

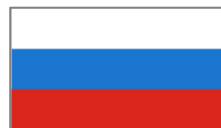


Об определении загрязняющих  
веществ фармацевтического  
происхождения в рамках проекта  
ТОПКОНС



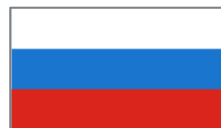
Outline of TOPCONS project with special  
reference to EPPP detection in  
environment

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# Content

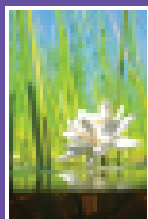
- I. About TOPCONS
- II. Target areas (multidimensional space) for the TOPCONS
- III. Integrated approach
- IV. Why hazardous substances are in the list of variables?
- V. How much do we know of EPPPs? and in EGOF? and in TOPCONS key species and living assemblages?
- VI. EPPPs as “vague” variables. Possible TOPCONS by-products as a tool for non-instrumental detection of homeopaths concentrations?





## TOPCONS -

Transboundary tools for spatial planning and conservation of the Gulf of Finland



TOPCONS is a Finnish-Russian co-operation project developing innovative tools for spatial management actions and sustainable consolidation of human activities and the marine nature values.

This Project is co-funded by the European Union, the Russian Federation and the Republic of Finland.



# I Overview of TOPCONS objectives and output and WP's

- The main objectives of the project are to create methodology and tools to aid in modelling and **mapping** the locations of the **most** diverse and **sensitive marine and coastal landscapes**, and in the light of this knowledge, to execute planning of the ecosystem-based management.
- TOPCONS produces knowledge background that can be directly utilized for the **planning of sustainable use and the conservation of the marine environment and remediation of the effects of human disturbances**.

## Work packages:

WP 2. Data collation, collection, harmonisation

WP 3. **Landscapes**

WP 4. **Sensitivity**

Want to know more? Add this to your bookmarks:

[www.merikotka.fi/topcons](http://www.merikotka.fi/topcons)

» to collect and harmonize existing and new biological, geological and hydrographical data from the eastern Gulf of Finland

» to develop maps on local scale benthic landscapes combining geological and biological diversity

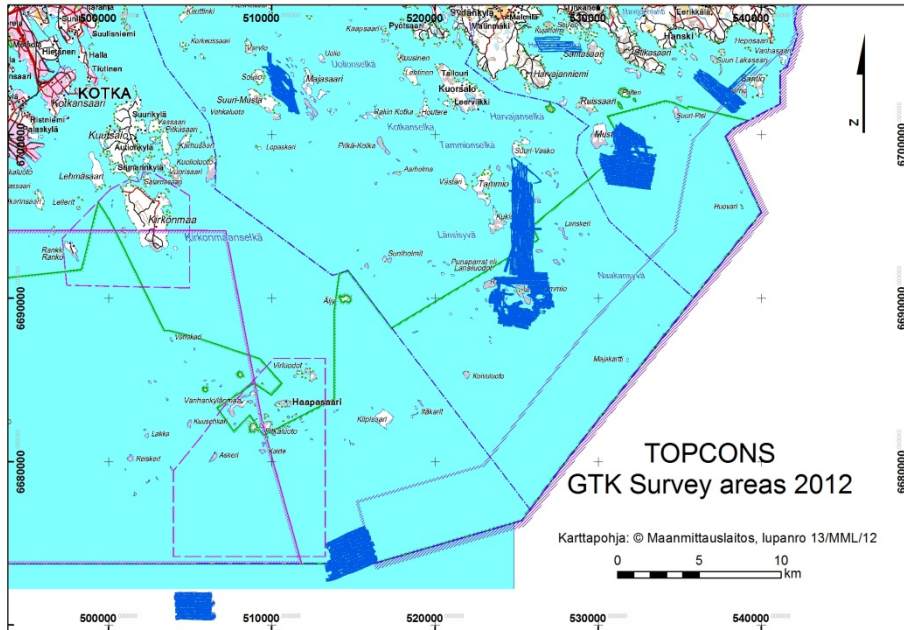
» to collate a dataset of human pressures in the area

