



# **Effect monitoring for endocrine disrupting substances in the Rhine river**

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# Association of Rhine Water works

**Dutch nat'l level: RIWA**

**Internat'l Rhine basin level: IAWR**

**Mission:**

Source water quality should allow drinking water production using simple treatment only!

# RIWA / IAWR

- **Initially “Pressure group” fighting water pollution**
- **Confronting polluters / decision makers with WQ data and demands**
  - *Strategy: actions based on sound science / hard evidence only!*
  - *Gradual shift from confrontation to cooperation*
- **Several Rhine memoranda (latest 2008)**
  - *WQ objectives for pollutants of concern*
  - *recommendations on pollution reduction*

# RIWA WQ monitoring network (part of IAWR basinwide network)

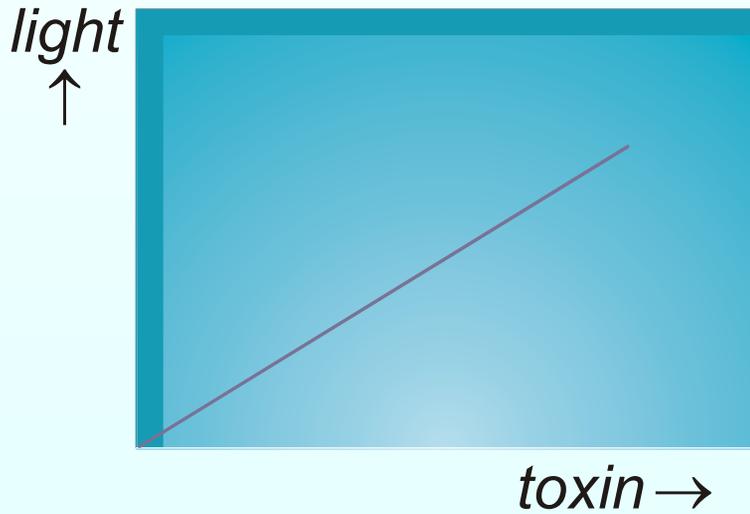
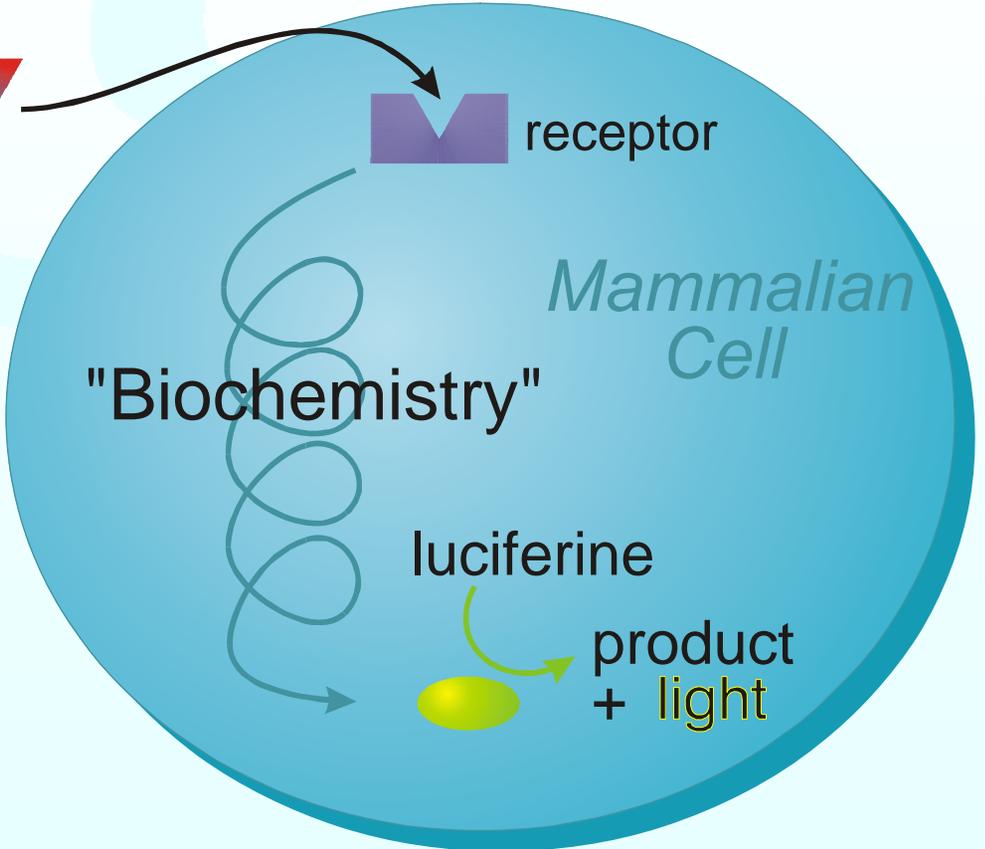
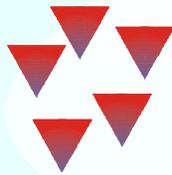
- **Cooperation with Nat'l Dutch and German water authorities**
  - *Harmonized program (WQ variables, methods, data exchange,...)*
- **Five locations in the Dutch part of the Rhine basin**
  - *German-Dutch border, intake sites*
- **Trend detection and compliance testing**
  - *“legal standards” & “emerging contaminants”*
  - *Chemical & biological*

