BONN

Workshop
on the implementation of Annexes II and V of the EU Water Framework Directive
in Bonn 26 and 27 November 2001

Contribution for Flanders (Belgium)
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Flemish Environment Agency (VMM)
- monitors & reports on quality of the environment
- control of surface water quality (regulation)
  - pollution of running waters & canals
  - bacteriological quality bathing water (incl. coastal waters)

Institute of Nature Conservation (IN)
- reports on the status of ‘nature’
  - promotion of integrated ecological monitoring
- research: ecological typologies, reference conditions

Institute of Forestry, Game Management and fisheries (IBW)
- amenity of surface waters for fisheries (angling)
  - monitors fish populations
  - develops IBI’s for fish

merge
1. Common understanding of concepts and terms
2. “State of the Art” for Flanders (Belgium)
   2.1 Flanders and its administration
   2.1 Ecoregions
   2.2 Typology
      - Watercourses
      - Lakes
   2.3 Synthesis
3. Reference conditions
4. Questions
Common understanding of concepts and terms
Figure 1: Influence of human use on the “ecological status” of the water body

PRESENT SITUATION
(within Flanders)

Ecological status of the water system

Intensity of human uses

Healthy

Unhealthy

High status (Biotic Integrity)

Good status (Basic ecological quality)

Moderate status (partly) degraded

HEALTHY

UNHEALTHY
Figure 2A: Human use in sustainable water systems

MAX = maximum tolerable intensity of human use to reach the goals of sustainable development
TARGET SITUATION (2015): version B

Figure 2B: Human use in sustainable water systems

MAX = maximum tolerable intensity of human use to reach the goals of “good status”
State of the art for Flandres
System A: Ecoregions for rivers and lakes

MAP A

1. Iberic-Macaronesian region
2. Pyrenees
3. Italy, Corsica and Malta
4. Alps
5. Dinaric western Balkan
6. Hellenic western Balkan
7. Eastern Balkan
8. Western highlands
9. Central highlands
10. The Carpathians
11. Hungarian lowlands
12. Pontic province
13. Western plains
14. Central plains
15. Baltic province
16. Eastern plains
17. Ireland and Northern Ireland
18. Great Britain
19. Iceland
20. Borealic uplands
21. Tundra
22. Fenno-Scandian shield
23. Taiga
24. The Caucasus
25. Caspic depression
Ecoregions:
European scale: 1
(System A)
western plains

Flemish scale: 3
(System B)
Campine, Polders, Sandy-loamy

Geology:
Flemish scale: 1
(System A)
Siliceous

Soil patterns: 3
(System A)
Siliceous
Calcareous (lime)
Organic (peat areas)

Substratum composition
(System B)
Typology of watercourses
classification of rivers

Biological elements: 1300 sampling points

Fish fauna
- Composition
- Abundance
- Age structure

Benthic invertebrate fauna
- Composition
- Abundance

Aquatic Flora:
- Macrophytes:
  - Composition
  - Abundance

Clustering – multivariate analysis
- grouping often based on human impacts
  - only in upper courses
    - “natural differences” can be observed
Morphological conditions
Sampling points
Field survey - Scale Flanders

Struktuurkenmerken waterlopen
Morphological conditions:

Width and depth

DTM:

Red: data available
Blue: data not yet available

• 1700km will be digitised and available in 2002
• Modelling flooded areas
Typology B: based ecoregions and cross-sections
Typology B: classification according to HUET (1942)
Typology of watercourses

Watercourses:

- Ecoregio (system B)
- Catchment area (syst B: < 10 km²)
- Altitude (syst A: lowland)
- Geology (syst A: siliceous)
- Width, depth, slope (system B) not available in digital form
Synthesis

1. Typology
   • How many ecoregions?
   • Geological scale?
   • How many river types?
   • Typology different according to the group of organisms?
   • What about catchment areas < 10 km²?
   • 1 system for 1 river basin district?