» to create a spatial planning tool to support sustainable management actions

» to produce a route map for the development of a regional marine strategy



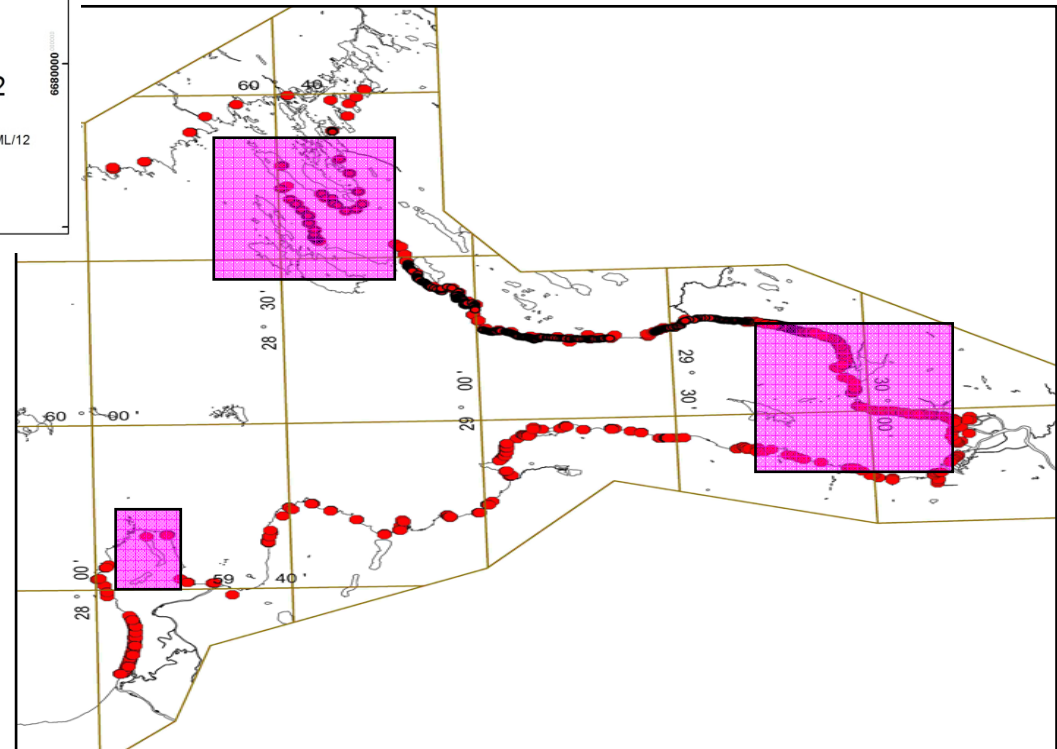
## II. Target areas in Finland and Russia



All are either potentially sensitive to pollution by hazardous substances (HZ) and eutrophication

or

Are selected as reference areas



Presented at trilateral meeting, 20.03.2013

## II. List of human activities and natural driving forces impacting marine landscapes in target areas

Presented  
at trilateral  
meeting,  
20.03.2013

⚡ **Actor(s): Population, its target groups and interests**

**Natural driving forces:**

**High contribution of coastal zone**

Relatively large catchment area

Expressed natural gradients (estuarine nature)