# Why effect-oriented monitoring?

- **Much more is out there than can be seen using regular chemical monitoring**
- **No info about the effects of the cocktail**
  - *EDCs, cholinesterase inhibition, genotoxicity, ...*
- **Do such effects hamper ecosystem development / sustainability?**
- **Are such effects reduced during drinking water treatment?**

# The CALUX test (Chemical Activated Luciferase Expression)

hormone disrupting  
chemicals



# Endocrine disruption measurements used in this project:

(all CALUX-modifications)

- **Estrogenic activity**
  - *ER $\alpha$*  CALUX (17 $\beta$ -estradiol, > 0.002 ng/L)
- **Androgenic activity**
  - *AR*-CALUX (dihydrotestosterone, > 0.01 ng/L )
- **Progestagenic activity**
  - *PR*-CALUX (Org2058, > 0.01 ng/L)
- **Glucocorticoid activity**
  - *GR*-CALUX (dexamethazone, > 0.5 ng/L)
- **Thyroid activity**
  - *TR $\beta$* -CALUX triiodothyronine, > 0.3 ng/L)

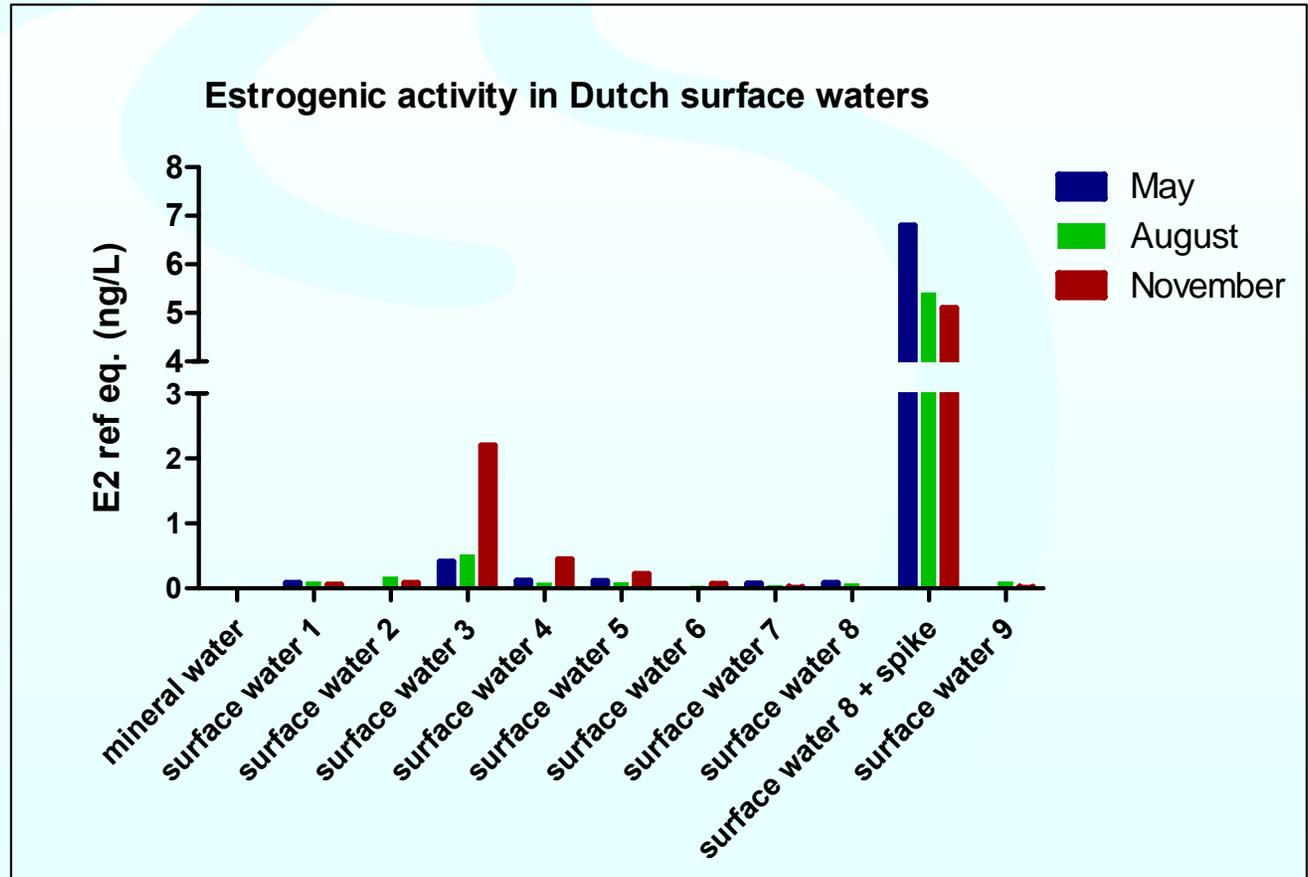
# Warning

- **Effect measurements are not limited to target compounds**
  - *several environmental pollutants have endocrine disrupting properties (atrazin, bisphenol A,...) → Interference*
- **Results expressed as “equivalents” of reference cpd**
  - *unknown mixture, thus indirect estimation of levels*

