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Pharmaceuticals – pollutants of emerging concern in the Baltic Sea region

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▲ Signing of the Helsinki Convention in 1974

12 000 t *in 1910*

Phosphorus (P) input to the Baltic Sea (waterborne)

71 295 t *in 1981*

1972 UN Conference on the Human Environment

1974 **Signing of the Helsinki Convention** (7 members)

1980 **Establishment of the HELCOM Secretariat**

1992 **Revision of the Helsinki Convention** (expanded to 10 members)

2000 **Entry into force of the 1992 Helsinki Convention**

2007 **Baltic Sea Action Plan**

27 940 t *in 2017*

1900 1950 2000

Baltic Marine Environment Protection Commission

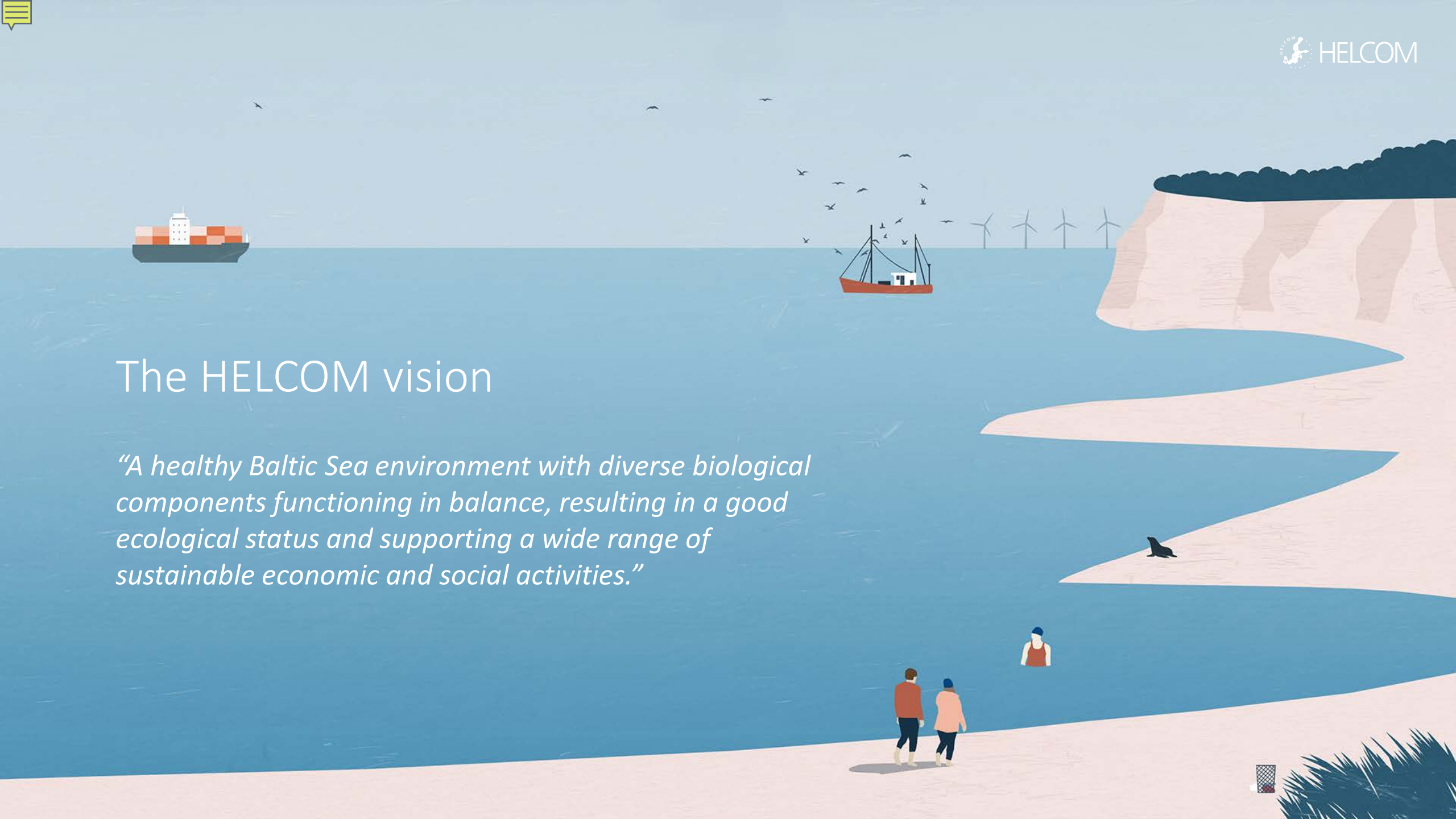
The Baltic Sea

Unique but fragile ecosystem

Catchment area: 4x area of the sea

Population (catchment): 85 million

Multitude of pressures



The HELCOM vision

“A healthy Baltic Sea environment with diverse biological components functioning in balance, resulting in a good ecological status and supporting a wide range of sustainable economic and social activities.”

Baltic Sea Action Plan 2030: structure & goals

Vision

a healthy Baltic Sea environment with diverse biological components functioning in balance, resulting in a good ecological status and supporting a wide range of sustainable economic and social activities.

Goal

Baltic Sea **ecosystem** is healthy and resilient

Goals

Baltic Sea unaffected by **hazardous substances and litter**

Environmentally sustainable **sea-based activities**

Baltic Sea unaffected by **eutrophication**

Horizontal topics

Climate change; monitoring; maritime spatial planning; economic and social analysis; financing; hot spots; knowledge exchange and awareness raising

Hazardous substances & litter

Hazardous substances and litter goal

"Baltic Sea unaffected by hazardous substances and litter"

Ecological objectives

Hazardous substances
- *Marine life is healthy;*
- *Concentrations of hazardous substances are close to natural levels;*
- *All sea food is safe to eat;*
- *Minimal risk to humans and the environment from radioactivity.*

Marine litter
- *No harm to marine life from litter.*

Management objectives

Hazardous substances
- *Minimize input and impact of hazardous substances from human activities.*

Marine litter