⚡ Seasonal variations

Unperiodic sea level fluctuations

⚡ **Geology**

**As a result: high heterogeneity of landscapes**

**Newly identified world-wide problems:**

**Residuals of medical products, Genetically modified organisms**

**Sinergetic (other) interactions of fActors (to be investigated)**

⚡ **Areas of sea uses overlaps**

⚡ Those relevant with minimum MSP requirements

**Seminatural:**

Anoxic/hypoxic conditions

Eutrophication and related Cyan blooms

Geologic hazards

Alien species / Changes in biodiversity

**Anthropogenic impacts (sea uses):**

⚡ Shipping, adjacent activities, infrastructure

⚡ Cables and pipelines

⚡ Recreation

Storm-surge barrirer

Dredging

⚡ Mineral and oil extraction

Washing new territories

⚡ Fisheries

Pollution by hazardous substances as

TBT, other methals

⚡ Military use

⚡ Archaeological and cultural heritage

Uncontrolled use of coastal lands

• UNESCO WS2006

## II. Target areas in Russia

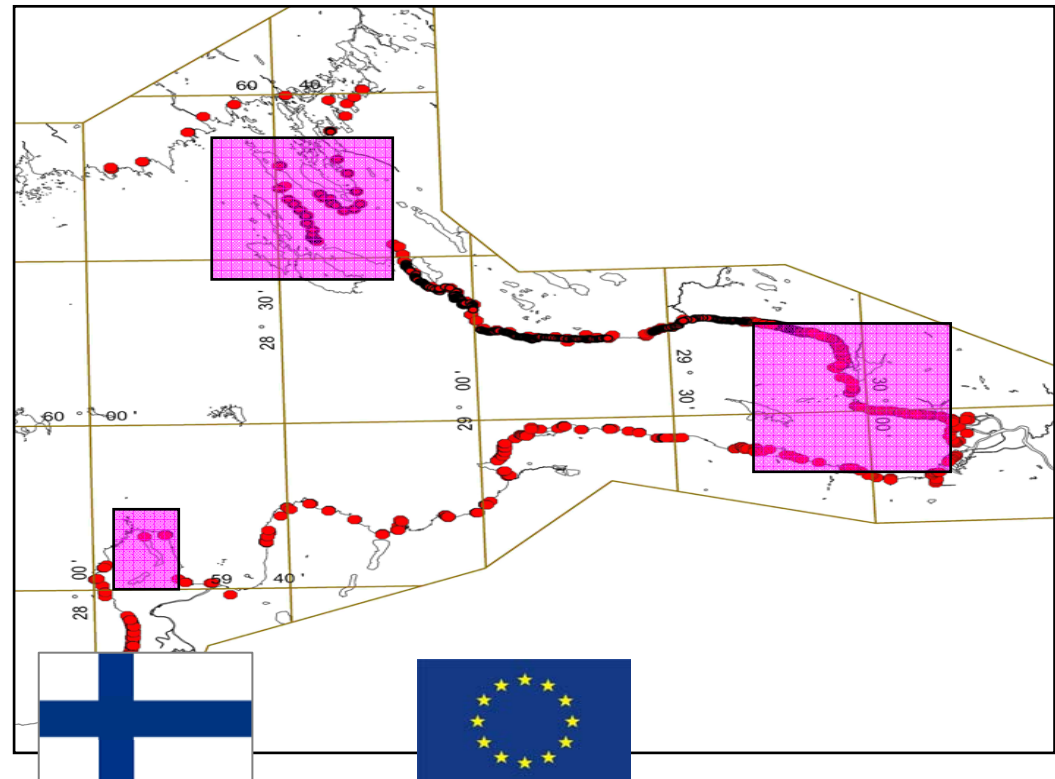
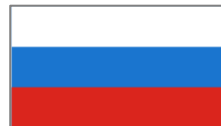
- ✓ Two model subareas on the Russian side of border are sampled in 2012 for HS's including Pharmaceuticals;
- ✓ SCRES RAS, the sub-partner of the TOPCONS (via SPBRC RAS) provides analytical detection of selected HS;
- ✓ Works with collected samples and analytical results are in progress and serve as background for 2013 year field planning (is going on)

All are either potentially sensitive to pollution by hazardous substances (HS) and eutrophication

or

Are selected as reference areas

All areas with few exceptions can also be provided with already existing geological, biological data and data on HS



