The HELCOM Maritime Assessment

How to visualize complex problems so that everybody understands

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Hermanni Backer
HS+ seminar 10 April 2019

HELCOM

Hello, I am a geographer with no formal education in visual design





I am a biologist. I don't have any formal training in design or data visualization either.
But we have something in common





We are interested in visualizing data so that as many as possible can understand





We are going to show you our attempt to make understandable complex issues in the Baltic Sea. We'll put the report Maritime Assessment as an example

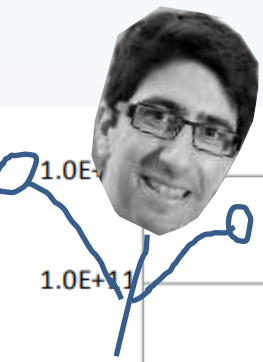




Scientific data is usually very difficult to visualize. Let us show you some examples







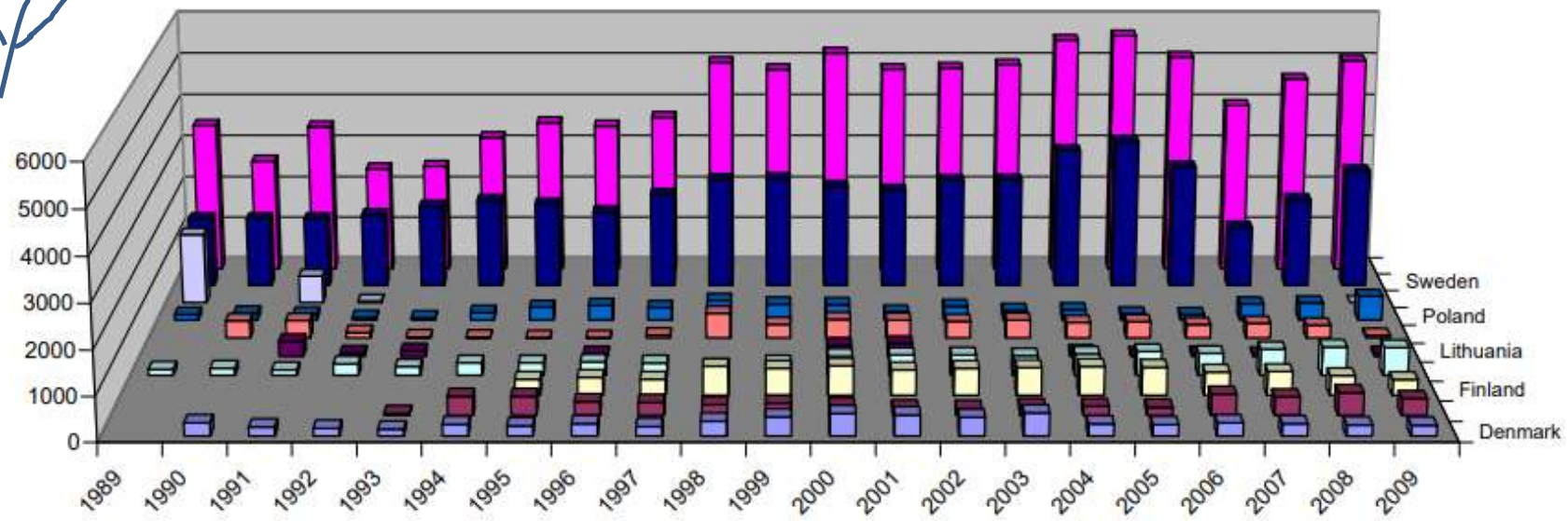
There are probably better ways to visualize this

Figure 2.4. Annual ^{60}Co discharges from local nuclear facilities into the Baltic Sea in 1999-2010.



And this

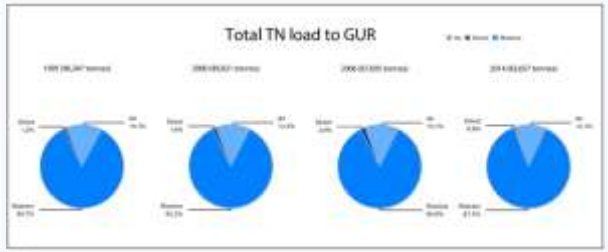
Figure 1. Number of flight hours per HELCOM country (hours), 1989-2009

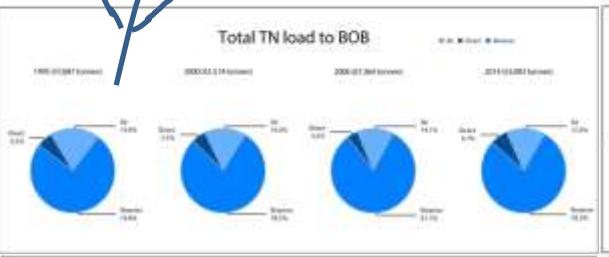


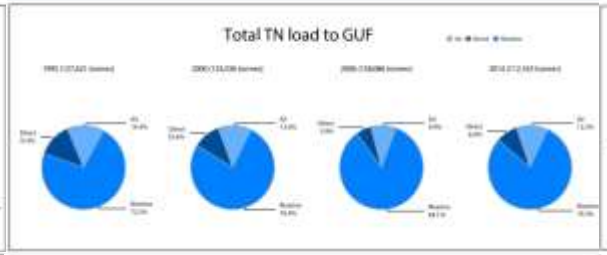
	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Denmark		292	199	172	153	253	225	275	209	325	416	497	463	412	510	265	251.2	289.8	270.6	245.8	239.8
Estonia					40	420	420	305	284	236	268	212	161	153	201	198.2	178.5	470.5	410	503	371
Finland							355	400	355	649	603	660	567	605	615	644	625	517	529	438	351
Germany	142	168	129	267	201	290	291	313	288	206	286	439	466	469	446	491.4	548.8	503.5	598.1	649.7	638
Lithuania			348	78	133			65				250	300			100	54	64	41		66
Latvia		400	408	127	24	18	8	8	64	577	320	436	412	387	414	365	384	311	343	298	61
Poland	131	164	140	62	49	179	301	345	291	465	375	362	187	320	228	239.4	141.1	130.5	380	405.5	560.9
Russia	1618		629	32																	0
Sweden	1600	1600	1600	1700	1900	2038	1953	1763	2189	2544	2565	2374	2281	2518	2532	3231	3455	2842	1397	2063	2758
Total	3491	2624	3453	2438	2500	3198	3553	3474	3680	5002	4833	5230	4837	4864	4946	5534	5638	5128	3969	4603	5046

