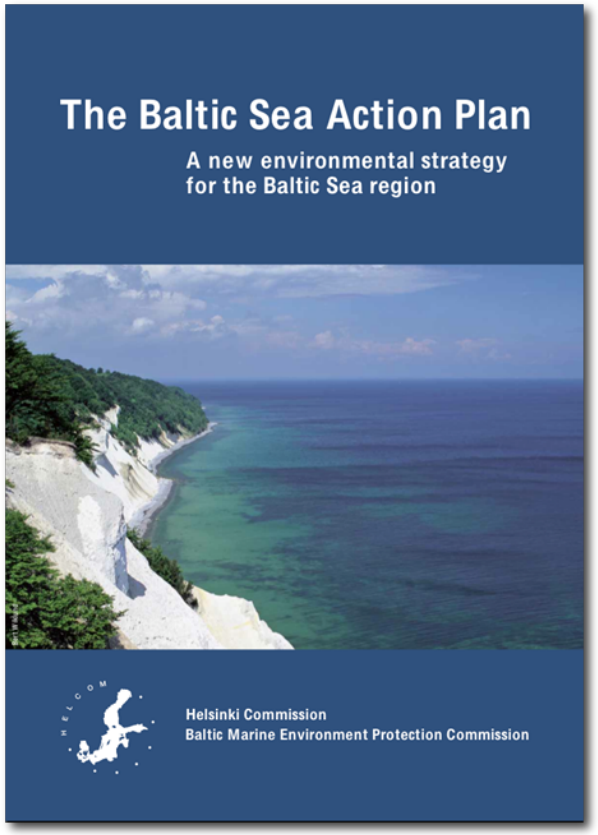
Science meet Management



The Baltic Sea Action Plan
against Eutrophication

Fredrik Wulff

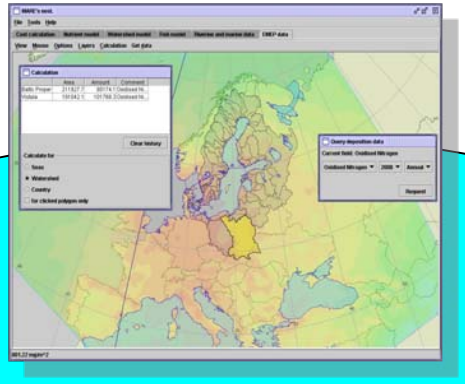
The HELCOM Challenge

- For the *entire* Baltic Sea
- How much should nutrient loads be reduced to reach a good environment?
- How to allocate nutrient reductions between countries?

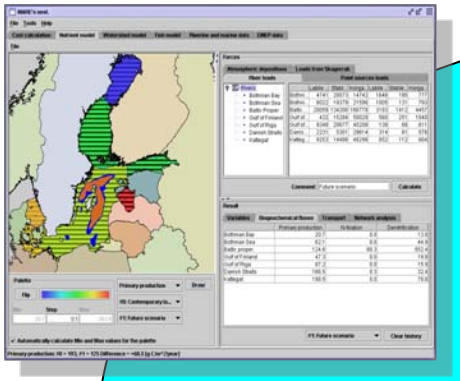
What is Baltic Nest?

- A model tool for describing Baltic Sea ecosystem dynamics
- A method to link scientific information to management decisions
- A unique decision support system for marine management