### III. Integrated methodical approach to data collection analyses and application

Presented  
at trilateral  
meeting,  
20.03.2013

- Collation of existing data from both countries
- Collection of spatial information and “point” data in field surveys using same methods
- Harmonization of analyses of field samples and data
- Development of maps describing biological and geological diversity
- **Development of maps describing human activities**
- Construction of a marine spatial planning tool combining both environmental and human activity information
- **Development of new research methods and hypotheses**
  - Remote sensing
  - Modeling
  - **Testing new variables for mapping and modeling**
  - **Testing new approaches to data collection**



# IV. Hazardous substances as markers: of human activities (1), interaction of natural and antropogenic forces (2) human being (3) :

(1) TBT;

(2) Cyanotoxins;

(3) Pharmaceuticals

also pharmaceuticals and personal care products (PPCP)

also Environmental Pharmaceutical Persistent Pollutant (EPPP),

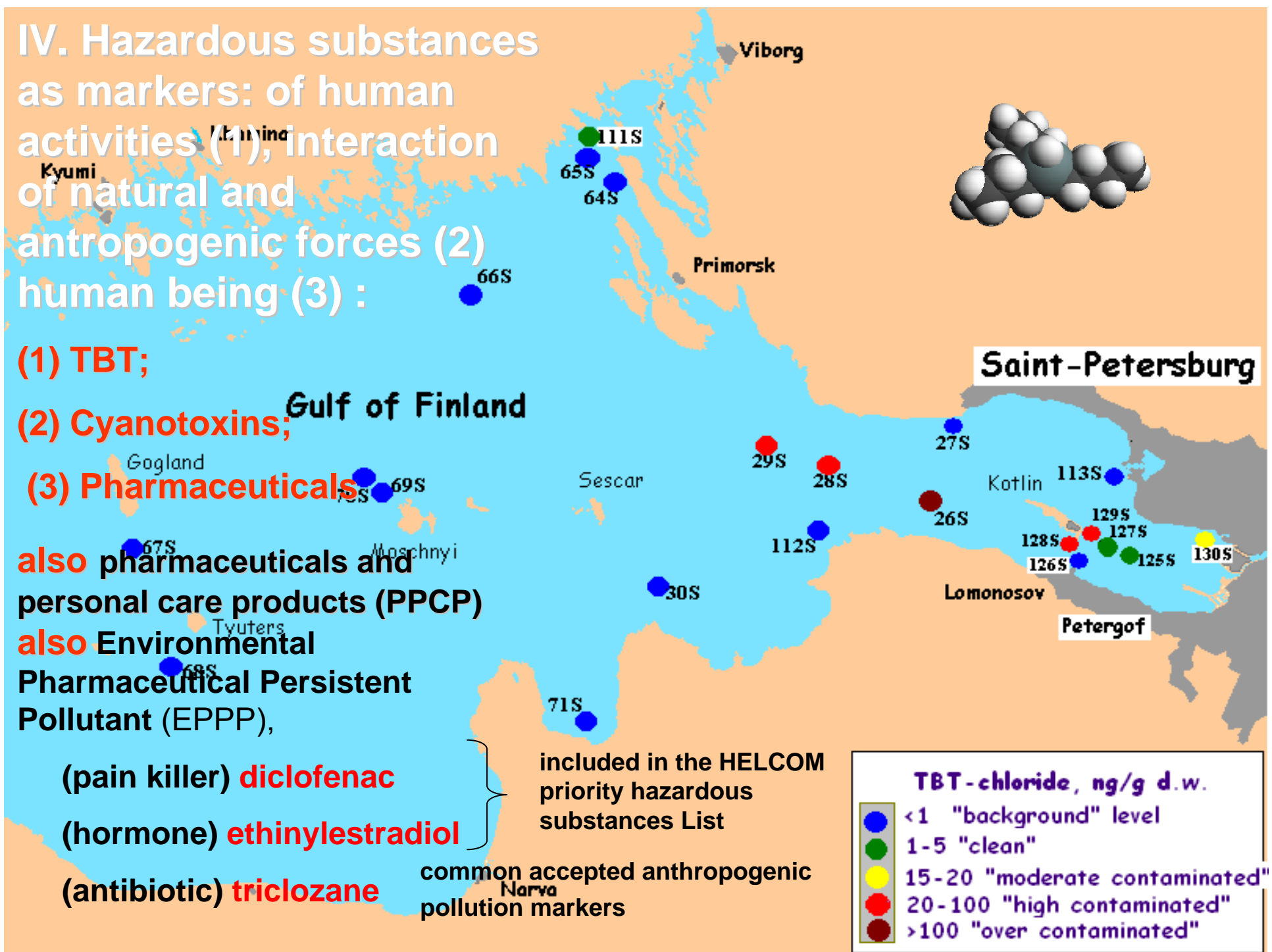
(pain killer) **diclofenac**

(hormone) **ethinylestradiol**

(antibiotic) **triclozane**

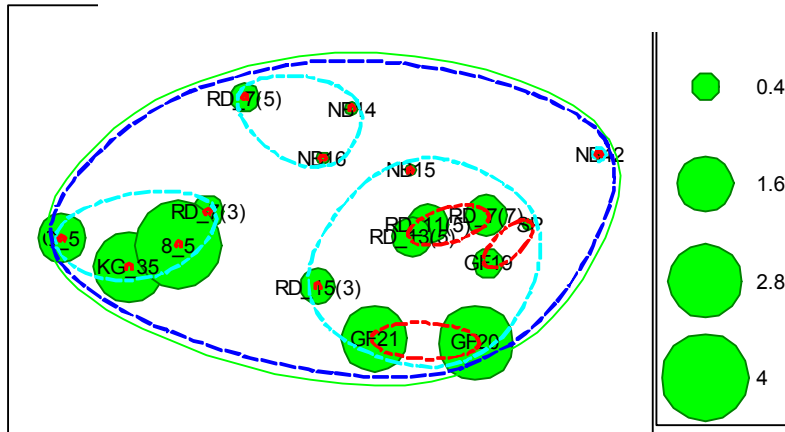
included in the HELCOM priority hazardous substances List

common accepted anthropogenic pollution markers





## IV. Why do we need Hazardous Substances in TOPCONS list of variables (in senses of detection)?



This bubble diagram is not about EPPP, this is example of BIOENV visualisations

- Development of maps describing human activities
- **Detection** of sources of biological data spatial variability **with HS data**
  - use HS as independent variables in BioEnv analyses (Primer V/6)
  - use as sample markers in CLUSTER and MDS (Primer V 6)
- Development of new **hypotheses for further projects**
  - Testing new variables for mapping and modeling
  - Testing new approaches to data collection
  - (1) Produce new or (2) re-consider "well forgotten old" (?) (3) of from other areas of science ideas for approaches to **detection** of a given substance in environment



there are thousands of different synthesized chemicals present at the same time in the environment, different interactions may occur and the result of these multiple exposure in human and nature are not sufficiently studied or understood.

#### IV. Peculiar features that make pharmaceutical desirable markers/variable in TOPCONS (and subsequent) interdisciplinary and in sea uses planning

Pharmaceutical chemicals **are not designed for entering the environment**

Pharmaceutical chemicals **are designed to be non-degradable** to resist the acid environment in the stomach, **and to be long-lasting**; to be administrated according to a specific defined time schedule.