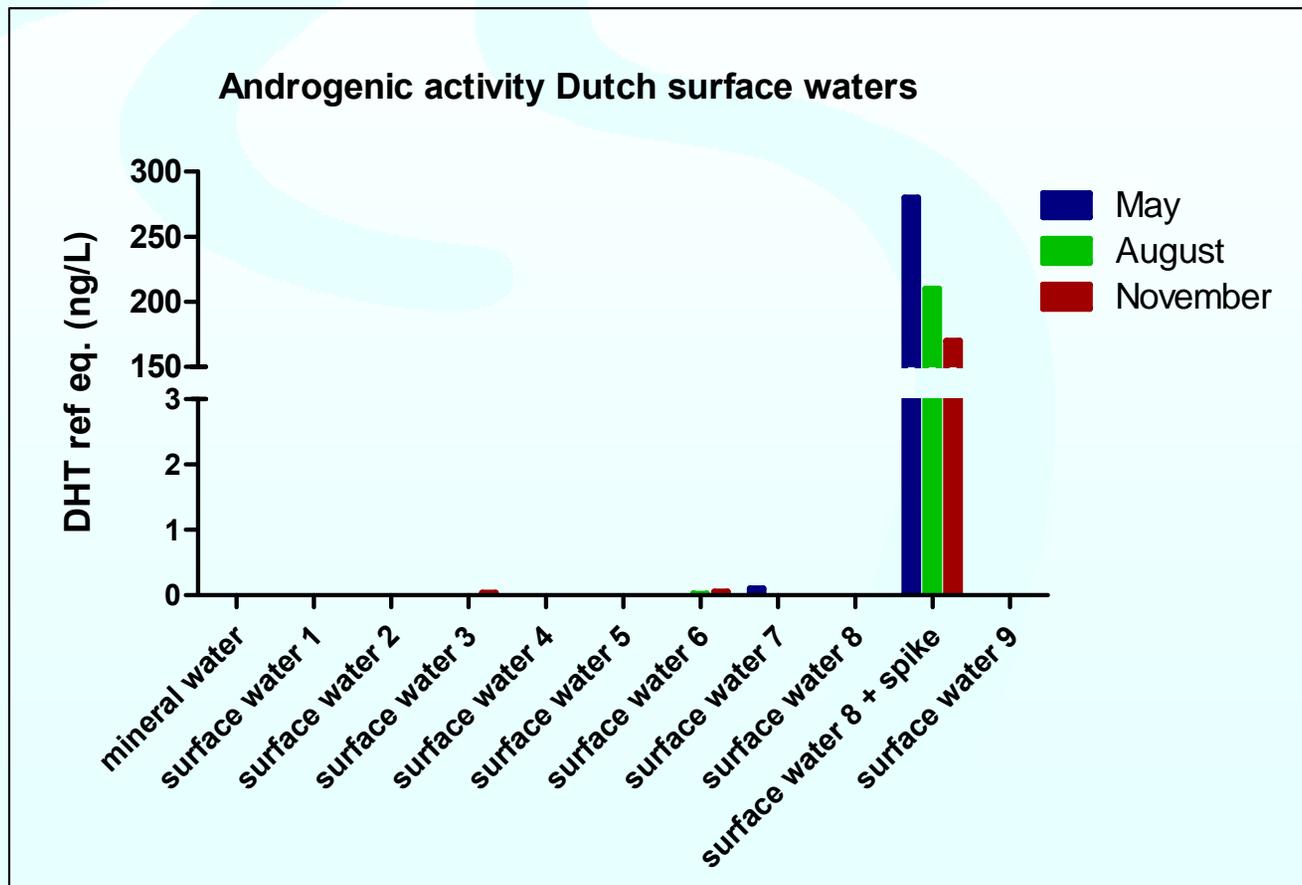
# Sampling sites



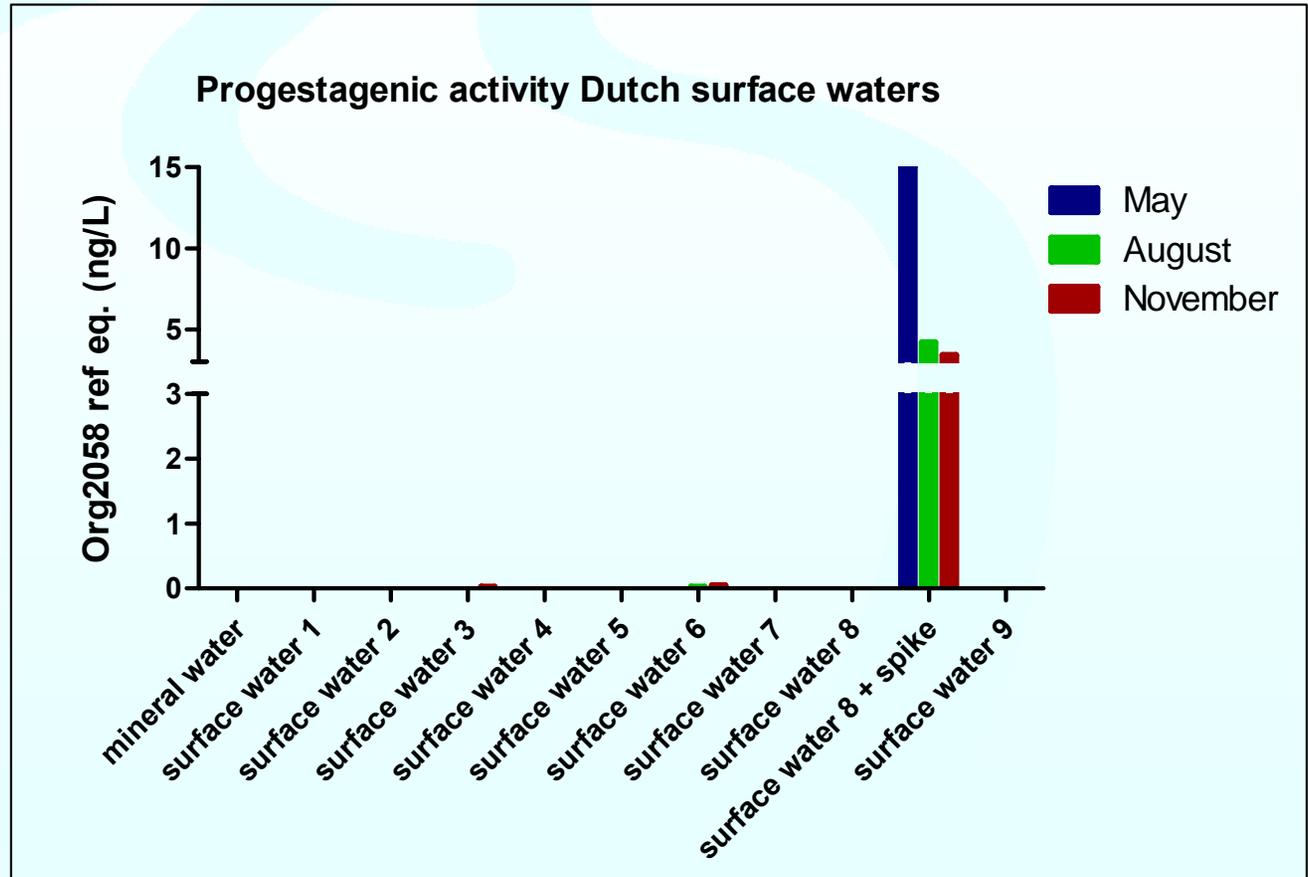