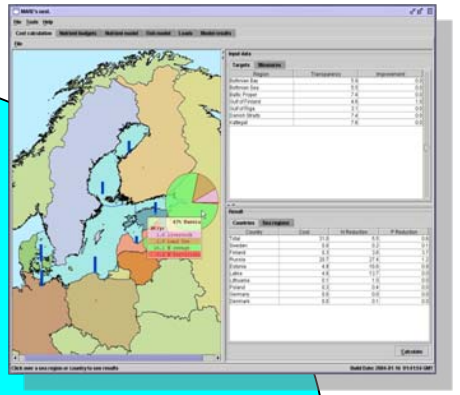
Atmospheric emissions and load



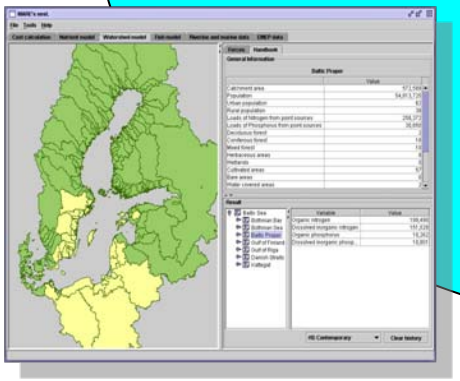
Marine modeling



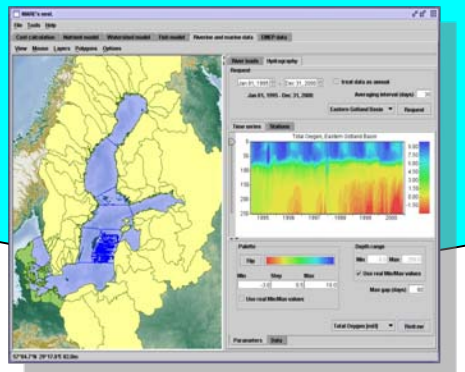
Cost minimization model



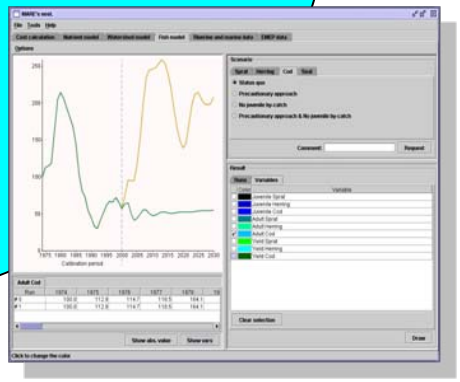
NEST can be used freely with any computer with Internet access from http://nest.su.se/nest/



Drainage basin modeling



Marine and runoff data



Fishery management

Stockholm Resilience Centre
Research for Governance of Social-Ecological Systems

Stockholm University

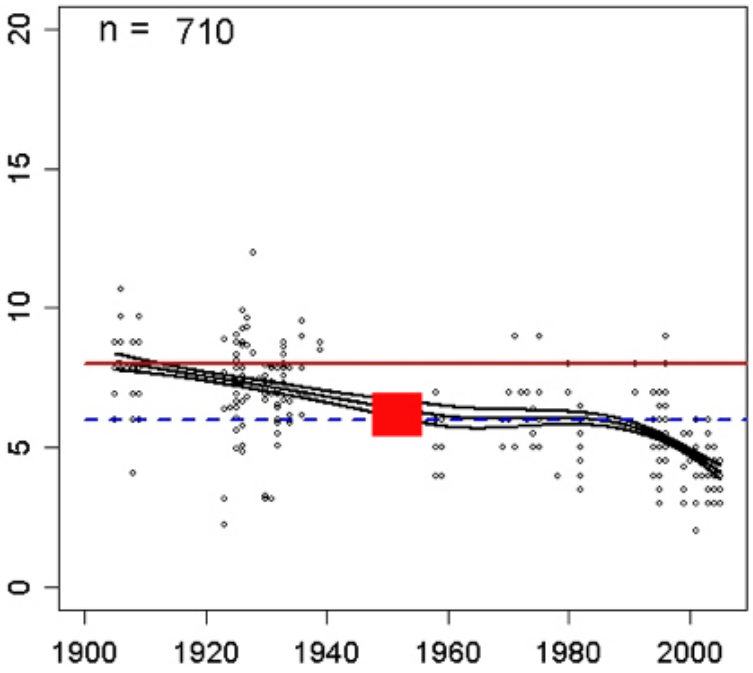
Baltic Nest Institute

BSAP: The three basic steps

1. Define allowable inputs
2. Estimate what will be done by excising legislations
3. Allocate the rest

Good Environmental conditions – set by HELCOM (EUTRO PRO)

