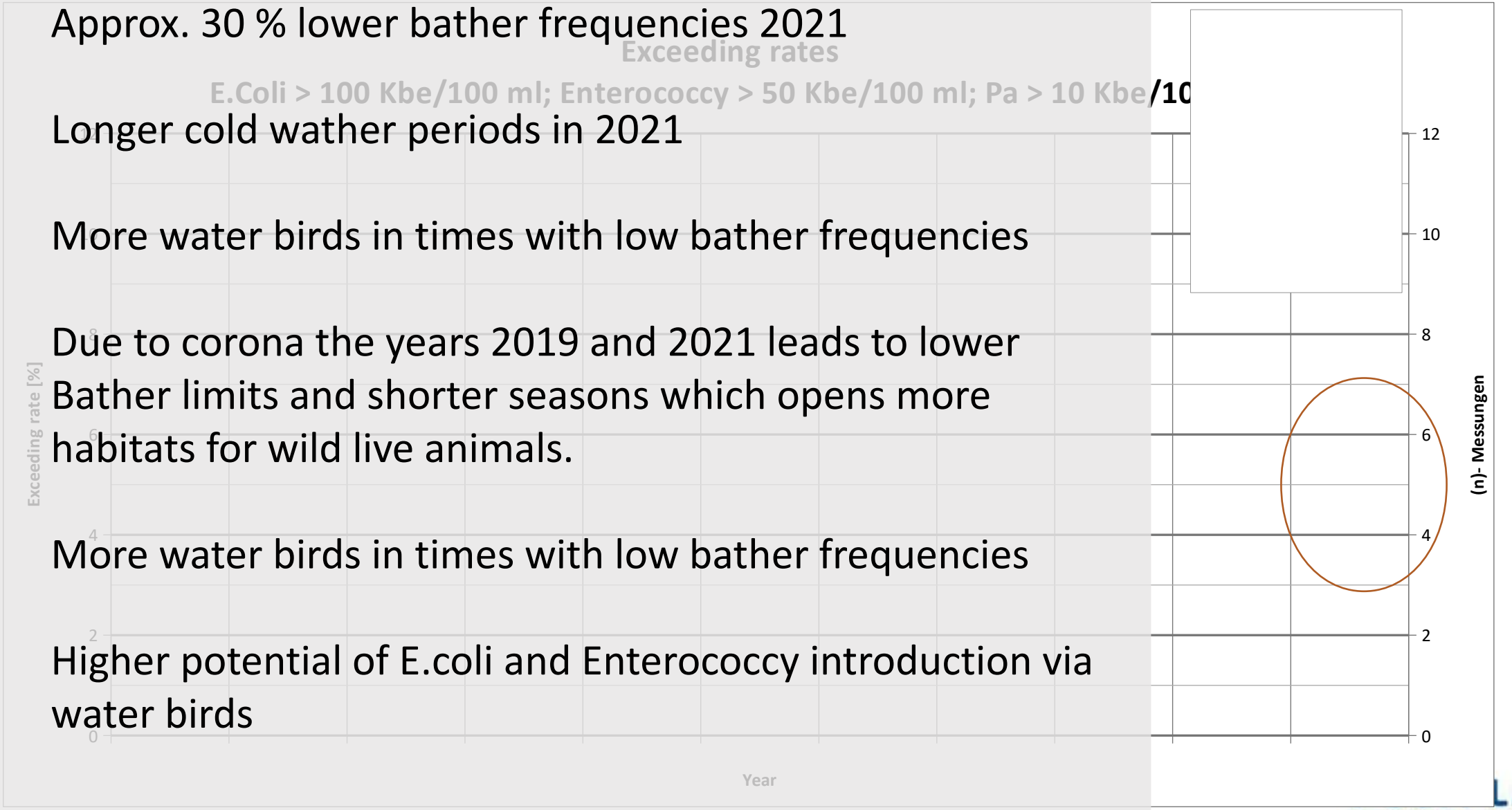
II. Longer cold wather periods in 2021

III. More water birds in times with low bather frequencies

IV. Due to corona the years 2019 and 2021 leads to lower Bather limits and shorter seasons which opens more habitats for wild live animals.

V. More water birds in times with low bather frequencies

VI. Higher potential of E.coli and Enterococcy introduction via water birds



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