2. Sampling stations
   • All types
   • How many of each type?
   • Same density for all countries?
TOWARDS A TYPOLOGY OF STANDING WATERS IN FLANDERS
Standing waters in Flanders

- harbour works
- > 50 ha
- < 50 ha
TROPHIC STATUS 186 STANDING WATERS
selected to represent variation but biased towards less impacted sites

- **Total Phosphorus (mgP/l):**
  - Range: 0.07 to 4.8
  - Number of waters: 60 to 80

- **Total Inorganic Nitrogen (mgN/l):**
  - Range: 0.3 to 9.6
  - Number of waters: 20 to 80

- **Chlorophyll a (µg/l):**
  - Range: 10 to 320
  - Number of waters: 20 to 80

- **Potential Oxygen Production (mg/l/h):**
  - Range: 0.1 to 3.2
  - Number of waters: 20 to 80
TYPOLOGY OF STANDING WATERS: MAJOR PRINCIPLES

- hierarchic information structure
- applicable to waters from all ‘ecoregions’
- reflect community composition of several groups of organisms
- links to management possible
- selection of ecological key variables
- links to historical references / ‘state changed’ assessment (esp. diatoms, macrophytes; diatom-inferred water chemistry)

Limited to permanent, essentially fresh and non-linear waterbodies (no ditches, canals,…).

Focussed on the littoral zone.
VARIABLES INCLUDED IN STANDING WATER SURVEY

Environment
- soil (texture, drainage)
- morphology
- ionic composition (EC, pH, major ions, Ionic Ratio,…)
- nutrients (silica, inorganic carbon, N and P components)
- metabolism (% O₂, COD, BOD₁, chl, O₂ production…)
- vegetation structure
- management, land use

Biota
- macrophytes (aquatic and shoreline)
- diatoms (sediment and epiphyton)
- rotifers (epiphyton)
- macro-invertebrates (excl. most chironomids & Oligochaeta)

small number of measurements

186 selected standing waters; 210-740,000 m²

single sample
ANALYTICAL STEPS

for each group of biota

1. initial classification (clustering)
2. canonical ordinations with selection of key variables
3. adjusted classification
4. distribution of community types along gradients of key variables
5. selection of common key variables
6. partitioning gradients into ranges applicable to all biota (‘best professional judgement’)

TYPOLOGY OF STANDING WATERS

Typological variables selected measure classes

brackish influence

- soil

- size

- depth

- pH

- silica

inorganic carbon / alkalinity

- [CO$_3^{2-}$ + HCO$_3^-$ + CO$_2$] *

- organic matter

- phytoplankton productivity

- biotic communities

[sodium]*
strictly sand/loamy sand (incl. 50 m buffer)
surface area
maximum depth
pH* ([silica]*)

COD*
oxygen production (24 h light)*

* median value
### REQUIREMENTS AND RELATION TO WFD

- Attribution of water body to type should be relatively stable.
- Cross reference to ‘System A’ possible.

<table>
<thead>
<tr>
<th>System A</th>
<th>System B obligatory</th>
<th>Flanders</th>
</tr>
</thead>
<tbody>
<tr>
<td>altitude</td>
<td>altitude</td>
<td>no differentiation (&lt; 200 m)</td>
</tr>
<tr>
<td>average depth</td>
<td>latitude</td>
<td>insignificant</td>
</tr>
<tr>
<td>surface (&gt; 50 ha)</td>
<td>longitude</td>
<td>insignificant</td>
</tr>
<tr>
<td>geology</td>
<td>depth</td>
<td>maximum depth (↑ average?)</td>
</tr>
<tr>
<td></td>
<td>surface</td>
<td>surface (2.5-50 ha, 50-100 ha?)</td>
</tr>
<tr>
<td></td>
<td>geology ('siliceous')</td>
<td>no differentiation</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>System B facultative</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>ANC</td>
<td></td>
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<tr>
<td>substrate</td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Flanders</th>
</tr>
</thead>
<tbody>
<tr>
<td>incl. ecoregion here?</td>
</tr>
</tbody>
</table>

- alkalinity or pH
- soil
- brackish influence
CONSEQUENCES OF A TYPOLOGY

- more variables/groups ⇒ more ecological ‘sense’
- more variables/groups ⇒ more references needed
- more variables/groups ⇒ more precise references
- more variables/groups ⇒ more monitoring

e.g. a tree with only 5 variables - brackish influence (2 classes), soil (2 classes), size (2 classes), depth (3 classes) and alkalinity (3 classes) - leads to 26 water types represented in recent survey of standing waters in Flanders ...
SYNTHESIS

