B-BLOOMS

O.S.T.C.

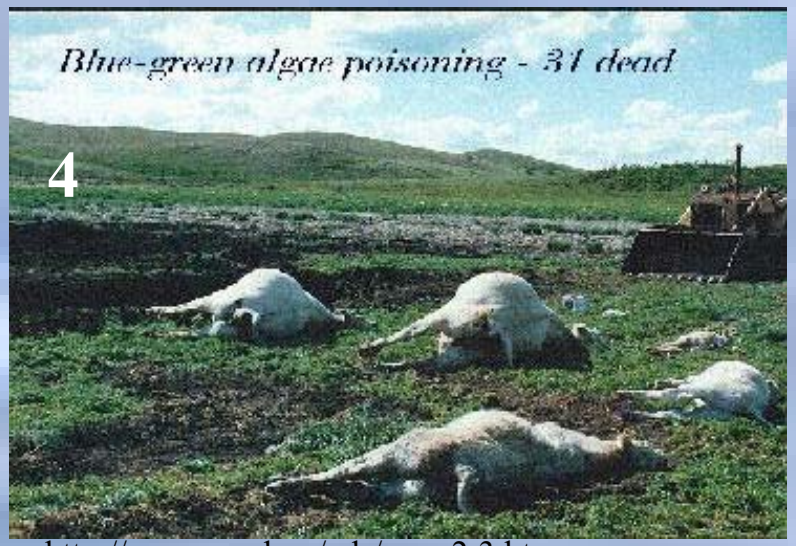
Algal blooms: emerging problem for health and sustainable use of surface waters

1. Warning of bloom in UK
2. Dead duck in Luxemburg
3. Bloom in New-Zealand
4. Dead sheeps in Canada

http://www.environment-agency.tv/ye/qa-ea-doc/

R. Willame, CRP-GL, Luxembourg

bio.waikato.ac.nz/staff/davidh_research.shtml



http://www.usask.ca/pds/news2-3.htm

Context

- Algal blooms: a **world-wide** problem in freshwater bodies
- Generally planktic **cyanobacteria**, though toxic freshwater dinoflagellates also recorded
- 40 to 70 % of cyanobacterial blooms release **toxins** in water
- Other **problems** due to malodorant compounds, inaesthetic aspect, clogging, anoxia
- **Cyanotoxins**: *hepatotoxins* and *neurotoxins* most frequent. Cause death of animals that drink the concentrated scums. Human casualties: only dialysis patients in Brazil.
- **WHO** guideline value = 1.0 µg/L microcystin-LR
- Recent evidences that nuisance blooms are probably **widespread** in Belgium

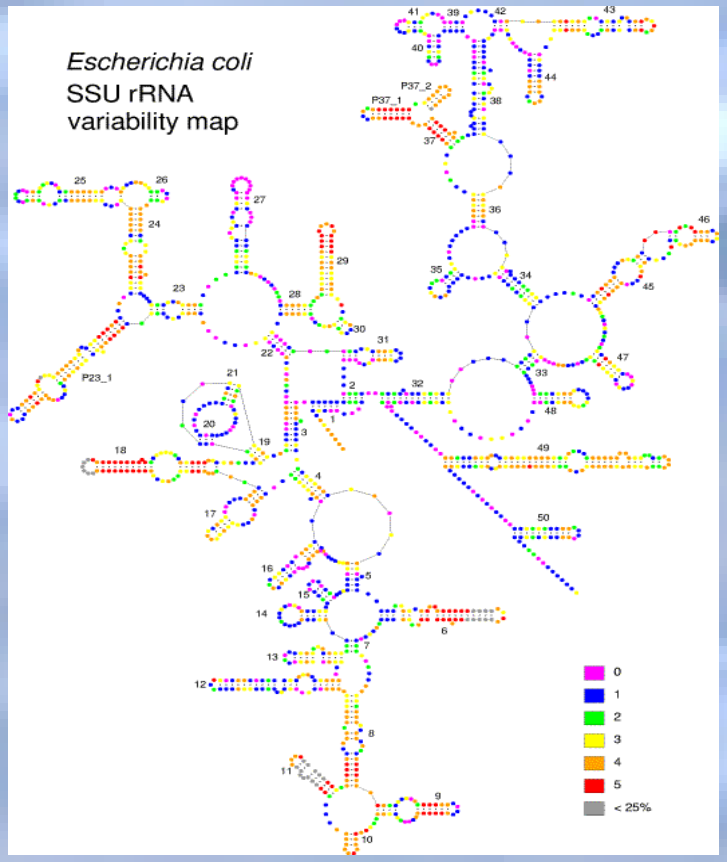
Context

- **Environmental conditions** include
  - high nutrient
  - low N:P ratio
  - high pH (low CO_2)
  - stability and long water residence time
- List of **toxic** cyanobacterial taxa increasing