- *Prevent generation of waste and its input to the sea, including microplastics;*
- *Significantly reduce amounts of litter on shorelines and in the sea.*

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https://helcom.fi/media/publications/Baltic-Sea-Action-Plan-2021-update.pdf

Cooperation between HELCOM & PA Hazards of the EU SBSR

http://www.helcom.fi/Lists/Publications/BSEP149.pdf

CWPharma Interreg Baltic Sea Region EUROPEAN UNION EUROPEAN REGIONAL DEVELOPMENT FUND

Compilation of data on the use of pharmaceuticals in veterinary.

Compilation of comprehensive data on pharmaceutical substances in the effluents of WWTP to evaluate input to the fresh water and marine environment.

Compilation of information on pharmaceutical waste management, promotion and advancing of "take back" systems for pharmaceuticals.

Information on active pharmaceutical ingredients (APIs) exceeding the predicted no-effect concentration (PNEC)

Recommendations on improvement of waste management for unused medicines

Report on Micropollutants in WWTPs effluents and policy briefs

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Topic: Contaminants of emerging concern	
HL22	Improve knowledge base on occurrence of pharmaceutical substances in the environment, their persistence and harmful effects and ensure availability of this information for broad expert community by 2025.
HL23	Identify priority pharmaceuticals by 2024 utilising the best available knowledge on their releases into the aquatic environment, environmental effects and available data on their use in the region, for efficient risk reduction and for subsequent integration of these substances to HELCOM assessments, as indicators of the state of the Baltic Sea and environmental pressure.
HL24	Develop guidance for the environmental monitoring and analysis of pharmaceuticals identified as indicators of the state of the Baltic Sea by 2025.
HL25	Organize an information campaign on what not to flush by 2025 (addressing chemicals, pharmaceuticals and litter).
HL26	Strengthen the collection of unused pharmaceuticals from the public in the Baltic Sea region by 2026.
HL27	In cooperation with health care institutions, increase awareness and knowledge of consumers about pharmaceuticals containing substances that are persistent and harmful for the environment, when scientifically justified information is available.