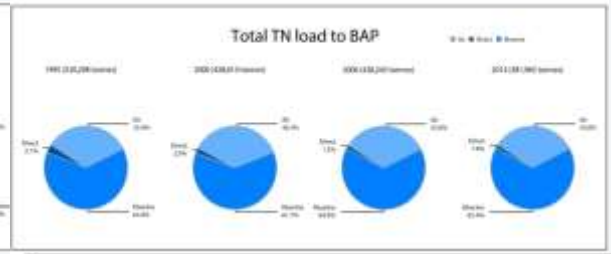

Total TN load to BAS
And this

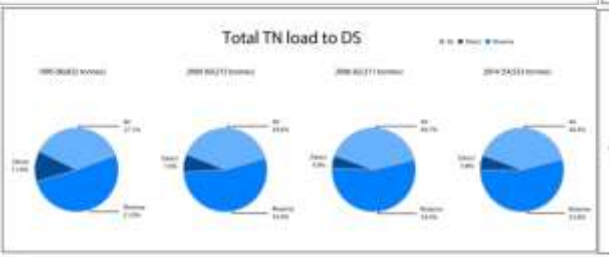

Total TN load to BOS


Total TN load to GUR

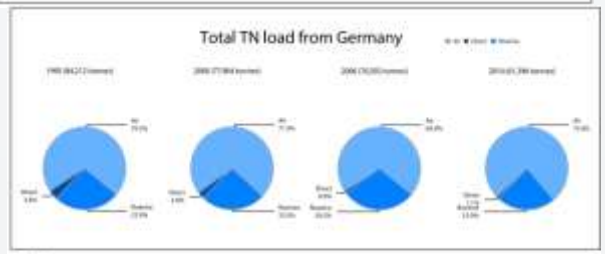

Total TN load to BOB

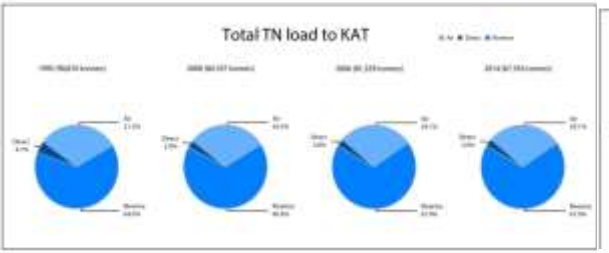

Total TN load to GUF

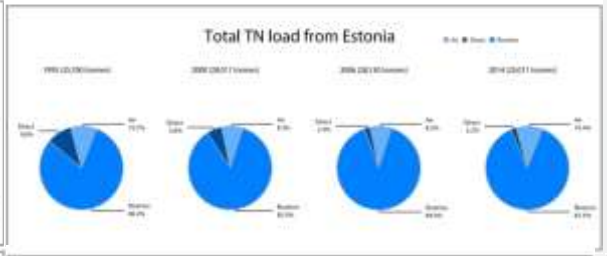

Total TN load to BAP

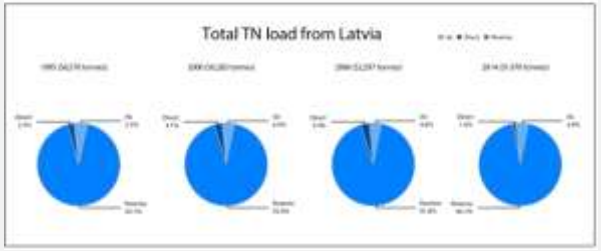

Total TN load to DS

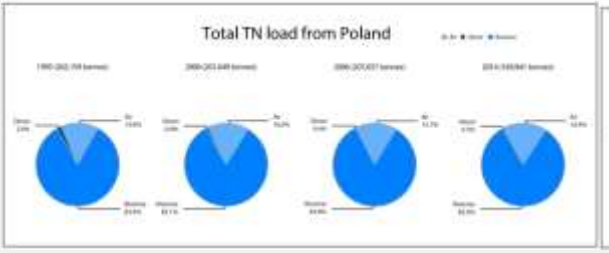

Total TN load from Denmark

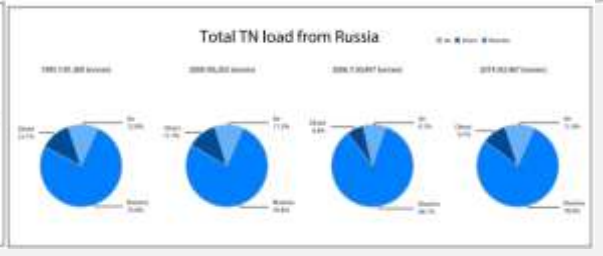

Total TN load from Germany

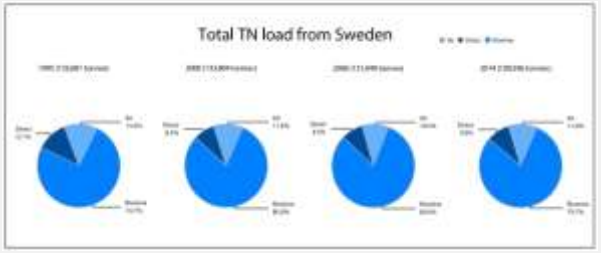

Total TN load to KAT


Total TN load from Estonia


Total TN load from Latvia


Total TN load from Poland


Total TN load from Russia


Total TN load from Sweden

But before showing you the Maritime Assessment let me explain this thing called HELCOM





To understand HELCOM we need to talk about a sea that has many problems





The Baltic Sea is unique and fragile

There are four characteristics that make the Baltic Sea unique and fragile





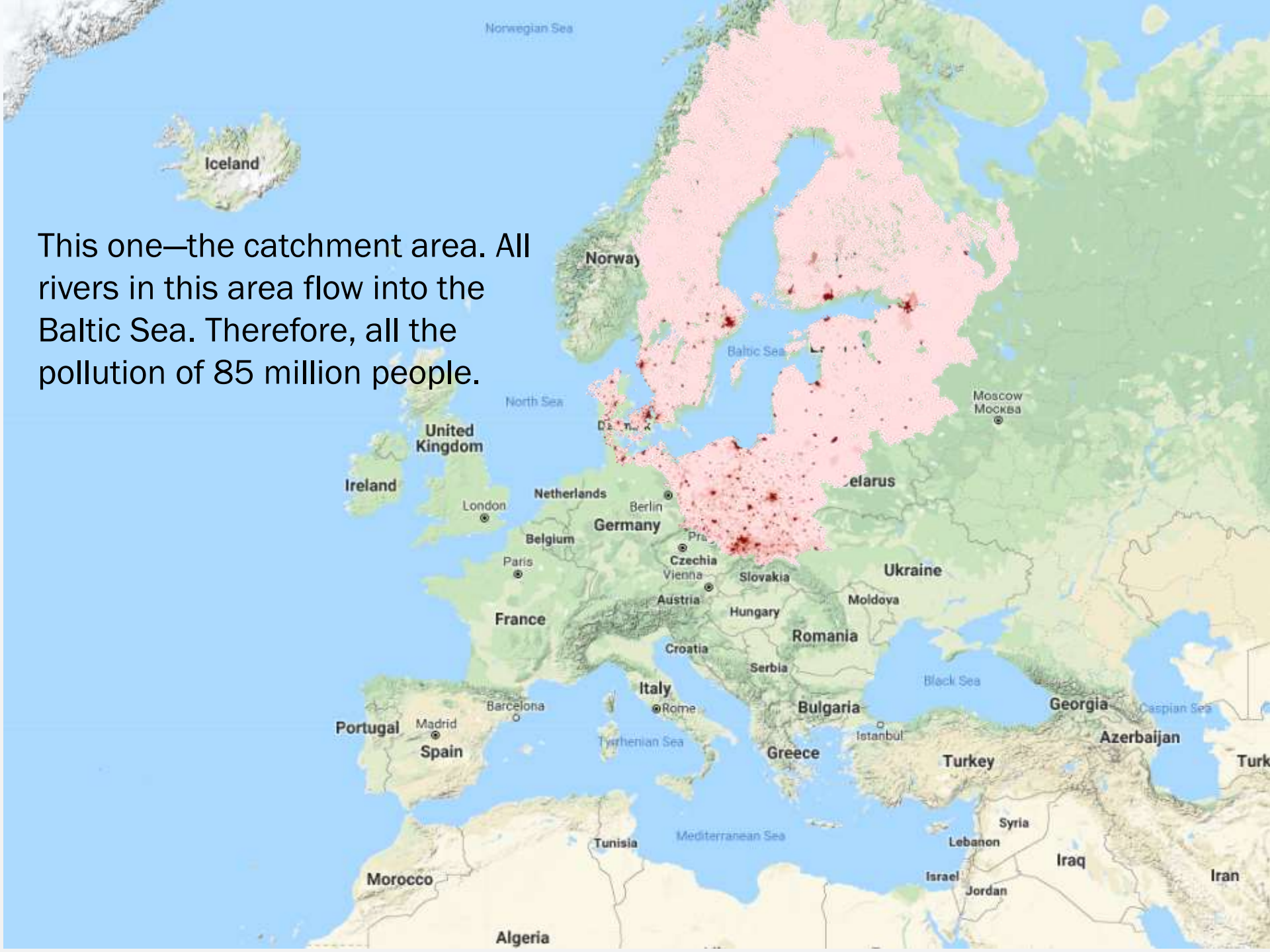
Many people living around; it’s a small area; there are low levels of salt and the Baltic is not so deep!