# Results



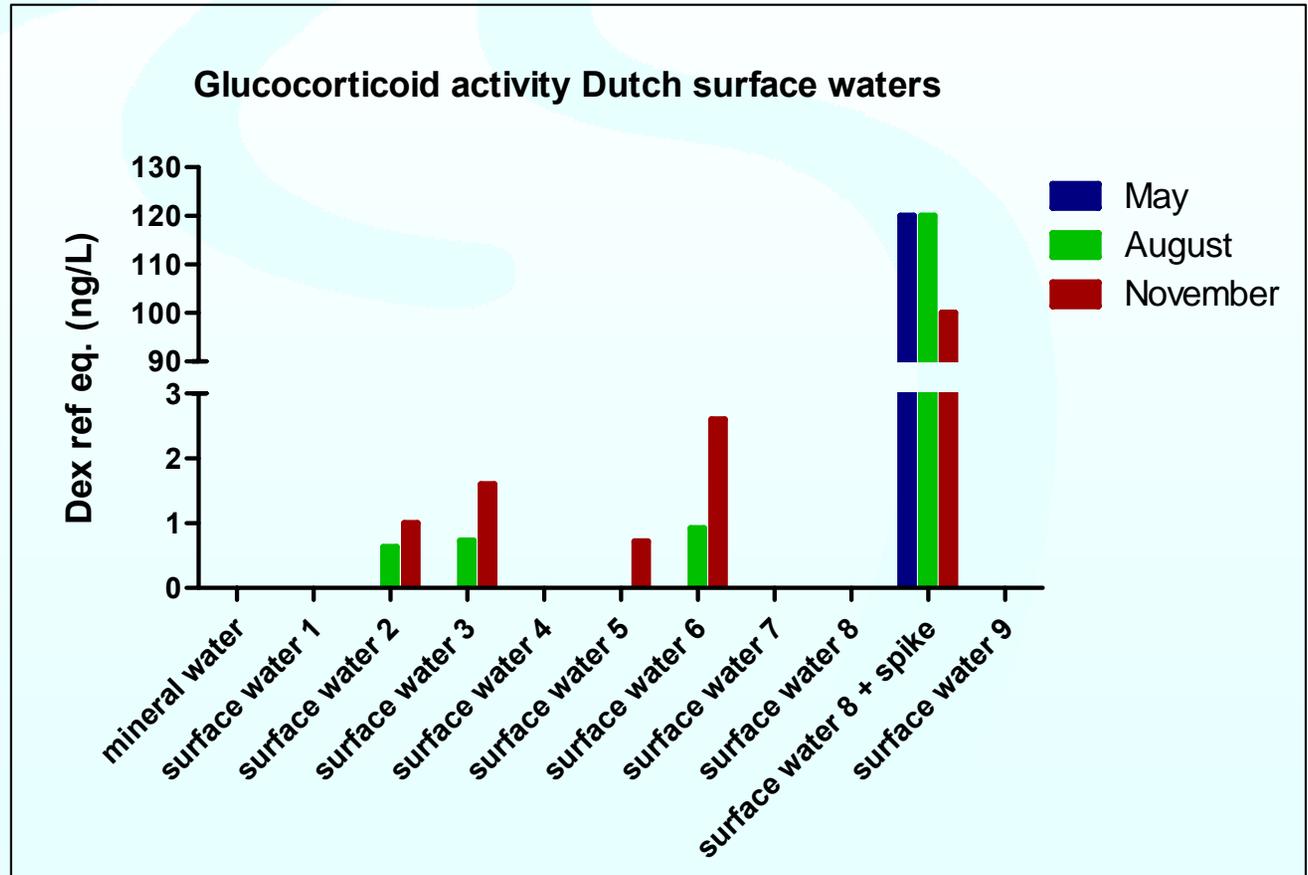
# Results



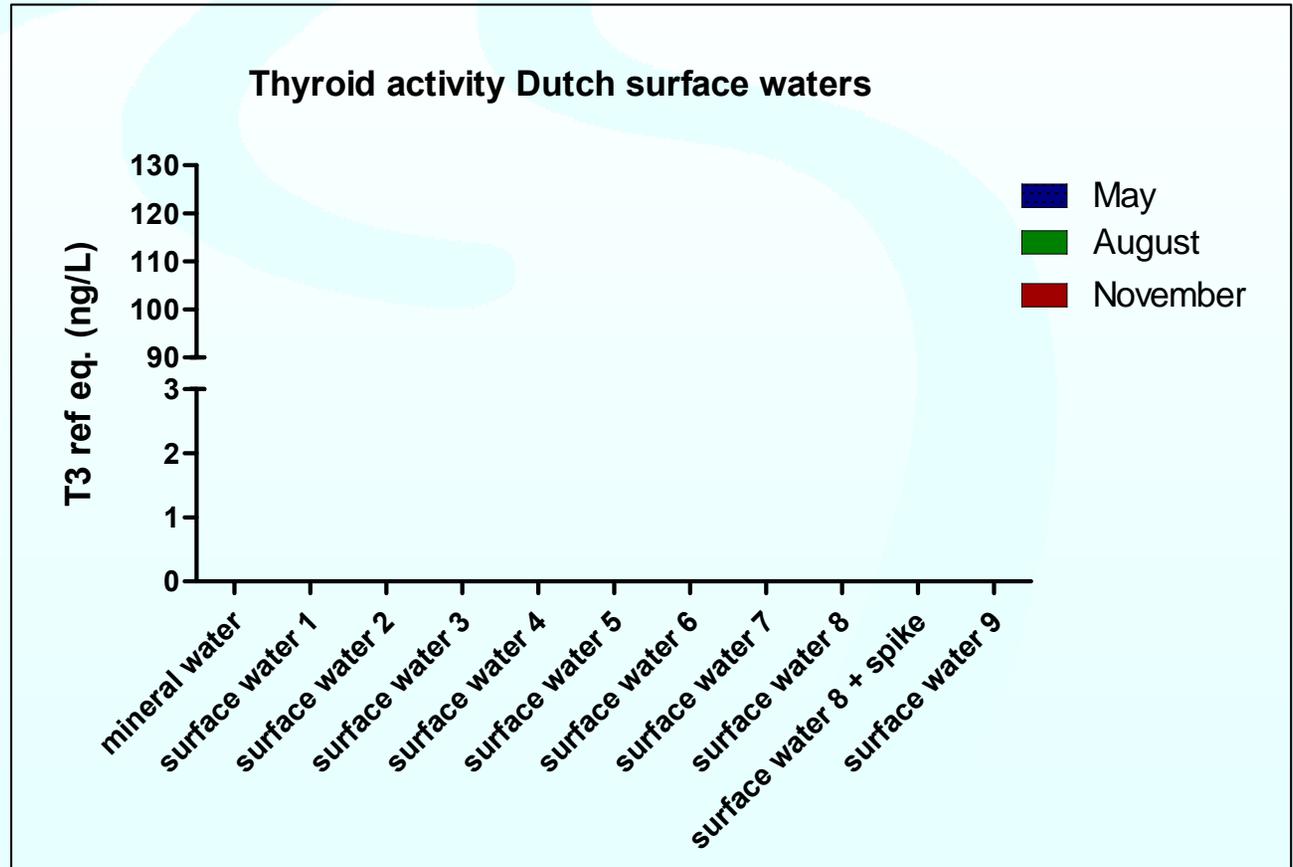