Joint documentation of regional coordination of programmes of measures for the EU MSFD

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ACTION 4: Micropollutants in effluents from wastewater treatment plants (PRESSURE WG)

- *Step 1: Compilation and assessment of available information and data of micropollutants of concern for Contracting Parties in the Baltic Sea*
- *Step 2: Compile information from CPs of treatment techniques and experiences– during*
- *Step 3: Summary report on advanced treatment techniques, including consideration of feasibility, costs, good practice and management options*

Micropollutants in effluents of WWTP identified by the HELCOM countries.

- Why call for data?
  - Better understanding of monitoring data
  - Assess need for focused measures in future HELCOM activities
- Long term goal = revise list of Priority substances

- Information request to Contracting Parties - ”concern about inputs of various POPs”
- Concern = CPs *consider or believe* being transported to Baltic Sea Via MWWTPs and RIVERS

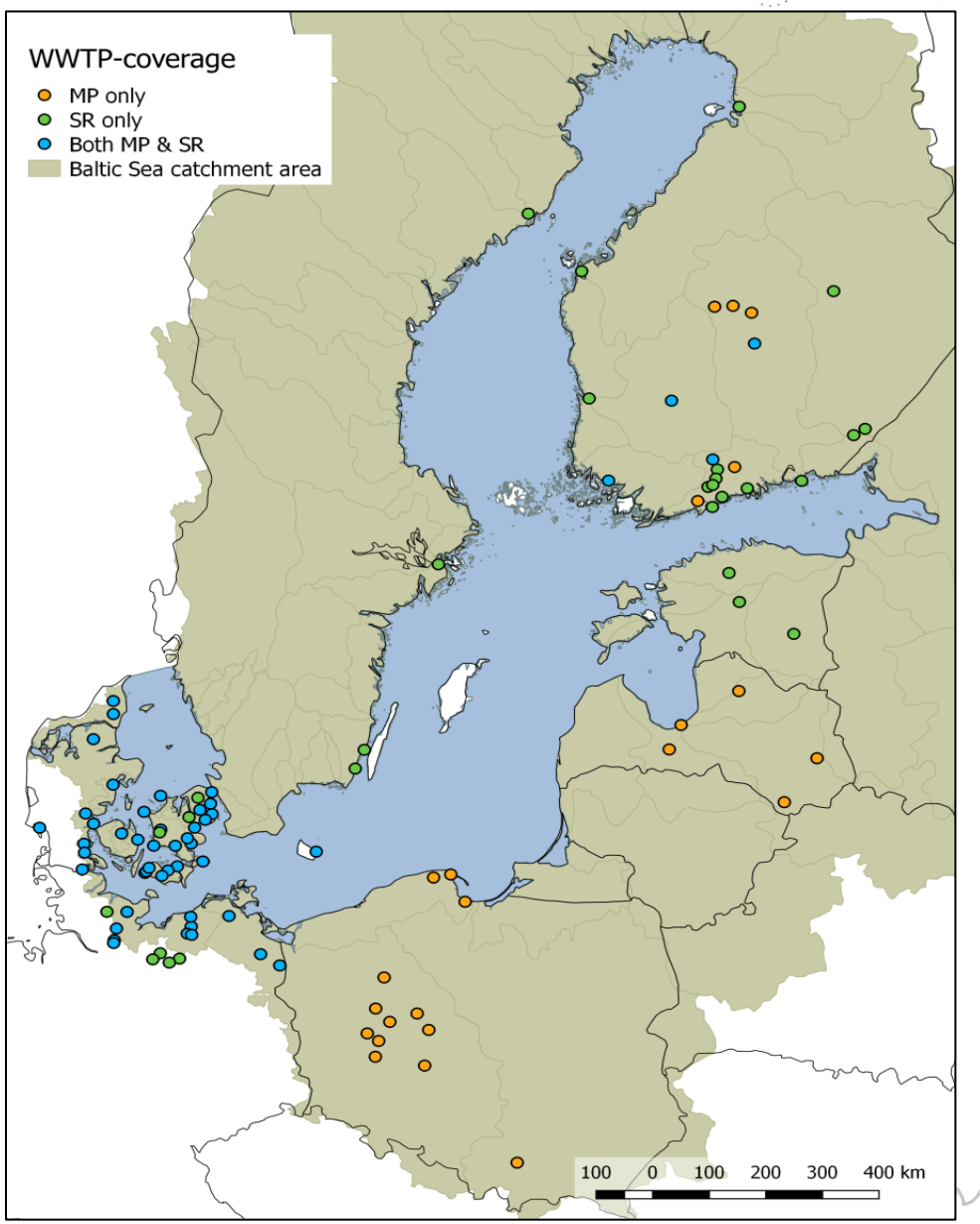
Substance (group)	WWTP
Dioxins (PCDD, PCDF, dioxin-like PCBs)	3
Other PCBs (other than dioxin-like)	5
Organotin compounds (TBT, TPhT, etc)	6
PBDEs (pentaBDE, octaBDE, decaBDE)	4
PFAS (PFOS, PFOA)	8
HBCDD	4
Nonylphenols (NP, NPE)	12
Octylphenols (OP, OPE)	12
Short-chain chlorinated paraffins (C10-13)	5
Medium-chain chlorin. paraffins (C14-17)	3
Endosulfan	2
DDTs (sum-DDT, DDE, etc)	2
PAHs (incl. metabolites)	8
BFRs (PBDEs etc)	5
HCHs (alpha, beta, gamma)	4
Heptachlor	4
Heavy metals	14
Pharmaceutical residues	12
Herbicides (except listed above)	6
Fungicides (except listed above)	5
Insecticides (except listed above)	5
Endocrine disrupting substances (EDS, except listed above)	9
Animal/veterinary drug residues (except listed above)	2
Disinfectants (except listed above)	5