They are **manufactured to be biologically active in living organisms**

**Are widely used globally** by humans and for food production , etc

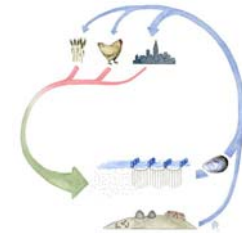
As the world's (and Baltic Sea region) **population is growing and ageing**, more people can afford medical treatment

**new treatments are developed**, the amounts of pharmaceuticals can be expected to increase rapidly

Presently **found in drinking water**

Presently **found in fish, mussels** (of biological TOPCONS object), etc

They are **excreted from humans and animals**, intact or metabolized, mainly into the urine, passing on to the environment directly or via sewage plants = Prescribed by EU legislation collection systems for unused or expired medicines – **will not prevent their enter into environment .**



## IV. Factsheet on findings of EPPP effects concerning TOPCONS objectives and selected EPPPs

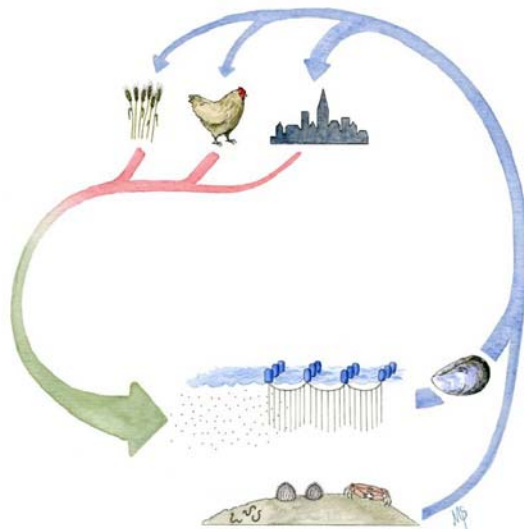
- Bioaccumulation of citalopram (SSRI, antidepressant) and propoxyfen (painkiller) has been found in perch in the Baltic Sea.
- Therapeutic levels of levonorgestrel (a sex hormone) has been found in Rainbow trout downstream a sewage plant
- **Estradiol (estrogen, synthetic hormone)** Concentrations in surface water alone are not sufficient to assess the risk of negative environmental effects in the aquatic environment. Synthetic hormones are endocrine disruptors. Thus, estrogenic compounds like ethinyl-estradiol (estrogen hormone) at concentrations < 1 ng per litre may cause both vitellogenin production (a frequently used index for feminization of male fish), and structural change in their sex organs. It has also been demonstrated that fish exposed to sewage treatment plant (STP) effluent can take up and concentrate estrogenic compounds, including ethinyl-estradiol, to very high internal levels. These observations on feminization of fish by estrogenic compounds in STP effluents have been observed in many countries, and have also been observed in other species, like frogs, alligators and molluscs.
- **Antibiotics (triclosan)** The term "eco-shadow" has been introduced to describe the ecological impact of antibiotics. Antibiotics with a wide spectrum that are also stable will have a greater impact on the bacterial flora (a long eco-shadow) than those with a narrow antibacterial spectrum which disintegrates more rapidly (a short eco-shadow)
- **Diclofenac** in rainbow trout as well has been found to cause damage to the kidney such as degeneration of the tubular epithelial cells and the cause of interstitial nephritis, maximum concentrations are detected in liver .

Bort, 1999 , Schwaiger, 2004, Zheng et al., 2007, Fick *et al* 2010 , Azzouz *et al* 2011 , other sources

V How much do we know of EPPPs? and in EGOF benthic and coastal landscapes? and in TOPCONS key species and living assemblages?

Antidepressants may be found in frogs and can significantly slow their development.

- Because of the high solubility of most PPCPs, aquatic organisms are especially vulnerable to their effects.
- In addition to being found only in waterways,
- the ingredients of some PPCPs can also be found in the soil.
- Not only does the pollution from PPCPs affect marine ecosystems, but also those habitats that depend on this polluted water.



Since some of these substances take a long time or cannot be degraded biologically, they make their way up the food chain, that involve **HUMAN, DOMESTIC and SINANTROPIC** species.

+ species **USED** for **AQUACULTURE** and for **COASTAL ZONE REMEDIATION TECHNOLOGIES**

The increased presence of estrogen and other synthetic hormones in waste water due to birth control and hormonal therapies has been linked to increased feminization of exposed fish and other aquatic organisms. The chemicals within these PPCP products could either affect the feminization or masculinization of different fishes, therefore impacting their reproductive rates.