  Most well-known:
  - ***Microcystis***
  - ***Planktothrix***
  - ***Anabaena***
  - ***Aphanizomenon***
  - ***Nodularia***
- Strains of the same species or samples from the same bloom may vary in toxin production

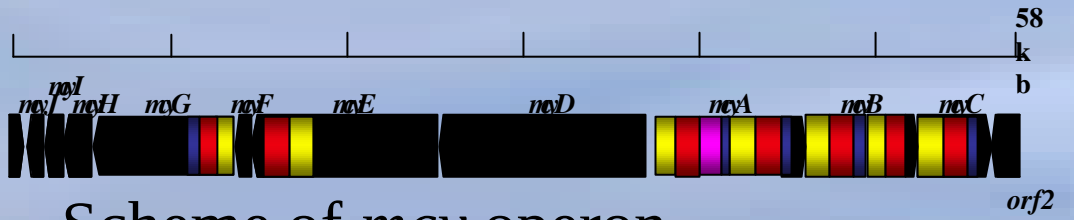
  $\Rightarrow$ need of **molecular** markers

Taxonomic molecular markers
are generally based on ribosomal DNA sequences



RNA WWW server

Toxicity molecular markers
can be based on recently discovered operons encoding the microcystins



Scheme of *mcy* operon

Shirai M. J. Biochim..126 (1999): 520-529.

Objectives

1) Document the extent, nature (diversity of organisms and toxins) and phenology of algal blooms in Belgian lakes and ponds

   Þ *database* **BLOOMBASE**

2) Contribute to the development of predictive models based on monitoring of the ecological conditions linked to bloom formations

   Þ *ANN model* **BLOOMODEL**

3) Develop tools (information, sampling protocols and kits, models, molecular markers) to create a national network for monitoring (**BLOOMNET**) and allow the rapid detection and identification of blooms

Research Partners

1) ULg, Centre d'Ingénierie des Protéines,

Institut de Chimie B6, 4000 Liège

Dr. Annick WILMOTTE, Christophe BOUTTE

Subcontractor: CRITT-Bioindustries, Toulouse, France

2) FUNDP, Unité de Recherche en Biologie des Organismes

rue de Bruxelles, 61 - 5000 Namur

Prof. Jean-Pierre DESCY, Dr. Véronique GOSSELAIN

3) UG, Sectie Protistologie & Aquatische Ecologie,

Krijgslaan 281, S8, 9000 Gent

Prof. Wim VYVERMAN, Dr. Koenraad MUYLAERT

Methodology (1)

1) Monitoring of reference lakes (FUNDP, UG)

Regular **sampling** and determination of classical **physico-chemical** parameters of the Lac de l'Eau d'Heure (FUNDP) and Blaarmeersen (UG)

2) Analysis of samples (ULg, FUNDP, UG)

- **Pigments** (HPLC with 'photodiode array', software CHEMTAX) (FUNDP, UG)
- **Microscopy** (ULg, FUNDP, UG)
- Isolation of cyanobacterial **strains** from blooms (ULg)
- Identification and measurements of **cyanotoxins** (assays & HPLC) (CRITT Bioindustries, subcontractor ULg)
- **Genotypic diversity** of bloom cyanobacteria (ULg, UG) (rDNA analysed by DGGE and clone libraries)
- Molecular diversity of **cyanotoxin genes** and detection by PCR (Polymerase Chain Reaction) (ULg)

Methodology (2)

3) Database, network and website (ULg, FUNDP, UG)

- Creation of a national network of bloom observers and samplers **BLOOMNET** (ULg, FUNDP, UG)
- Design and creation of a database using Microsoft ACCESS, **BLOOMBASE** (FUNDP)
- Design and creation of a website **BLOOMWEB** giving access to BLOOMBASE and information from BLOOMNET (Ulg, FUNDP, UG)

4) ANN Modeling (FUNDP)

- Construction of an ANN (Artificial Neural Network) model to identify and predict blooms (**BLOOMODEL**)
- Coupling of **BLOOMODEL** with watershed models for the Lac de l'Eau d'Heure

Expected results

- gather data on extent and characteristics of the algal blooms in Belgium
- create a national network **BLOOMNET** and a permanent database **BLOOMBASE** about algal proliferations in freshwaters
- integrate our country into European research activities (networks and integrated projects) and international studies
- design a predictive model (of the Neuronal Network type) for blooms, **BLOOMODEL**
- help Flanders and Wallonia to implement the EC Water Framework Directive, because they will have to monitor the freshwater quality in lakes (including biological parameters like **algal blooms**)

Valorisation of data

- Website **BLOOMWEB**
- Publications in peer-reviewed international journals
- Communications in national and international congresses
- Help to implement the EC Water Framework directive and to design policies concerning freshwater quality
- Use of **BLOOMBASE** and **BLOOMODEL** for later studies (global change, etc)