Pharmaceutical data coverage

102 WWTPs for two data calls

Data on 117 individual substances were compiled.
11 therapeutic groups:

- anti-inflammatory and analgesic substances,
- antimicrobial and antiparasitic,
- cardiovascular agents,
- central nervous system,
- contrast agents,
- chemotherapeutic agents,
- metabolic and gastrointestinal agents,
- respiratory agents,
- hormones and hormone antagonists,
- recreational drugs,
- metabolites.



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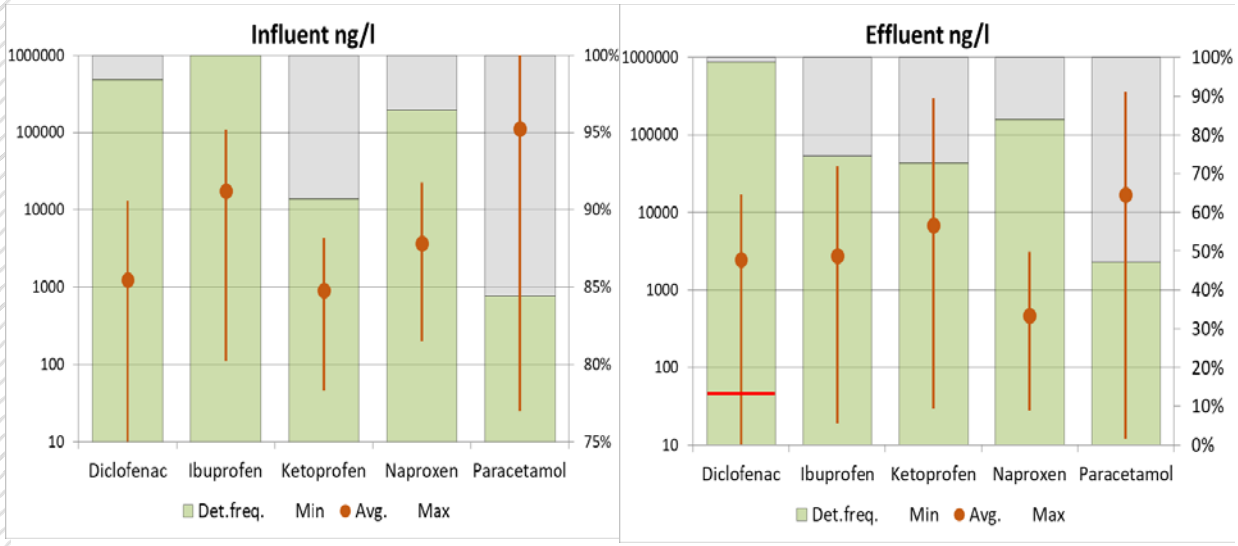
PLATFORM BSR WATER