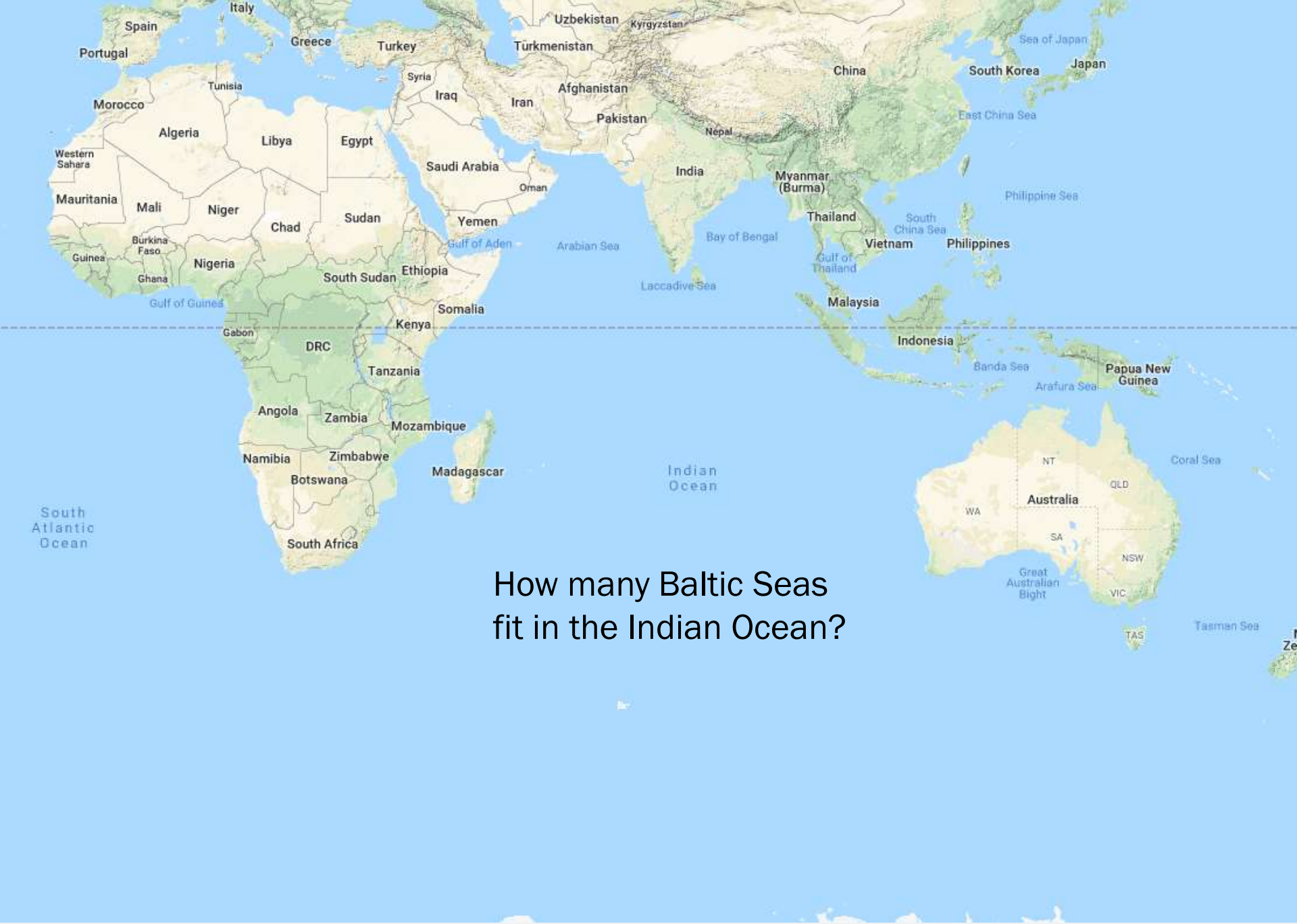


This is how we usually see the Baltic Sea... But there is another way



This one—the catchment area. All rivers in this area flow into the Baltic Sea. Therefore, all the pollution of 85 million people.


The Baltic Sea is very small
Norwegian Sea
Iceland
Sweden
Norway
Finland
Latvia
Moscow
Москва
North Sea
United Kingdom
Ireland
Netherlands
London
Berlin
Poland
Belarus
Germany
Belgium
Prague
Czechia
Paris
Vienna
Slovakia
Ukraine
Austria
Moldova
Hungary
France
Romania
Croatia
Serbia
Black Sea
Italy
Barcelona
Rome
Bulgaria
Georgia
Caspian Sea
Portugal
Madrid
Istanbul
Azerbaijan
Spain
Tyrrhenian Sea
Greece
Turkey
Syria
Mediterranean Sea
Tunisia
Lebanon
Iraq
Morocco
Israel
Iran
Jordan
Algeria

