



Lake Rauwbraken

1

beach and playground
under water park (dive lake)

Problem

Blooms of Cyanobacteria
Plankthorix
Aphanizomenon

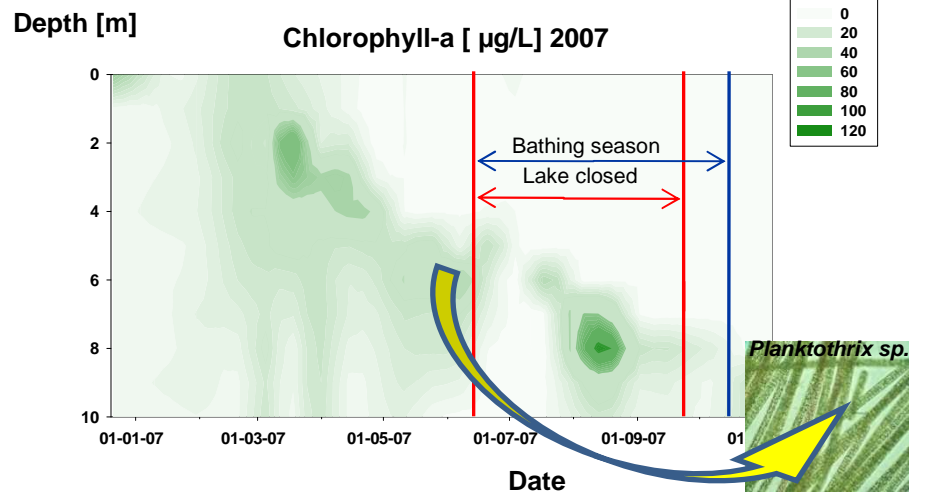
Toxic
Foul odour

Main features

sand excavation (4 Ha., max. depth 15 m)
standing water
stratifying
eutrophic to hyper-eutrophic

Baseline

2



Treatment

Flock and Lock

In-lake phosphorus binding.



3

Applying Flock and Lock

Day 1: dephosphatization by application of 4 tonnes Lanthanum modified clay (Phoslock®).

Day 2: flocculation, 2 tonnes of Poly Aluminium Chloride (PAC), buffered with 200 kg Ca(OH)₂.

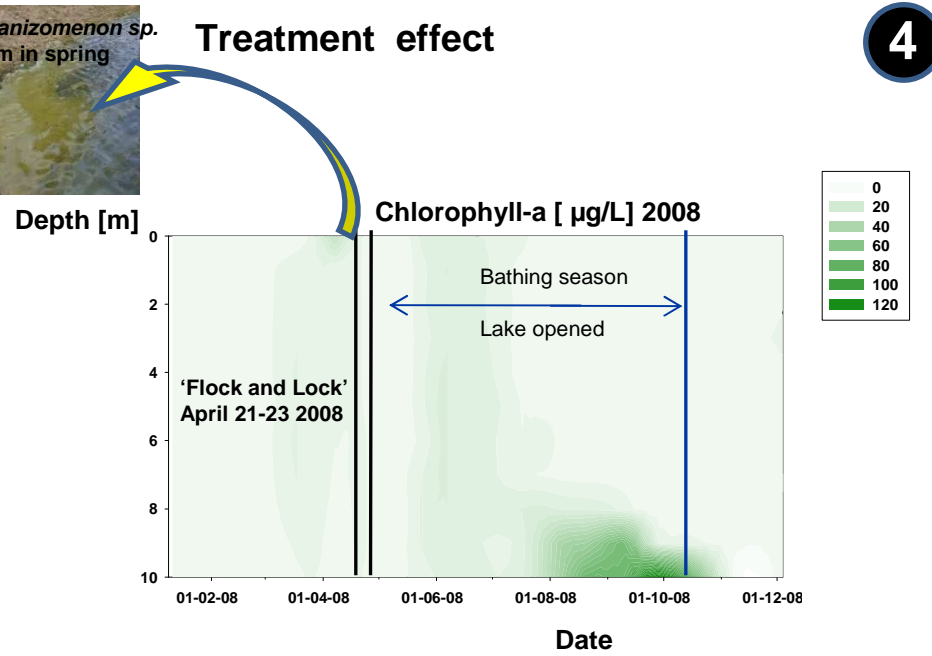
Day 3: sediment capping by an addition 16 tonnes of Lanthanum modified clay (Phoslock®).