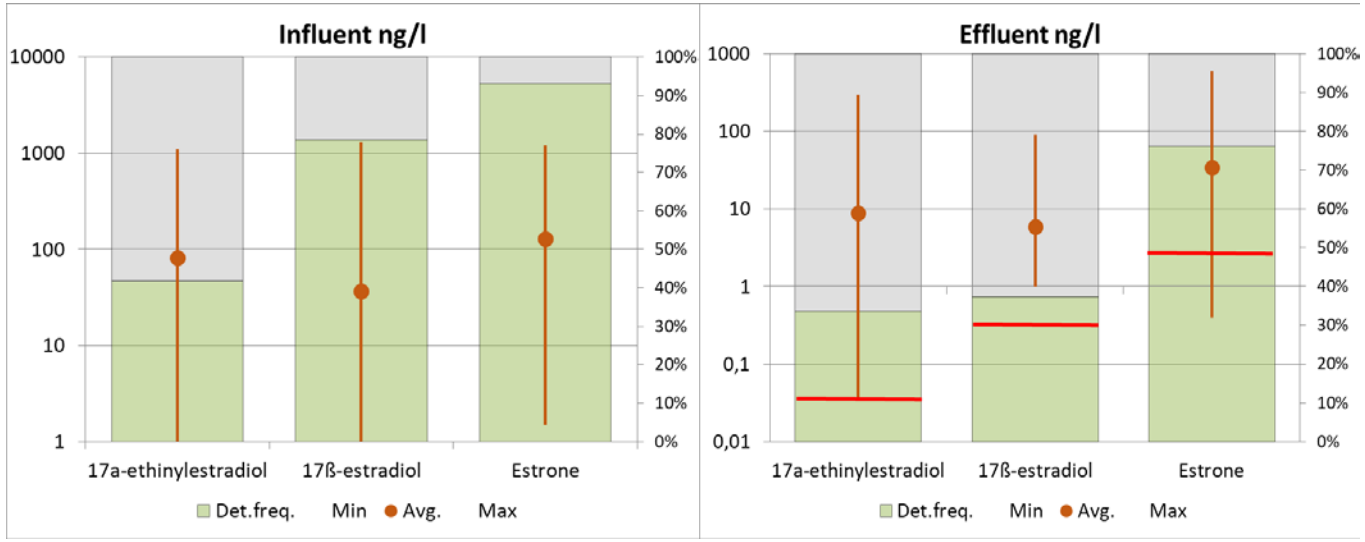
Anti-inflammatory and analgesic substances

(detected 13 out 18 substances)



Hormones and hormone antagonists

(detected 11 out 15 substances)



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PLATFORM BSR WATER

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Policy brief on pharmaceuticals in WWTP.