Gulf of Finland Water transparency



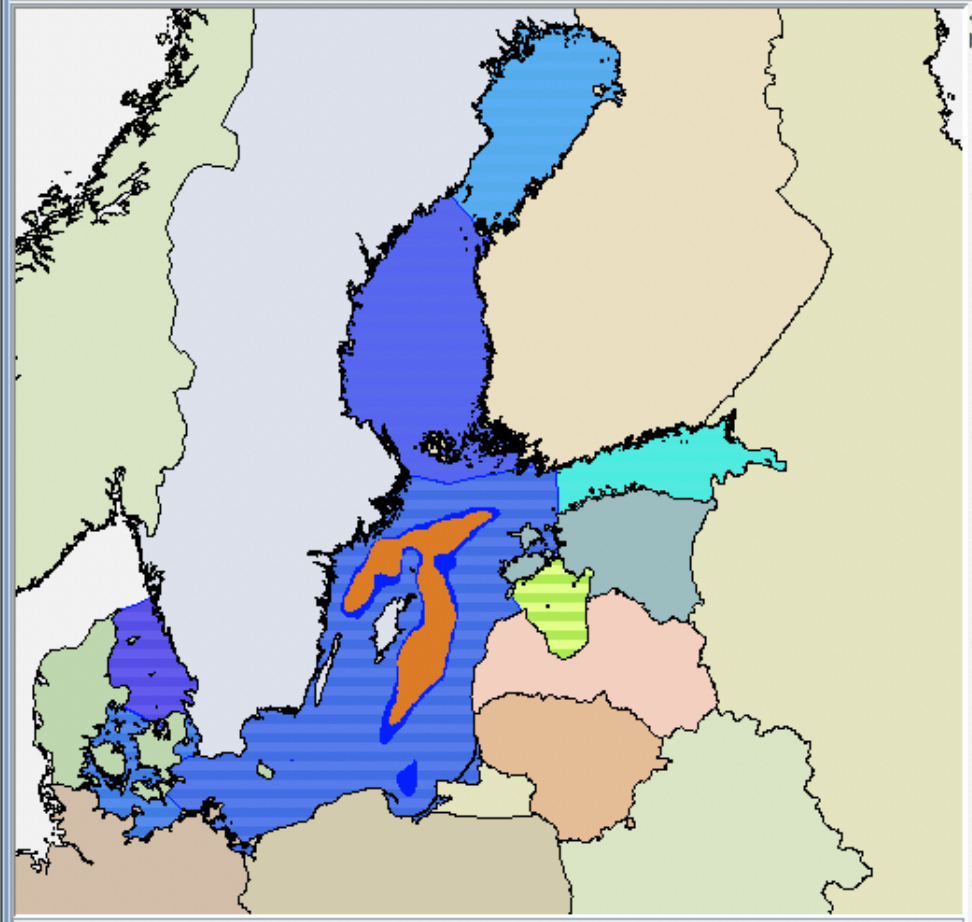
For most regions this means conditions comparable to those in the 1950-1960ties

Baltic Nest

File Tools Help

Cost calculation | Cost Model | Marine model | BaltSem marine model | Watershed model | Fish model | Riverine and marine data | EMEP data

File



Palette

Flip

Min 17.02 | Step 0.10 | Max 41.58

Total N | Draw

#0: DEAFAULT LOAS

#2: BSAP

Automatically calculate Min and Max values for the palette

Forces

Atmospheric depositions | Loads from Skagerrak

River loads | Point sources loads

	Labile Or...	Stable O...	Inorganic N	Labile Or...	Stable Or...	Inorganic P
Bothnian...	7114	28455	15867	1549	172	864
Bothnian...	8192	24576	24018	1371	152	934
Baltic Pr...	34672	81900	116686	3731	1081	1934
Gulf of F...	15116	45350	46214	3401	489	970
Gulf of R...	12680	23548	42174	588	93	749
Danish S...	3888	5832	21173	653	73	684
Kattegat	7177	10765	26315	862	96	615

Comment: BSAP | Calculate

Result

Variables | Biogeochemical fluxes | Transport | Network analysis

	Total N	Total P	Transparency
Bothnian Bay	22.5	0.2	5.8 6.6
Bothnian Sea	19.5	0.4	7.0 8.0
Baltic Proper: 0 -...	18.5	0.5	7.0 8.1
Gulf of Finland	24.6	0.6	6.0 5.9
Gulf of Riga	41.6	0.7	4.5 4.2
Danish Straits	18.9	0.6	7.7 7.7
Kattegat	17.0	0.6	8.5 9.0
Baltic Proper: 60...	20.9	1.5	