Close to NOT TOO MUCH...

## V. General gapes in knowledge concerning environment

- Effective environmental detection methods have to be developed and global detection strategy applied **to map the current global situation**. **We (TOPCONS) START the mapping from project SUBAREAS**
- There are currently no test methods to assess whether negative effects may occur after long-term environmental diffuse exposure in humans, during the vulnerable periods of development, on aquatic micro-organism or how it may affect other animals.
- = Little is known on the possible negative effects and impacts of EPPP in humans and the environment by diffuse and systematic exposure, for long periods of time, especially during the vulnerable periods of development. **However we feel** therefore the precautionary principle must be guiding.
- Concentrations in surface water alone are not sufficient to assess the risk of negative environmental effects of these synthetic chemicals. Consideration must be taken to bio-accumulation in fish and other aquatic food used by humans, as well as to additive and synergetic effects between pharmaceutical and other chemicals in the contaminated water.
- In a small study, several pharmaceuticals were found in milk of goat, cow and human. More research is needed to find out how common this is, the concentrations and the sources.

## V. EPPP impact: what is it depending on?

### EPPP themselves:

- **concentrations,**
- types,
- distribution of pharmaceuticals in the environment;
- the pharmacokinetics of each drug
- the structural transformation of the chemical compounds either through metabolism or natural degradation processes;
- **Interactions between drugs**

### Targets (organisms and populations)

- type of organisms (genotype-dependent effect)
- susceptibility of organisms (phenotypic plasticity)
- Position of a given species in a given food chain (functional diversity of assemblage)
- Already accumulated amount in a given organisms/population
- **Duration of exposure**
- **Concentration of exposure**

## VI. Consideration of concentrations – EPPPs as “vague”, variables for statistic analyses and emergent to detect and assess

- Concentrations in surface waters, groundwater and partially treated water are typically less than 0.1 µg/l (or 100 ng/l), and concentrations in treated water are generally below 0.05 µg/l (or 50 ng/l).

- NB! as larger amounts of pharmaceuticals are consumed, there is a risk that the concentration of pharmaceuticals in drinking water will increase.

- Low concentration might appear to guarantee that they hardly pose any problem to public health. Is this true?

- Concentrations in treated water are generally below 0.05 µg/l (or 50 ng/l)

+

Dilution in environment =???????

Homeopathic concentrations, =undetectable concentrations?

+ dynamic aspects of low chronic exposure to concentrations

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the persistent and diffuse exposure to low doses of pharmaceutical synthetic chemicals, for long periods of time, is not currently well known or studied

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TOPCONS in its present state: only analytical detection of detectable “allopathic” level

## VI. Is dilution the solution for EPPPs?

Is falling tree making noise if there is nobody to hear (detect) it?

Does homeopathy really work?

- 1 – **in case of human**
  - psycho somatic component (placebo effect)
- 2 – non-psychosomatic way (**common for human and other organisms, including those do not go to doctors, read books and drug instructions**)\* – to cure similar by similar.

**NB! Important homeopathic principle – one time – one remedy!!!**

\*Don Hamilton Homeopathic Care for Cats and Dogs (small doses for small animals), N. Atlantic Publishers, ????



Non-instrumental detection in environment is needed

= Little is known on the possible negative effects and impacts of EPPP in humans and the environment by low concentration and systematic exposure,

**Non-instrumental detection is theoretically possible  
broadscale and locality – dependent biological sampling planned and performed as following after creation a set of layers for EPPP and modelling of their diffuse distribution in target landscapes (if customized modelling will be applied)**

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Desirable TOPCONS by-product: TOPCONS's topographical platform based "hereditary" or "brother" project addressed to above issue and using TOPCONS tools and methods expected to be available by the end of 2014