# Results



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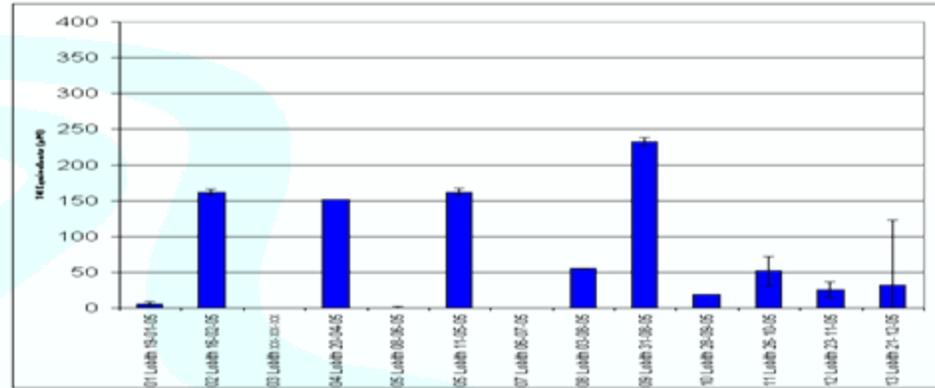
# Results



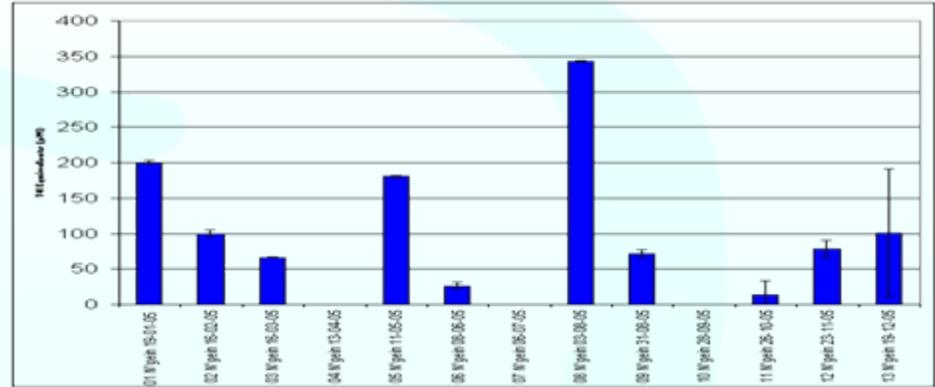
# Earlier Thyroid results

(1 pM ~0.7 ng/L)