Shortly after flock and lock

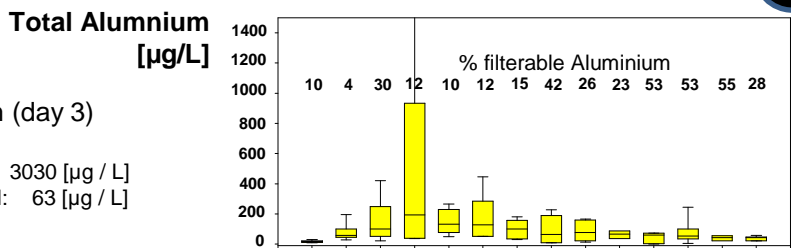
Treatment effect

4



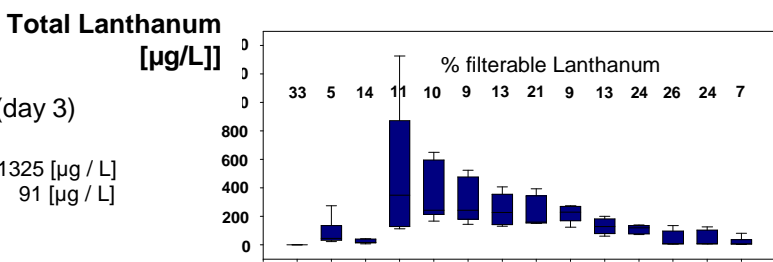
Aluminium and Lanthanum

5



Maximum (day 3)

Total Al: 3030 [µg / L]
Filterable Al: 63 [µg / L]



Maximum (day 3)

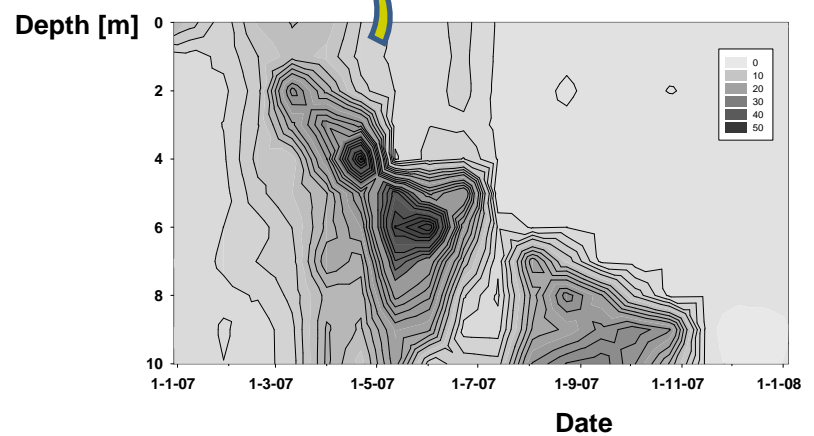
Total La: 1325 [µg / L]
Filterable La: 91 [µg / L]

Day (within treatment) Date
-1 1 2 3 4 5 6 8 10 18 23 65 76 109
20.04.08 26.04.08 01.05.08 08.08.08



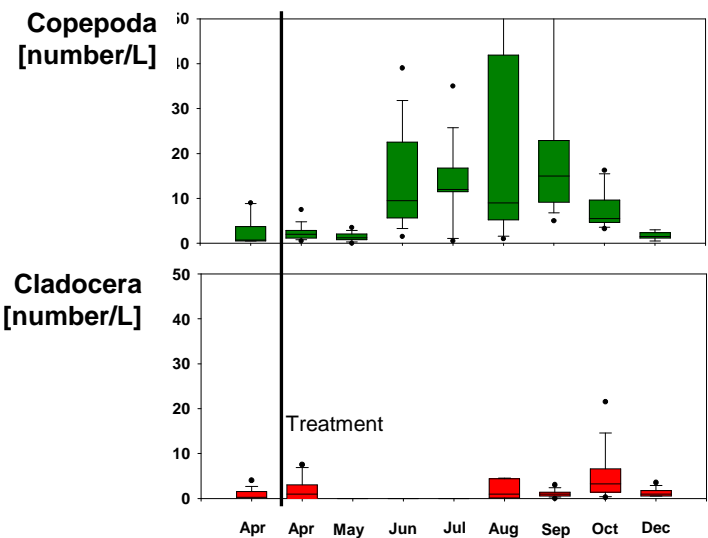
2007 Turbidity [NTU]