# Instead of summary:

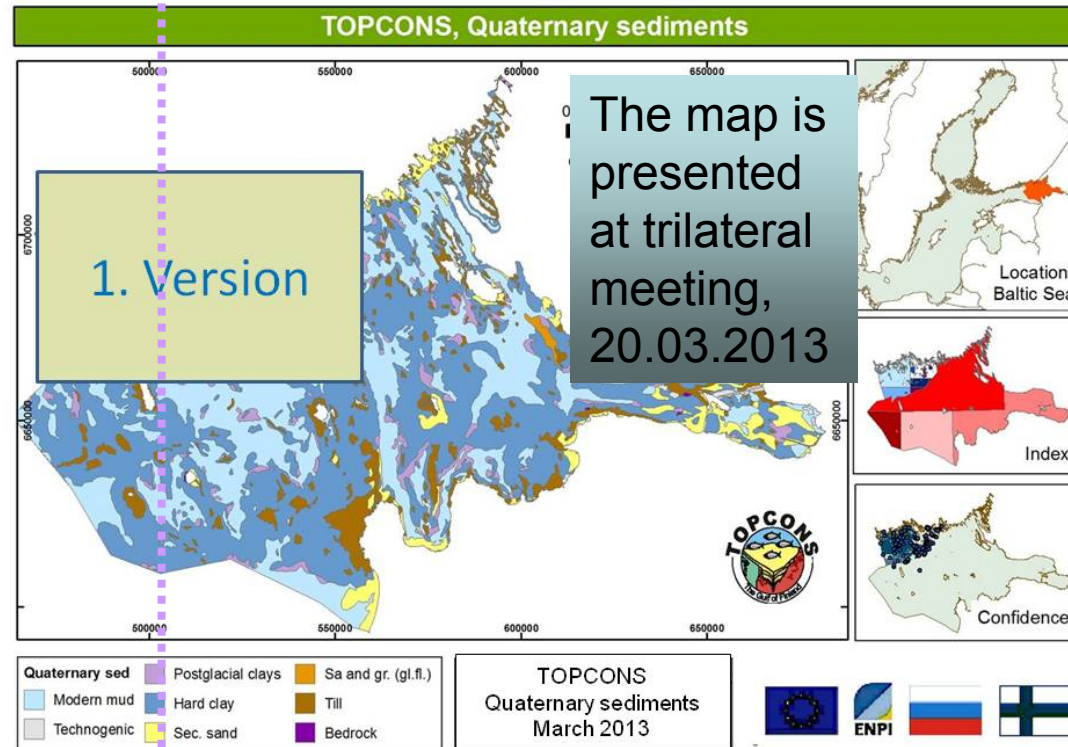


A set of layers will be added to the landscape modelling concerning selected EPPPs and their detectable concentrations

Statistical analyse of biological variables and EPPPs concentrations will be done and biological validation of above set of layers will be carried out

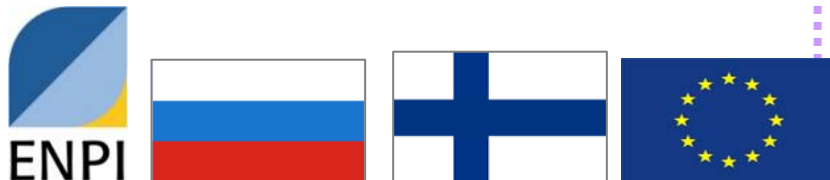
Present  
(2012-2014)

Future (20??  
-20??)



→  
Hypotheses

It might be found that Key species population and assemblages structure can be helpful to detect impact of low (non-detectable) concentrations following (1) principle of similarity (S. Hahneman) and (2) known effects of homeopathic remedies

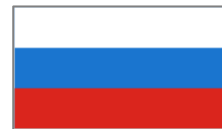




Thank you for your attention!



Q: Are drugs crucibles for Evolution?  
(not discussed, but looks like a question for the flock of related projects)



FISHERIES and ENVIRONMENTAL MANAGEMENT GROUP