#2: BSAP | Clear history

Step 1: Allowable Nutrient Inputs

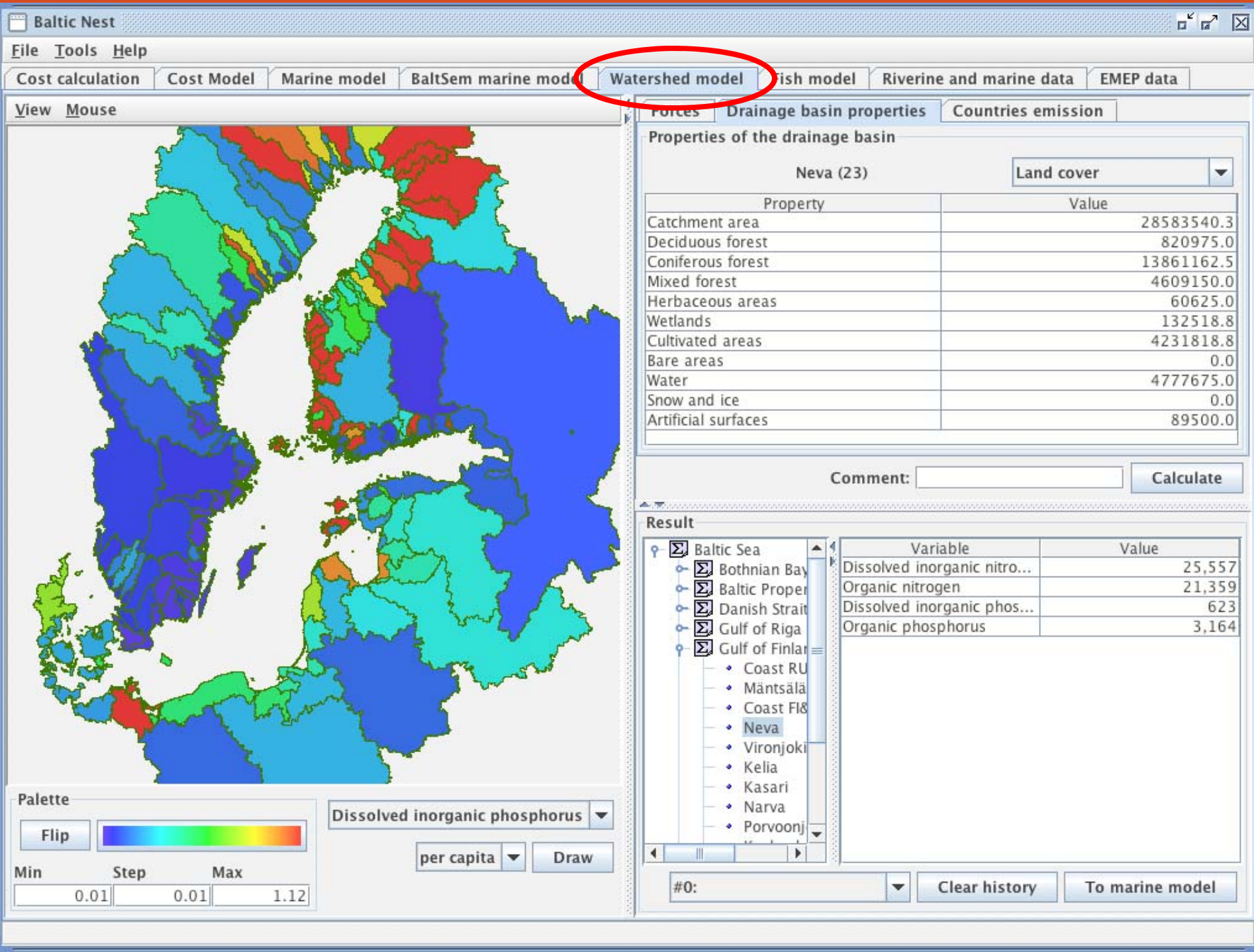
	Load 97-03		Needed reduction		Maximum allowable inputs			
	N	P	N	P	N	N atm	P	P atm
BB	51,436	2,585	0	0	51,436	10,584	2,585	562
BS	56,786	2,457	0	0	56,786	32,636	2,457	1,178
BP	327,259	19,246	94,000	12,500	233,259	154,857	6,746	3,205
GF	112,680	6,860	6,000	2,000	106,680	15,394	4,860	445
GR	78,404	2,180	0	750	78,403	12,018	1,430	270
DS	45,893	1,409	15,000	0	30,893	28,453	1,409	318
KT	64,257	1,573	20,000	0	44,257	24,437	1,573	336
SUM	736,714	36,310	135,000	15,250	601,713	278,379	21,060	6,314

Table 1. Loads of total nitrogen and phosphorus (tons year^{-1}) to the Baltic Sea sub-basins (riverine and coastal point sources), averaged for 1997-2003 (from official data reported to HELCOM) and the reductions needed to reach the environmental targets as well as maximum allowable inputs.