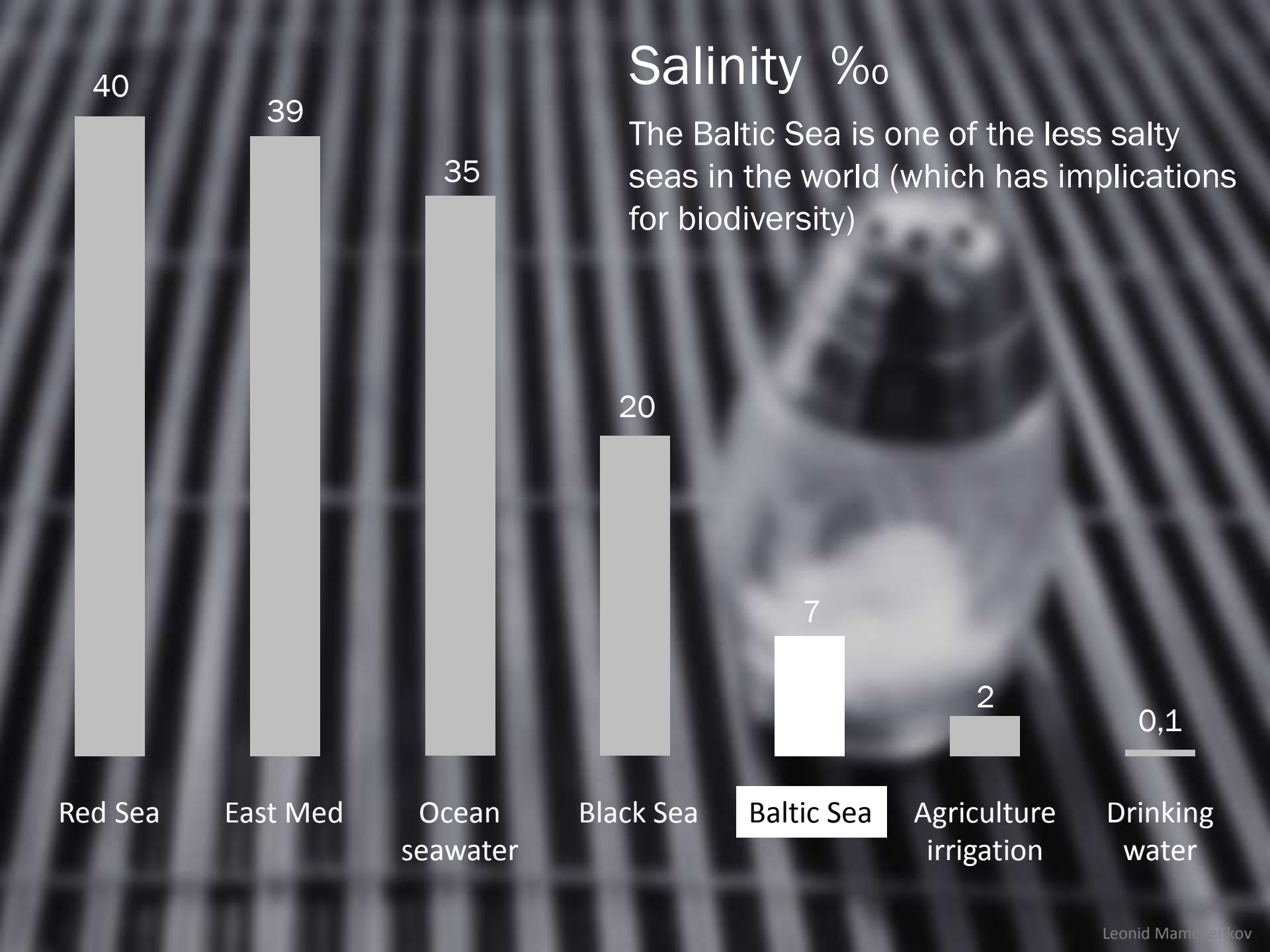


How many Baltic Seas
fit in the Indian Ocean?


60
Spain
Italy
Portugal
Greece
Turkey
Uzbekistan
Kyrgyzstan
Turkmenistan
Sea of Japan
China
South Korea
Japan
Tunisia
Syria
Iraq
Iran
Afghanistan
Morocco
Pakistan
East China Sea
Algeria
Libya
Egypt
Nepal
Western Sahara
Saudi Arabia
India
Myanmar (Burma)
Oman
Philippine Sea
Mauritania
Mali
Niger
Chad
Sudan
Yemen
Thailand
South China Sea
Gulf of Aden
Arabian Sea
Bay of Bengal
Vietnam
Philippines
Burkina Faso
Guinea
Nigeria
Ethiopia
Gulf of Thailand
South Sudan
Ghana
Malaysia
Gulf of Guinea
Somali
Kenya
Indonesia
Gabon
DRC
Banda Sea
Papua New Guinea
Tanzania
Arafura Sea
Angola
Zambia
Mozambique
Coral Sea
NT
QLD
Namibia
Zimbabwe
Australia
Botswana
WA
SA
NSW
South Atlantic Ocean
South Africa
TAS
Tasman Sea

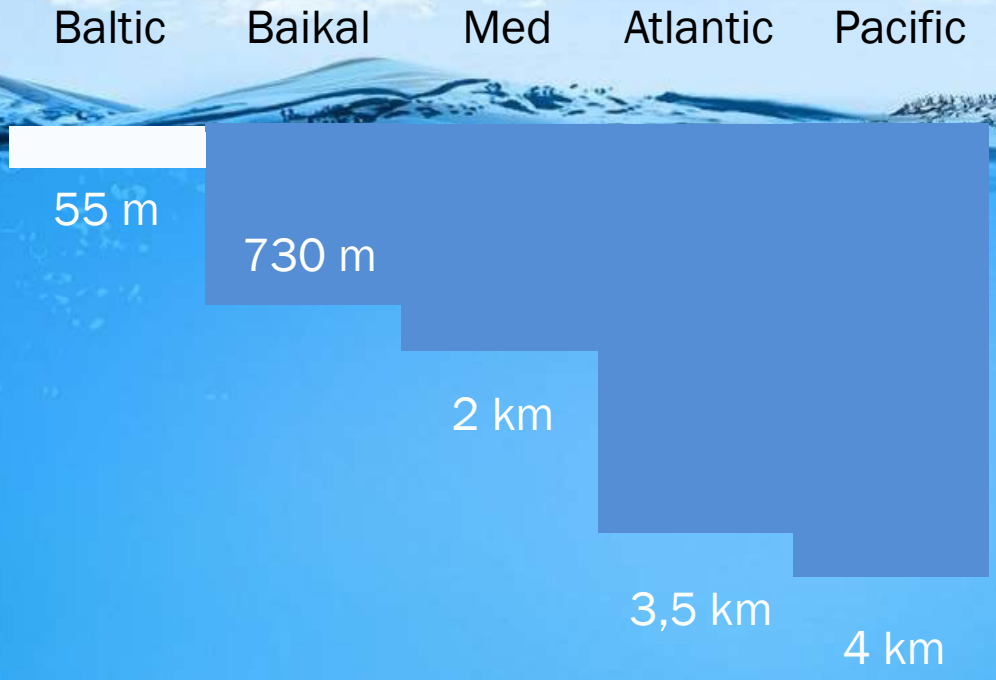
Salinity ‰

The Baltic Sea is one of the less salty seas in the world (which has implications for biodiversity)



Leonid Mamchenkov

Mean depth



It is also one of the shallowest seas in the world

Max depth



Yes, the Baltic is like a big swimming pool

The Baltic Sea is unique.
These special charactieristic
make it very fragile.





Our dear sea has been so sick… and still is! That's why HELCOM exists.





HELCOM? What’s that?