6



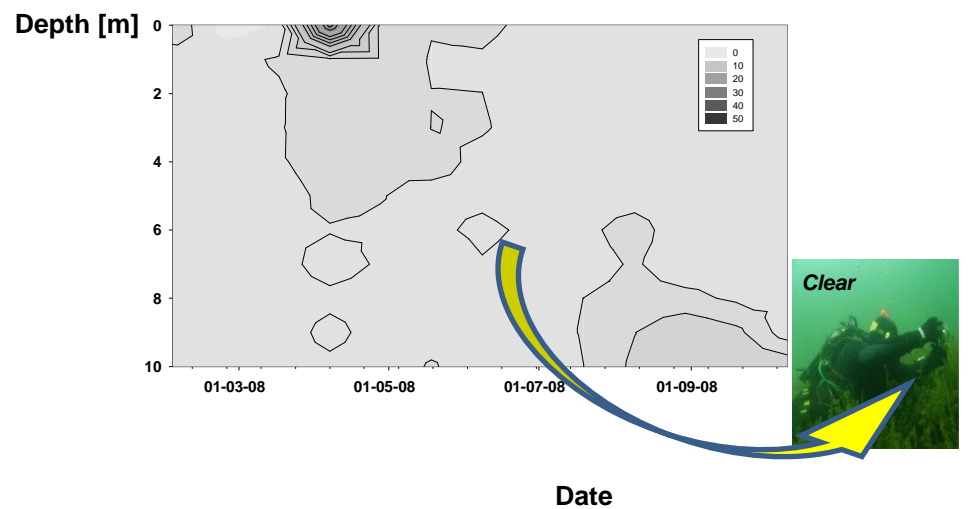
Zooplankton

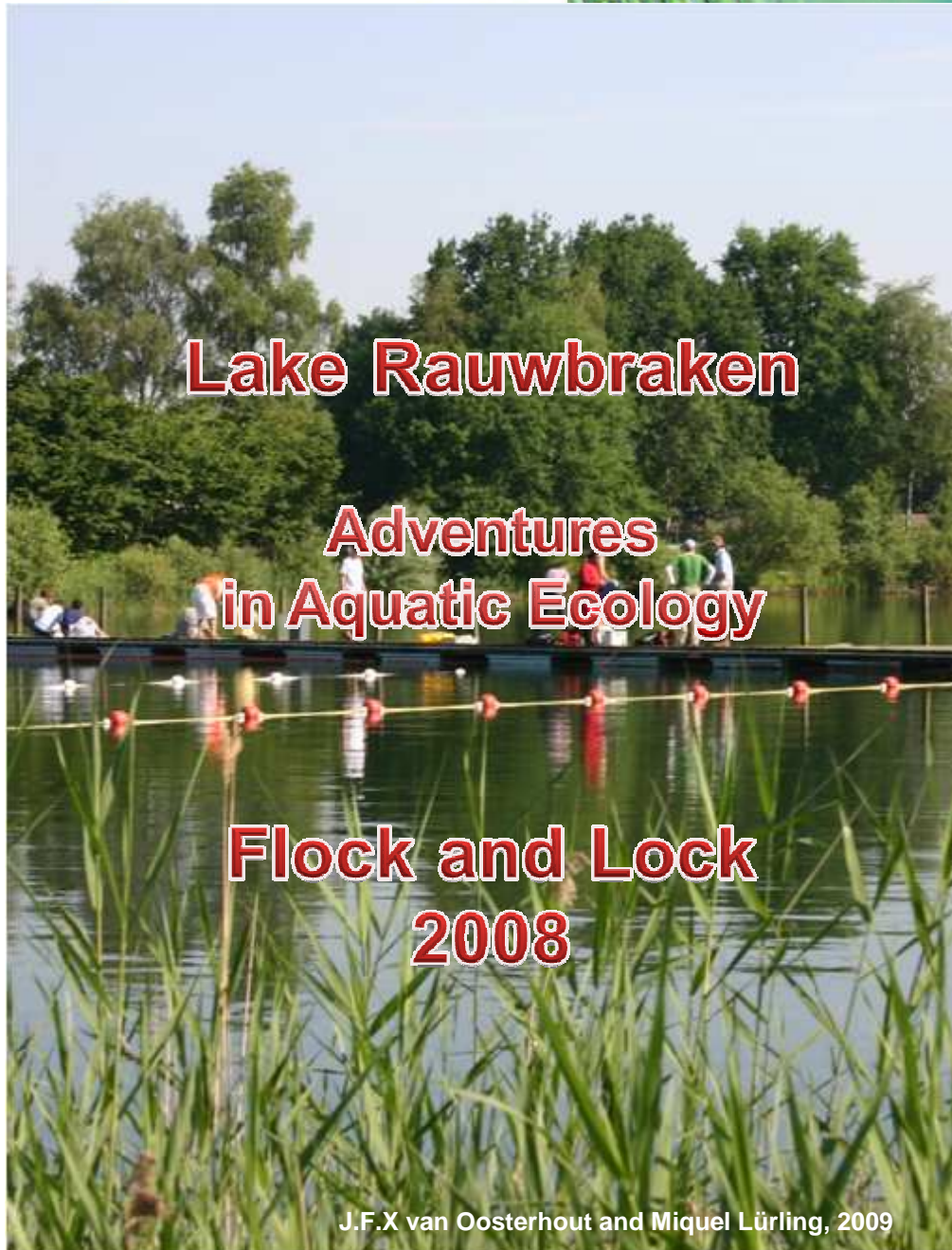
7



2008 Turbidity [NTU]

8





Lake Rauwbraken (Tilburg, Netherlands) has a history of several cyanobacteria blooms which result in closure of the lake to all recreational use. After 2 years of intensive monitoring by the Department of Aquatic Ecology and Water Quality Control of Wageningen University (the Netherlands), it was decided that 'flock and lock' was the most promising treatment for this lake. Pre-treatment total Phosphorus ranged from 4 – 944 µg/L, mean 150 µg/L (sediment 1 g/kg). In April 2008, the lake was struck by a bloom of *Aphanizomenon sp.* Much of its biomass accumulated in heavy scums, which resulted in lower total-P, chlorophyll-a values and turbidity [NTU] as observed during the monitoring program. Due to the bloom of *Aphanizomenon sp.* no recreational use was anticipated in Spring 2008. However, Lake Rauwbraken could open to the public, free of Cyanobacteria, just 2 days after the flock and lock treatment. The lake remained open for the entire 2008 swimming season. Post treatment total Phosphorus fell below 10 µg/L.

2 years monitoring (2006, 2007), continued (2008-2009)

- Temperature, oxygen, pH, turbidity, Secchi-depth;
- Suspended solids, chlorophyll-a;
- Nutrients: N,P, C (total and dissolved)
- Phytoplankton composition

Total chlorophyll-a (fig 2,4) and turbidity (fig .6,8): bi weekly depths 0 ,1,2, ..10 [m]
Aluminium and Lanthanum (fig. 5) statistics based on depths 1,3,5,7,10 [m]
Zooplankton (fig. 7) statistics based on median per month , depths 0,1,2,...10 [m]

Photography: Miquel Lurling, Frank van Oosterhout, Vincent van Hoof.

Colofon:

Rauwbraken under water park is an initiative by the Dutch Under Water Parks Foundation, a non-profit organization to promote water related recreation, natural history education and research in the field of aquatic ecology.

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PHOSLOCK®
Phoslock Europe GmbH

Phoslock® was developed jointly by the Australian Government's Commonwealth Scientific Research Organization (CSIRO) and the Western Australian Government's Water and Rivers Commission (WRC) and is now manufactured and sold by Phoslock Water Solutions Ltd of Sydney, Australia. In Germany Phoslock® is marketed under the name Bentophos. An application of Phoslock® can be considered an *in situ* dephosphatization measure.



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