The country allocation scheme

Step 2: Reductions imposed by improved waste water treatment

- The wastewater treatment levels, as required by EU (91/27/EEG) set nitrogen reduction to 70%-80% and phosphorus reduction to 80% for cities above 10,000 inhabitants and are comparable to the HELCOM requirements.
- For cities between 10,000 and 2,000 inhabitants we are assuming secondary treatment levels, i.e. 35% for nitrogen and 35% for phosphorus.
- Effluents from populations that live in rural areas were treated as manure
- Information on MWWTP connection for 2004


Baltic Nest
File Tools Help
Cost calculation
Cost Model
Marine model
BaltSem marine mode
Watershed model
ish model
Riverine and marine data
EMEP data
View Mouse
Forces
Drainage basin properties
Countries emission
Properties of the drainage basin
Neva (23)
Land cover
Property
Value
Catchment area 28583540.3
Deciduous forest 820975.0
Coniferous forest 13861162.5
Mixed forest 4609150.0
Herbaceous areas 60625.0
Wetlands 132518.8
Cultivated areas 4231818.8
Bare areas 0.0
Water 4777675.0
Snow and ice 0.0
Artificial surfaces 89500.0
Comment:
Calculate
Result
Baltic Sea
Bothnian Bay
Baltic Proper
Danish Strait
Gulf of Riga
Gulf of Finlan
Coast RU
Mäntsälä
Coast FI&
Neva
Vironjoki
Kelia
Kasari
Narva
Porvoonj
Variable
Value
Dissolved inorganic nitro... 25,557
Organic nitrogen 21,359
Dissolved inorganic phos... 623
Organic phosphorus 3,164
Palette
Flip
Min
Step
Max
0.01
0.01
1.12
Dissolved inorganic phosphorus
per capita
Draw
#0:
Clear history
To marine model

Changes in P loads

due to EU WWT directive

Decreased phosphorus load

P	DE	DK	EST	FIN	LIT	LAT	RU	PO	SE	Σ
BB	0	0	0	-3	0	0	-2	0	0	-5
BS	0									0
BP	0									-3,212
GF	0									-1,306
GR	0									-190
DS	0									0
KT	0									0
Σ	0									-4,713

Increased phosphorus load

	DE	DK	EST	FIN	LIT	LAT	RU	PO	SE	Σ
BB	0	0	0	0	0	0	0	0	20	20
BS	0	0	0	45	0	0	0	0	70	115
BP	49	12	0	0	0	3	0	0	177	241
GF	0	0	0	0	0	0	0	0	0	0
GR	0	0	0	0	0	0	0	0	0	0
DS	45	362	0	0	0	0	0	0	9	416
KT	0	80	0	0	0	0	0	0	123	203
Σ	94	454	0	45	0	3	0	0	400	996

Remaining reductions

	N	P
BB	0	0
BS	0	0
BP	81,399	9,288
GF	333	694
GR	0	560
DS	14,880	0
KT	19,957	0
Total	116,569	10,542

Table 7. Additional nutrient load reductions (tons yr^{-1}) needed to reach the environmental target of each basin when improved WWT has been implemented.

Step 3 Allocation

- The remaining needed total load reductions to each basin are calculated with the % share for each country of the remaining total loads to the particular basin.

Country allocations

Country	Phosphorus	Nitrogen
Germany	242	5,621
Denmark	16	17,207
Estonia	222	896
Finland	146	1,199
Lithuania	881	11,746
Latvia	300	2,561
Russia	2,500	6,967
Poland	8,755	62,395
Sweden	291	20,780
Common	1,662	3,779
Total	15,014	133,152

BSAP current state

- Significant load reduction have already been achieved during the last years (not detected for 1992-2003)
- The total loads to be reduced will thus be less

TIMETABLE FOR THE BSAP REVISION

BEFORE THE 2013 MINISTERIAL MEETING

2010	**Re-evaluation of environmental targets**	**Update of models Ensemble modeling**	**Update of data**
2011	Environmental targets ready	Recalculation of maximum allowable inputs	Revised country allocation schemes
2012	Scientist and managers agree on environmental targets	scientist and managers agree on environmental targets	scientist and managers agree on country allocation scheme
2013	HELCOM MINISTERIAL MEETING		

Other options

- Reduce atmospheric depositions (now 25% of current N load)
- Inputs from North Sea
- Shipping
- Nutrient trading
- ‘Ecological engineering’
- Fishery management

Science can help to

- Define operational environmental targets
- Show what is needed to reach such specific environmental targets
- Describe the relative importance of various factors influencing pollution
- Define how much can you improve the environment – by whom
- Describe what are minimum cost/ or cost alternatives to reach a specific target

Science can not define

- What is a good Baltic sea?
- How much is it worth - What is good enough?
- How long can we wait?
- Which measures are political and socially acceptable
- How to implement measures

Thank You