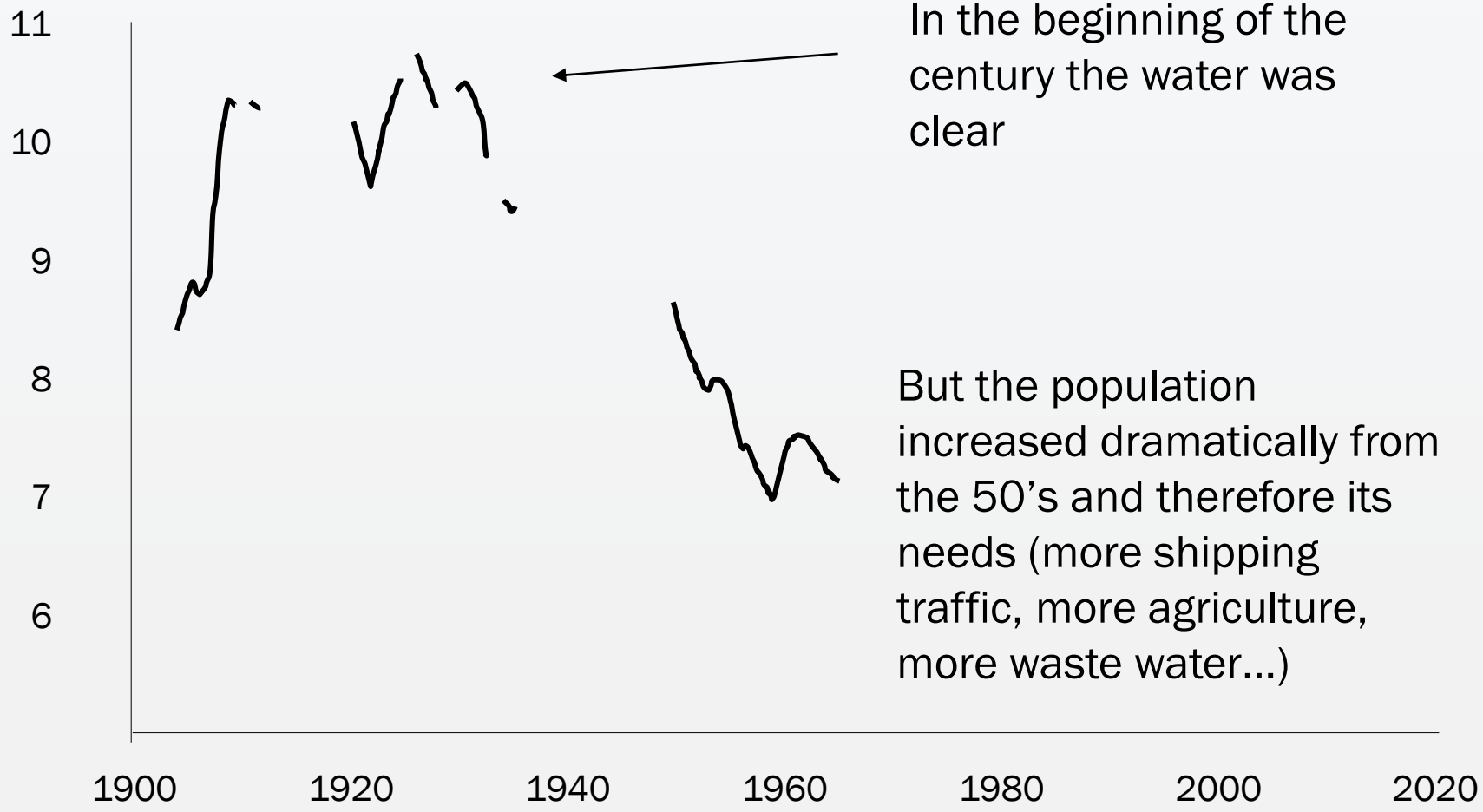




50 years ago scientists started to realize that the Baltic Sea was getting very sick. What did they notice? Let’s see some graphs…

WATER CLARITY summer Secchi depth

In meters

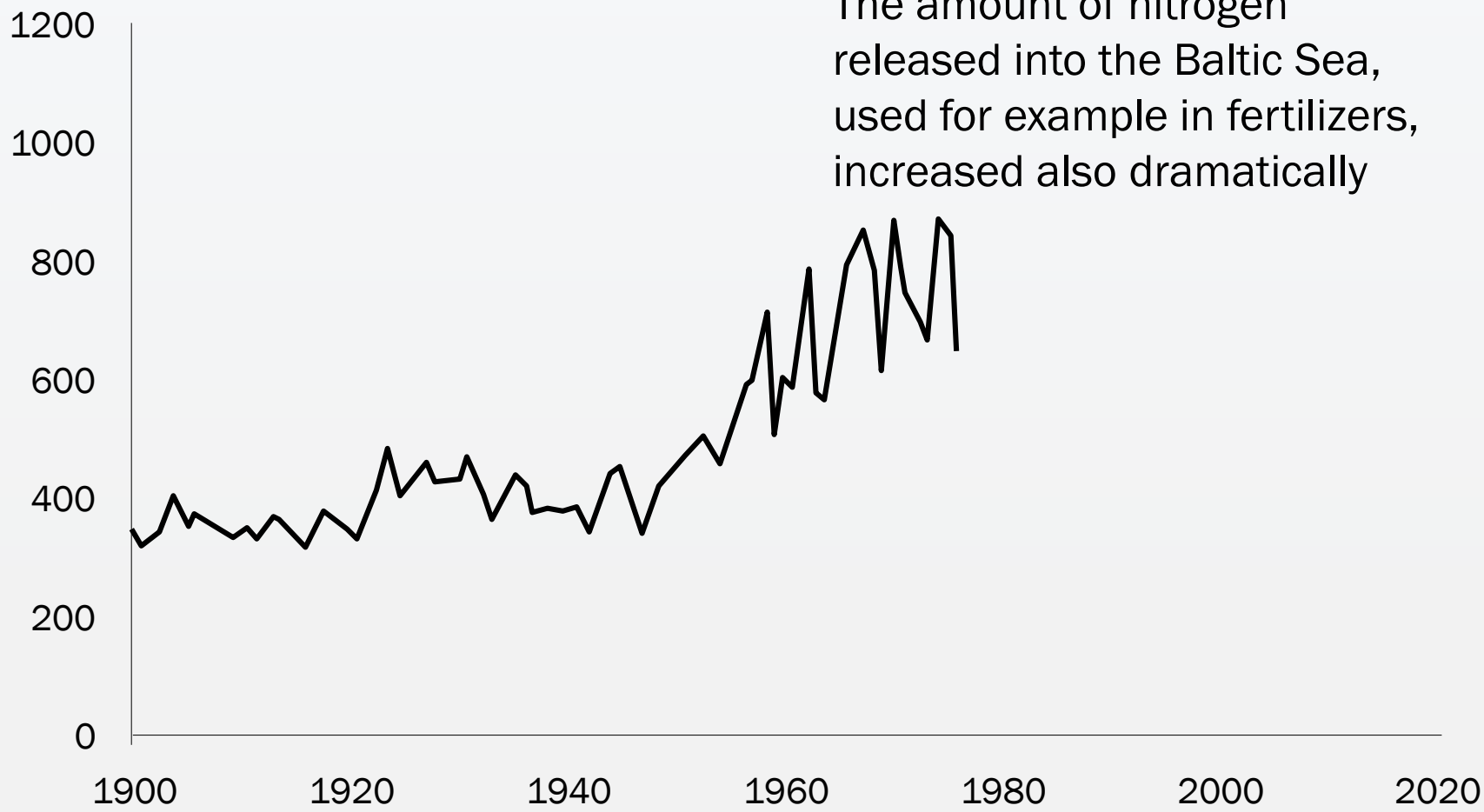


In the beginning of the century the water was clear

But the population increased dramatically from the 50's and therefore its needs (more shipping traffic, more agriculture, more waste water…)