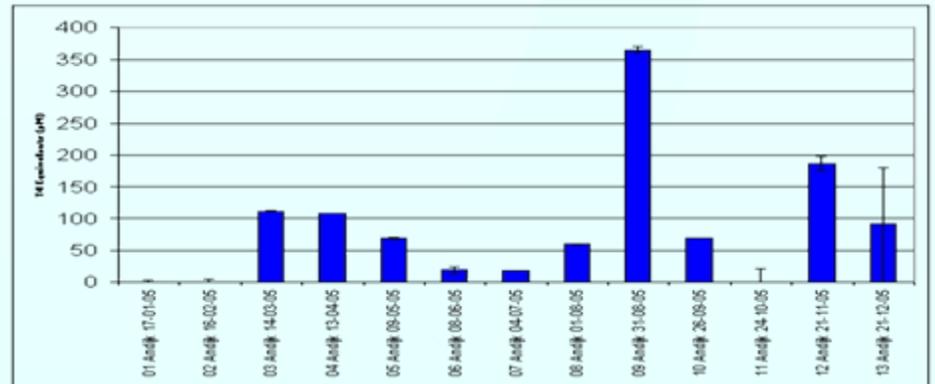
Lobith



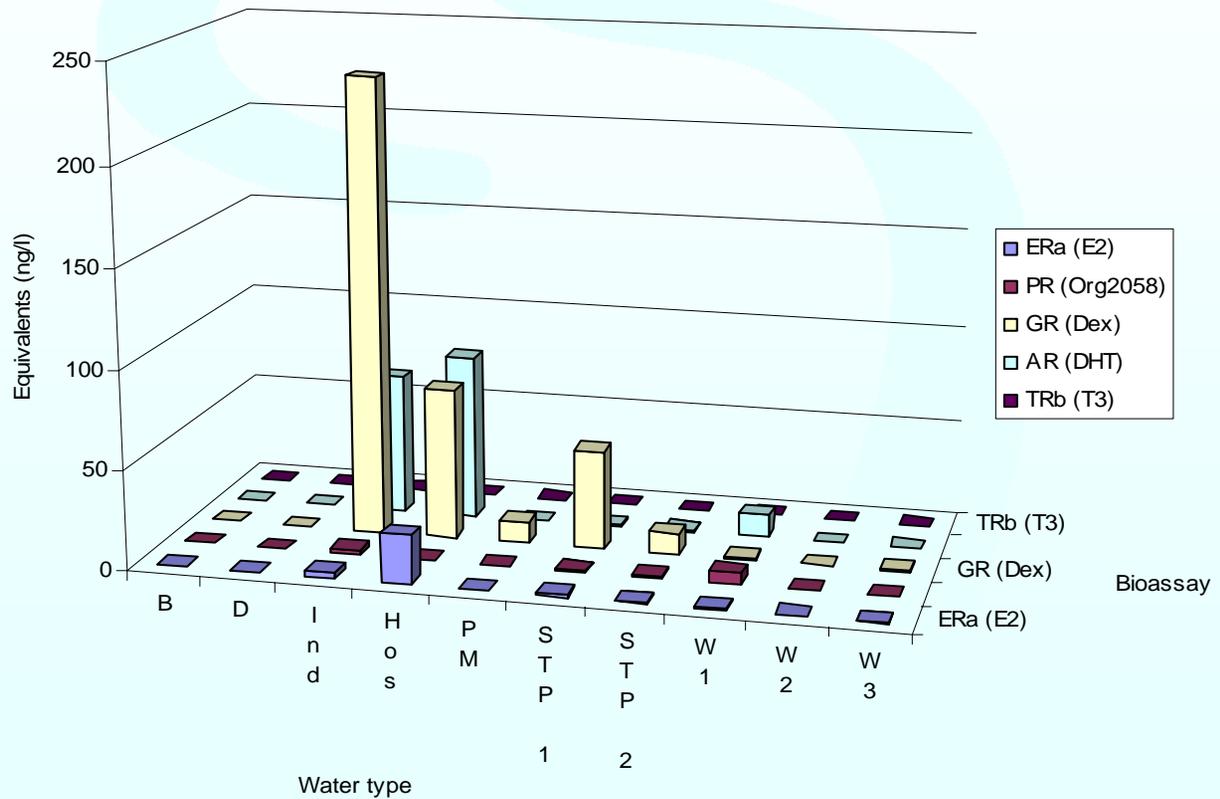
N'gein



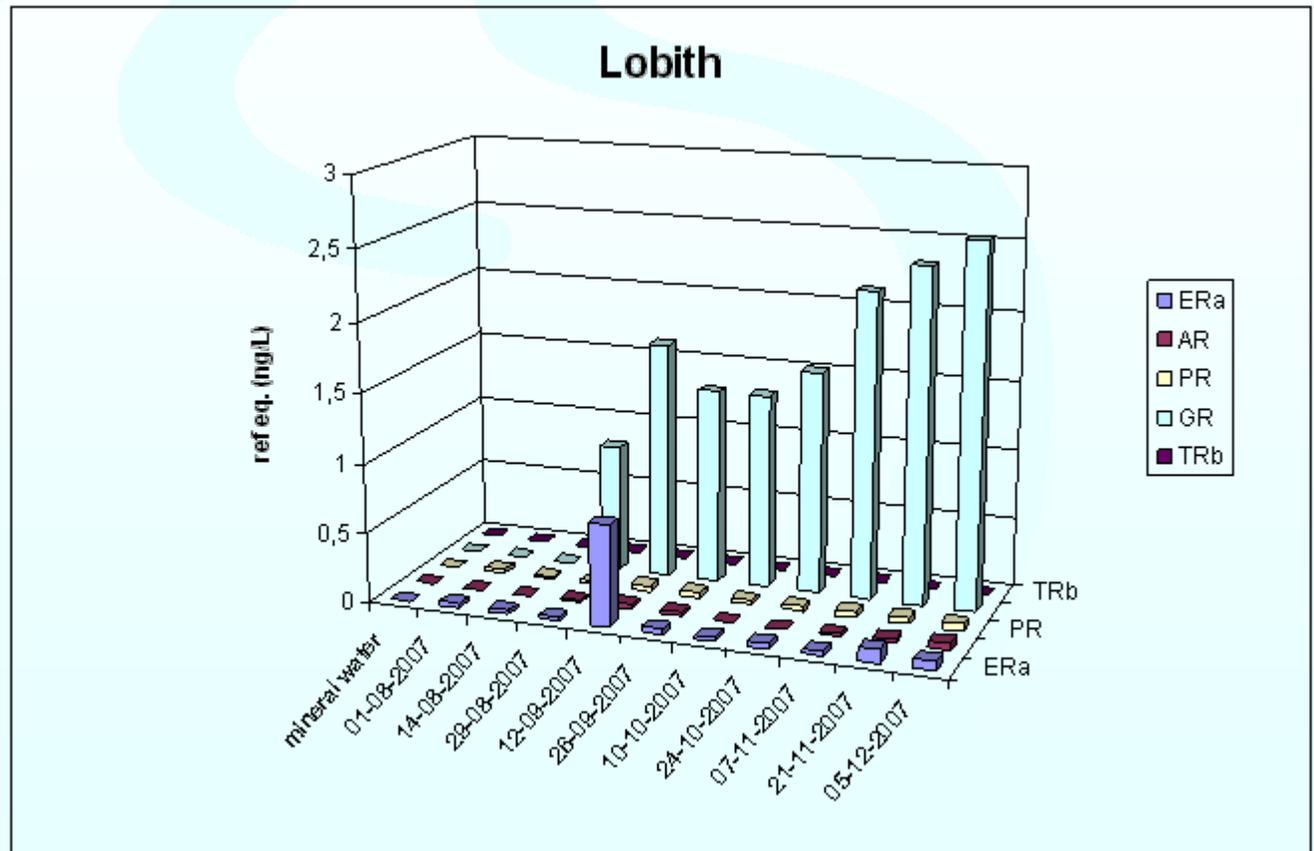
Andijk



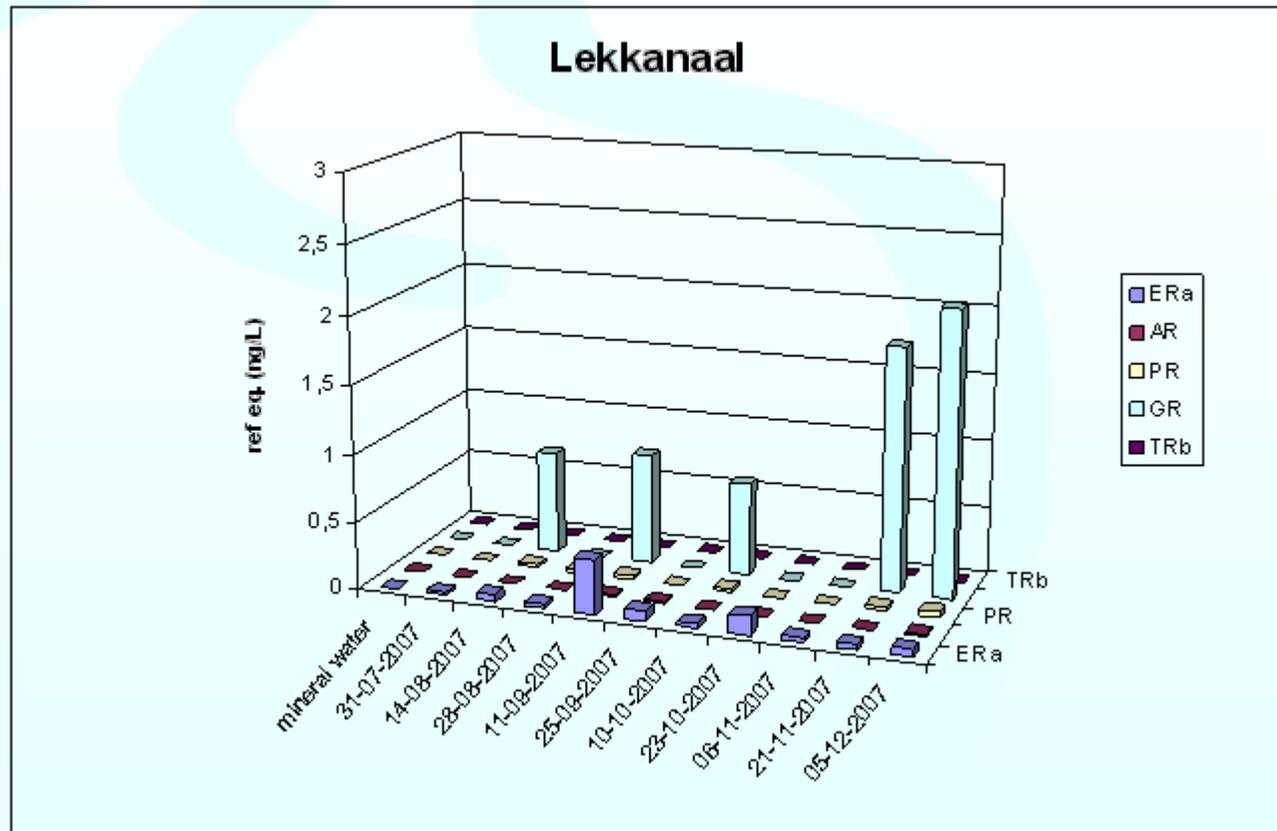
# Results waste water



# Results time series (14d)



# Results time series (14d)



# Conclusions

**Estrogenic activity fairly constant over time**

- *Consistent with earlier findings*

**Androgen and progesterone activity no concerns**

**Glucocorticoid activity surprisingly high, seasonal effects?**

**Thyroid activity radically different from earlier findings**

- *Method based?*

**Waste water levels higher than surface water (well, duh)**

# Conclusions (cont)

**Thyroid activity radically different from earlier findings:**

*First series of measurements with transport protein (TTR & TBG)*

*This series with specific receptor*

→ **indicates more non-specific activity in 1st series**

**Caution with effect measurements!**

# Recommendations

- Further research into “what causes glucocorticoid activity”
- Does this activity pass drinking water treatment steps
- Do we need to reduce discharges from effluents
- Do we need WQ standards for effect-oriented measurements