STANDING WATERS

- mainly small (<< 50 ha), shallow, artificial, privately managed ↔ dynamic, less predictable systems
- 18 > 50 ha. (excl. shipping docks); man-made
  - 2 reservoirs drinking water
  - 4 gravel pits (Maas)
  - 11 sand extraction pits
  - 1 oxbow lake
- limitation to > 50 ha strongly limits representativity, esp. ecological status ↔ lower limit 2.5 ha ? (excl. ‘ponds’)
- strong typological variation
REFERENCES FOR WATER BODIES IN FLANDERS

- generalities
- problems
- status in Flanders
- questions
EU FRAMEWORK DIRECTIVE

sets ‘fish’, ‘benthic invertebrates’, ‘macrophytes/phytobenthos’ and ‘phytoplankton’ as yardsticks for ecological assessment but does not specify how this should be interpreted exactly, e.g.

- all invertebrates or just chironomids, or beetles, or ...?
- all phytobenthos, or just diatoms, ...
- all phytoplankton, or just blue greens, or just pigments, ...?

appears to be inspired especially from the perspective of regions with homogeneous catchments and many large, rather pristine, regionally similar waters of natural origin, ideal for modelling and predicting ...
SOME OF THE PROBLEMS WITH REFERENCES...

- subjectivity (perception, amenity), irreversibility of ecological change
- coping with natural dynamics (succession) & heterogeneity (‘uniqueness’): lack of data?
- what if conservation value is largely ‘man made’ (created and maintained by human intervention) - e.g. in Flanders, human activities have been essential for enhancing diversity of water bodies
WHAT SHOULD WE MEASURE?

references

distance to target

observed
NOW THAT FOCUS IS ON BIOLOGICAL COMPONENTS, WHAT TO ACCEPT AS A REFERENCE?

intended WFD reference

perceived reference

sensitivity!
GENERAL HISTORY OF LARGE-SCALE, SEVERE HUMAN DISTURBANCE IN FLANDERS (esp. water quality)

- late Middle Ages
- late 19th C.
- early 1930’s
- late 1940’s

larger rivers

- smaller watercourses, downstream
- dystrophic standing waters
- smaller watercourses, upstream
- other standing waters

regional differences

local impacts of varying intensity
POTENTIAL DATA FOR REFERENCES ON COMMUNITIES OF ‘UNDISTURBED’ WATERS IN FLANDERS

<table>
<thead>
<tr>
<th></th>
<th>fish</th>
<th>benthic invertebrates</th>
<th>macrophytes</th>
<th>phytobenthos (diatoms)</th>
<th>phytoplankton</th>
</tr>
</thead>
<tbody>
<tr>
<td>'spatial state' surveys (optimistic view)</td>
<td>♥</td>
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<td>sediment-based palaeoecology</td>
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- Low potential for typological/spatial coverage
- ♥♥♥♥ relatively high potential for typological/spatial coverage
- - absent or unreliable
- ( ) for some taxonomic groups only
- ♥ already exploited to some extent (further work necessary)
GENERAL SYNTHESIS

- most water bodies heavily impacted; none pristine
- integrated ecological monitoring not yet operative
- establishment of reference conditions incomplete
- choice of typology pending
- substantial data gathering for application of typology (mapping) still necessary
in order to be effective, sensitivity to deviation should be set as high as possible, but a ‘coarse’ workable typology and data limitations imply that references will comprise a wide array of possible conditions...

ecological objectives are coupled to hydrological setting, history, etc. of individual water bodies: always conflicts with generalisation...

in view of the highly anthropogenic character of water bodies, can references be fitted to ‘sustainable’, rather than unimpacted’ conditions (cf. modified waters)?

should ‘distance to target’ not always be measured as distance to biotic reference and habitat reference (incl. natural processes)?

to what extent can functional or other general metrics be used to compensate for lack of more specific data?

are compound indices desirable / acceptable at all as measures of deviation from reference?