NITROGEN waterborne inputs via waterways

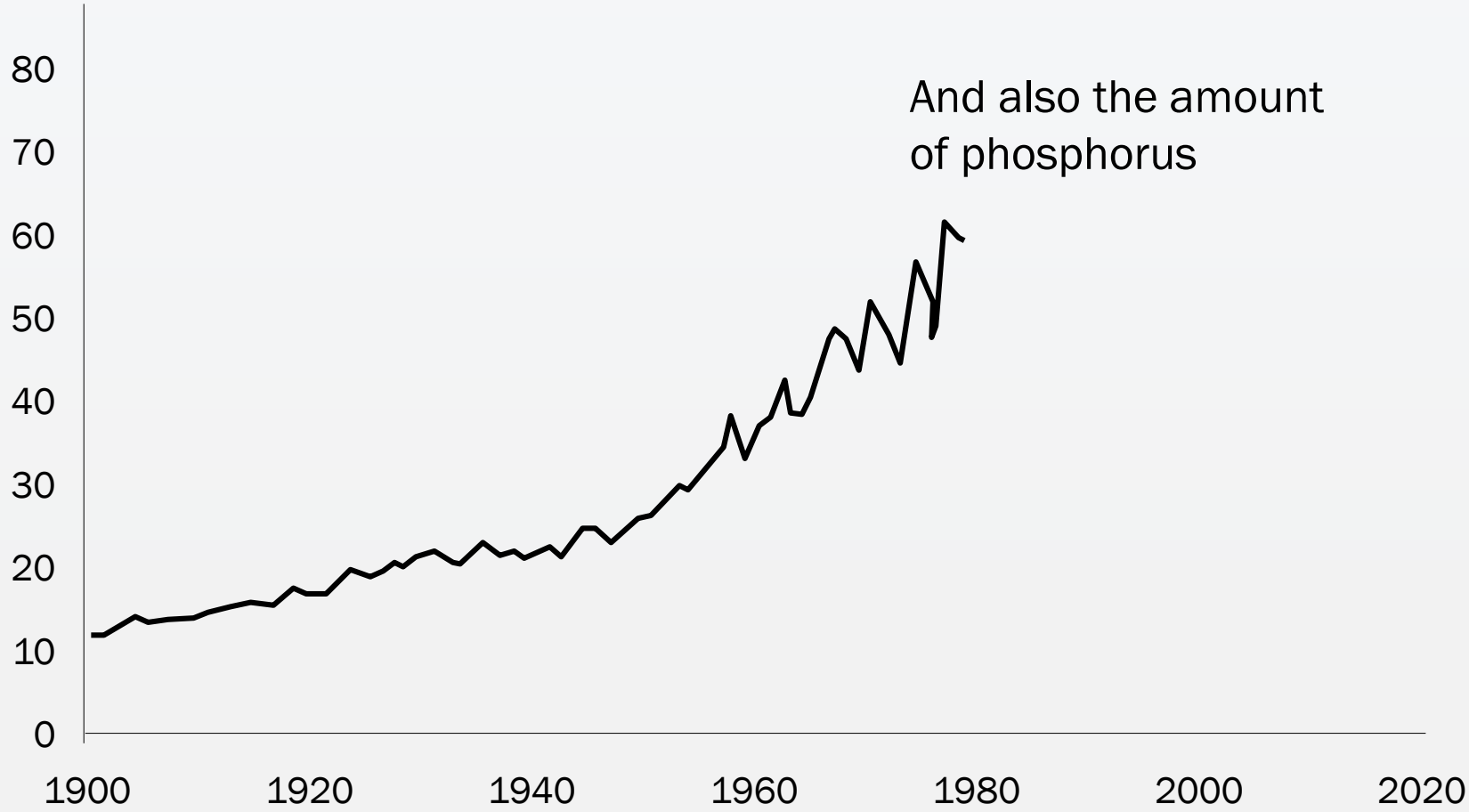
Tons per year (t/a) in .000



The amount of nitrogen released into the Baltic Sea, used for example in fertilizers, increased also dramatically

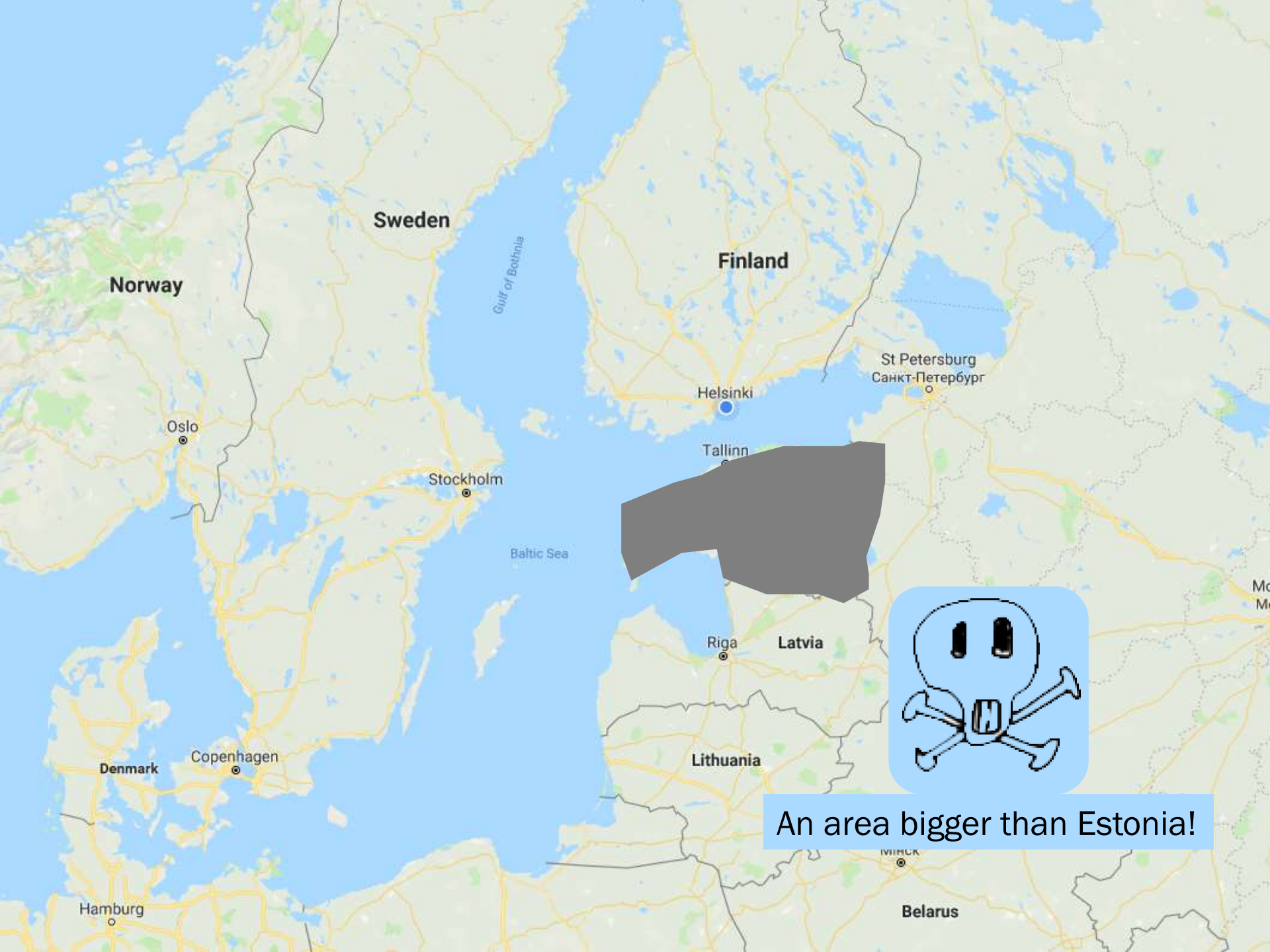
PHOSPHORUS waterborne inputs via waterways

Tons per year (t/a) in .000




The excess of nitrogen and phosphorus causes EUTROPHICATION, one of the main problems of the Baltic Sea


Sweden
Norway
Finland
Gulf of Bothnia
Helsinki
St Petersburg
Санкт-Петербург
Oslo
Tallinn
Stockholm
Estonia
Riga
Latvia
Lithuania
Denmark
Copenhagen
Hamburg
Belarus
It causes many problems. For example, bottom-living organisms in this area are dead due to eutrophication


Sweden
Norway
Finland
Gulf of Bothnia
Helsinki
St Petersburg
Санкт-Петербург
Oslo
Tallinn
Stockholm
Baltic Sea
Riga
Latvia
Lithuania
Denmark
Copenhagen
Hamburg
Belarus
An area bigger than Estonia!