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- **Analytical methods, sufficient to detect APIs at concentrations close to respective environmental quality standards, should be applied throughout the region. Detection limits and analysis method should be aligned among countries.**
- **A database containing information on the occurrence and concentrations of APIs in wastewater, inland surface waters, ground waters and in the marine environment is to be established and made available for expert community. This would help creating a scientifically sound basis for strengthening the management cycle for this group of hazardous substances.**
- **This database would also serve as the main source of information for the development of respective indicators of the state of the Baltic Sea or advancement of existing ones (e.g. diclofenac).**
- **Even the limited data compiled in this report proves that active pharmaceutical substances, including those with scientifically proven environmental effect, are continuously released to the aquatic environment.**
- **Many API from various groups are frequently detected, demonstrating concentrations in effluents at similar level as in influents. In some cases, such as diclofenac and ketoprofen, concentrations in effluents are even higher than in influents. It demonstrates that conventional wastewater treatment is not efficient for removing pharmaceuticals from sewage water.**
- **Low removal level of APIs from wastewater and limited capacity to restrict their use call for more measures to minimize the release of APIs. These measures should not only be focused on improving technologies at WWTPs to increase their removal efficiency but also target pharmaceuticals at their source (e.g. prescription, consumption reduction, responsible handling and disposal, pretreatment for large hospitals and pharmaceutical manufactories).**

The third holistic assessment of the Baltic Sea environmental health - HOLAS III

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HELCOM indicators

STATE OF THE BALTIC SEA - HOLISTIC ASSESSMENT -

Ecosystem components

Birds
- Abundance of waterbirds in the breeding season.
- Abundance of waterbirds in the wintering season.
- Number of drowned mammals and waterbirds in fishing gear.*

Marine mammals
- Population trends and abundance of seals.
- Nutritional status of seals.
- Reproductive status of seals.
- Distribution of Baltic seals.
- Number of drowned mammals and waterbirds in fishing gear.*

Fish
- Abundance of key coastal fish species.
- Abundance of coastal fish key functional groups.
- Abundance of seatrout spawners and parr.
- Abundance of salmon spawners and smolt.

Benthic habitats
- State of the soft bottom macrofauna community.
- Condition of benthic habitats.**

Pelagic habitats
- Zooplankton mean size and total stock.
- Chlorophyll-a.
- Cyanobacterial bloom index.*
- Diatom/Dinoflagellate index.*
- Seasonal succession of dominating phytoplankton groups.*

Commercial fish
- Spawning stock biomass (cod, dab, sole, herring, sprat).****
- Fishing mortality (cod, dab, sole, herring, sprat).****

Favourable status of Baltic Sea ***biodiversity***

Baltic Sea unaffected by ***eutrophication***

Eutrophication
- Dissolved inorganic nitrogen.
- Dissolved inorganic phosphorus.
- Total nitrogen.
- Total phosphorus.
- Chlorophyll-a.
- Cyanobacterial bloom index.*
- Oxygen debt.
- State of the soft-bottom macrofauna community.
- Coastal water indicators (national).
- Water clarity.

Non-indigenous species
- Trends in arrival of new non-indigenous species.

Marine litter
- Beach litter.**
- Litter on the seafloor.**
- Microlitter in the water column.**

Energy and noise
- Continuous low frequency anthropogenic sound.**
- Distribution in time and space of loud low-frequency and mid-frequency impulsive sound.**

Contaminants
- HBCDD.
- Metals (Mercury, Lead, Cadmium).
- PBDEs.
- PFOS.
- PAHs and their metabolites.
- PCBs, dioxins and furans.
- TBT and imposex.*
- Radioactive substances.
- White tailed sea eagle productivity.
- Reproductive disorders: malformed embryos of amphipods.***
- Diclofenac.*

Baltic Sea undisturbed by ***hazardous substances***

Environmentally friendly ***maritime activities***

Pressures
- Input of nutrients to the subbasins.
- Operational oil-spills from ships.

Seafloor integrity
- Cumulative impacts on benthic biotopes.**

Pressures

Possibilities towards HOLAS III (2023)

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Contaminants

- HBCDD.
- Metals (Mercury, Lead, Cadmium).
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Improved confidence assessment?

Inclusion of new indicators?

Assessment of Biological Effects?

Improved integrated assessment?

TBT to core?

Longer data series?

Sediment cores?

Copper indicator?

Additional threshold values?

Surveillance indicator - screening?

Causal framework – drivers, activities etc?

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Thank you.