In 1974, all countries around the Baltic Sea decided to react and signed the HELSINKI CONVENTION to protect the marine environment.

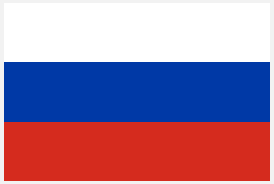


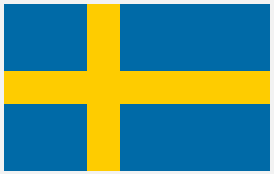





The Helsinki Commission (HELCOM) was established in order to apply the Convention. It is formed by all representatives of the 9 governments around the Baltic plus the EU







And the first HELCOM Secretariat was formed in 1981.
The Secretariat coordinates HELCOM activities.

Now you know about HELCOM…
Scientists and policy-makers
together to save the Baltic Sea





But this is a workshop about data visualization. The scientific community need to visualize data in a way that policy-makers can understand





And this is very, very difficult.
In my opinion there are three
main reasons why it is challenging

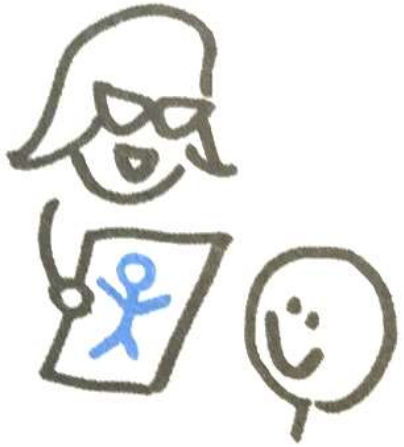




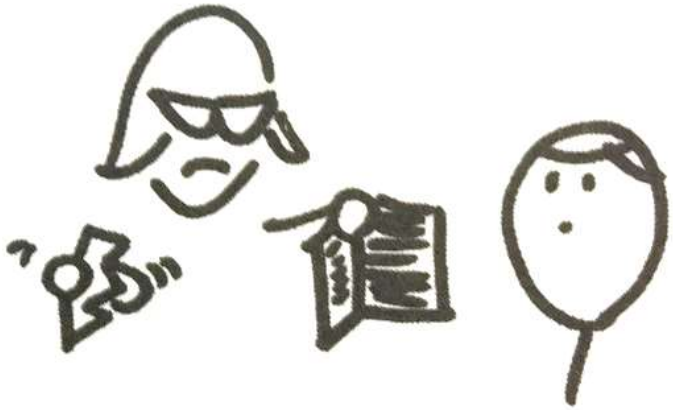
1. Lack of visual literacy

Visual expression is considered to be for artists instead of a tool for thinking. Also, data visualization is not taught properly, if at all.

. . . is because just when we were starting to understand things . . .



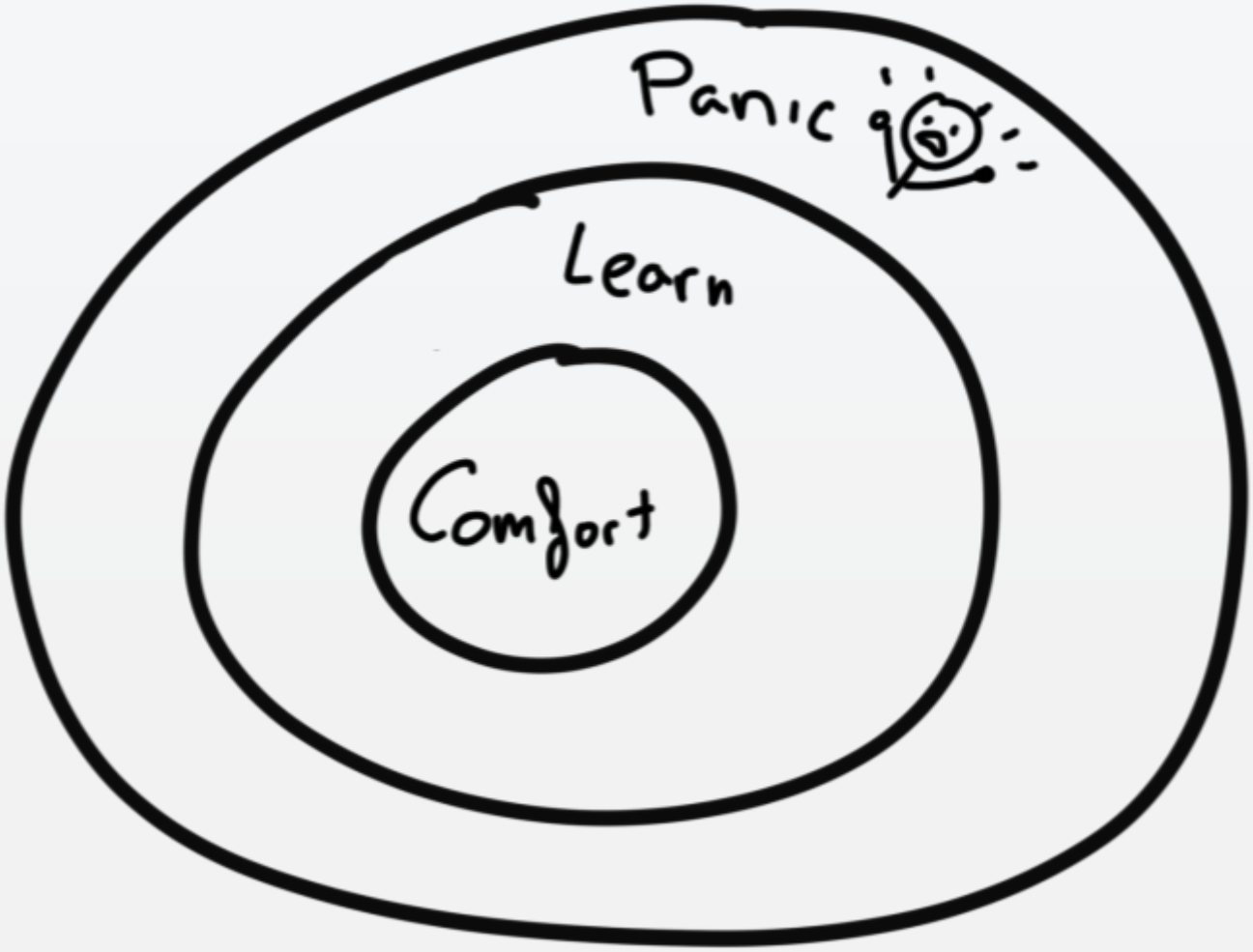
. . . they took the pictures away.



Dan Roam (2011) "Blah, blah, blah"

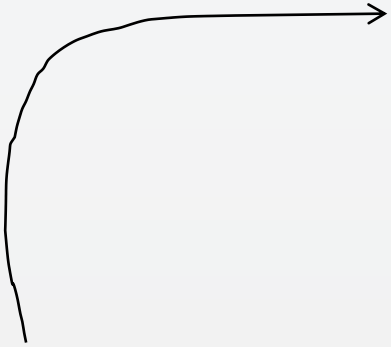
2. ”It has always been done like this!”

Doing something different is hard.



3. Prioritize accuracy over clarity

Scientists put, logically, a lot of emphasis in details. That's good for research but not always for communicating.



If this guy can explain quantum physics to 7 year olds we all can



Quantum Physics for 7 Year Olds | Dominic Walliman | TEDxEastVan


We need to change this!

We in HELCOM are trying to make data more understandable.
We don't have a formal training in data visualization but we like reading.

Let me show you some examples of what we have done.

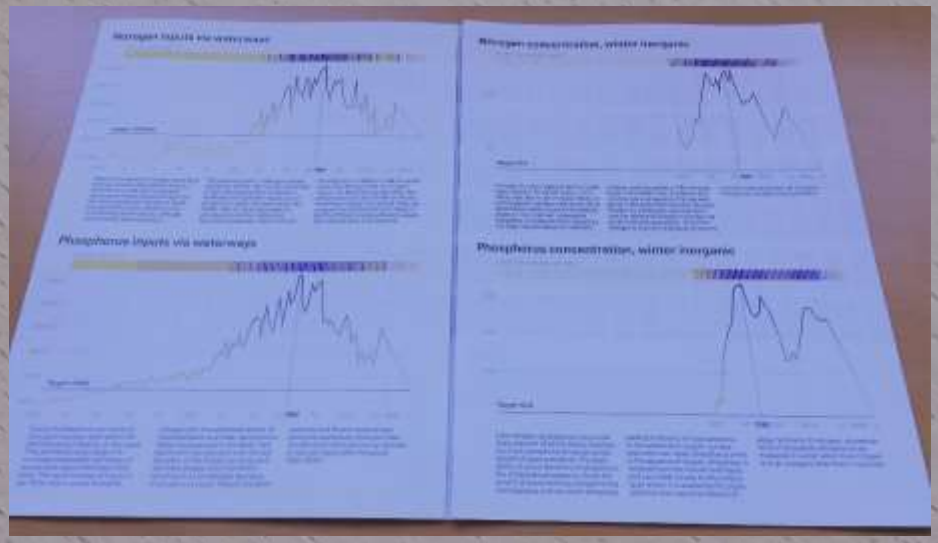





Joost Grootens
This is a work HELCOM commissioned to Dutch designer Joost Grootens

BALTIC SEA IS ON ITS WAY TO RECOVERY





Planning the Bothnian Sea was designed by Johannes Nieminen and Tuomas Siitonen





This animation of the shipping traffic with HELCOM data was made by Lauri Vanhala

1. First priority passenger ports (2010 HELCOM PRF Roadmap)

Port	No. of international passengers (ferries and cruise ships)[1]	No. of cruise passengers (cruise ships only)[2]	No. of cruise ship calls[3]	Arrangement of port reception facilities for sewage (2013)	Application of the "no-special-fee" system for sewage (2013)	Additional
Tallinn (EE) http://www.portoftallinn.com/paljassaare-harbour Cruise Baltic port category: X-large	2006:6760000* 2007: 6514294 2008: 7247366 2009: 7257646 2010: 7900000 2011: 8500000 2012: 8800000	2006: 305026' 2007: 294738 (292158') 2008: 377522 (375578') 2009: 416605 (415575') 2010: 392000 (390000') 2011: 443000 (437517') 2012: 442000 (440504')	2006:289' 2007:268' 2008:298' 2009:305' 2010:279' 2011:293' 2012:294'	Since 2011 fixed reception points connected to public sewage system ($30m^3/h$) available at Tallinn Old City Harbour quays no. 1 and 3. In other quays there is no direct discharge to sewer system –i.e. the quays are served by floating vehicles ($150-300m^3$) and tank trucks ($7-17m^3$) if requested.	Yes A standard waste fee is charged from every ship with some exceptions. Sewage volumes exceeding $7m^3$ are subject to extra payment.	The Port of Ta started in 201 of fixed recept connected to t public sewage These improve cover Old City quays no 13-1 a new cruise c
Rostock (DE) http://www.rostock-port.de/ Cruise Baltic port category: Large	2006:2541144* 2007: 2583042* 2008: 2689551* 2009:2405100* 2010: 2195154 2011: 2249091 2012: 2343707	2006: 173500 2007: 133700 2008: 171800 2009: 161800 2010: 177200 2011: 257300 2012: 300000	2006: 138 2007: 93 2008: 115 2009: 113 2010: 114 2011: 158 2012: 181	Direct discharge to sewer system available in the cruise terminal. Tank trucks available in the cargo port.	Yes Up to $300m^3$ of sewage is included in the "no-special-fee" system. Sewage volumes exceeding $300m^3$ are charged with 3EUR/m^3.	The cruise por Warnemünde with a connect berths to the n sewer system. In 2013 the m treatment plan sewage with a intake rate of 9 L/s). Sewage from (incl. grey wat
						accepted only defined and p sewage qualit
Copenhagen (DK) http://www.cmport.com/ Cruise Baltic port category: X-large	2006:829000* 2007: 2583043* 2008: 2689551* 2009:1456000* 2010: 1502000 (1431000*) 2011: 1604000	2006:458000' 2007:509000' 2008: 560000 2009: 620000 (675000') 2010: 662000 2011: 820000	2006:280' 2007:289' 2008:301' 2009:334' 2010:307' 2011:368' 2012:372'	Direct discharge to sewer system , 250-300 m3 sewage per hour per berthing place, will be available on new quay which will be	Yes Collection of that part of the sewage attributable to the ship's operations is made under 'no	In the Port of PRFs for sewa the new 1,1 k quay which wi in autumn 201 will be taken i 2014. The new

We remade a report with tables and numbers and made it with maps and graphs—the Port Reception Facilities report

Saint Petersburg (Russia)

312 cruise calls

http://www.pasp.ru UN LOCODE RULED



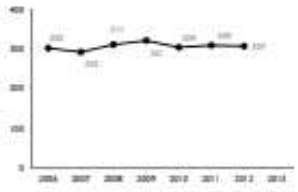
1. Sewage Port Reception Facilities 2014

The Saint Petersburg area includes in total five harbours serving passenger traffic.

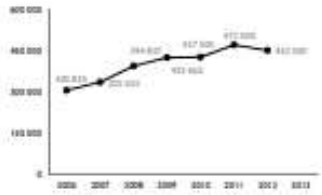
2. Passenger traffic trends in Saint Petersburg

A compilation based on statistics from the Baltic Sea coastal countries national administrations, regional ports organizations (BPO, ESPO), the publication "Baltic Port List" and the Nordic Council of Ministers.

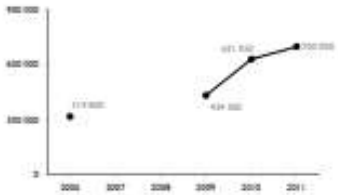
Cruise ships calls



Cruise ships passengers



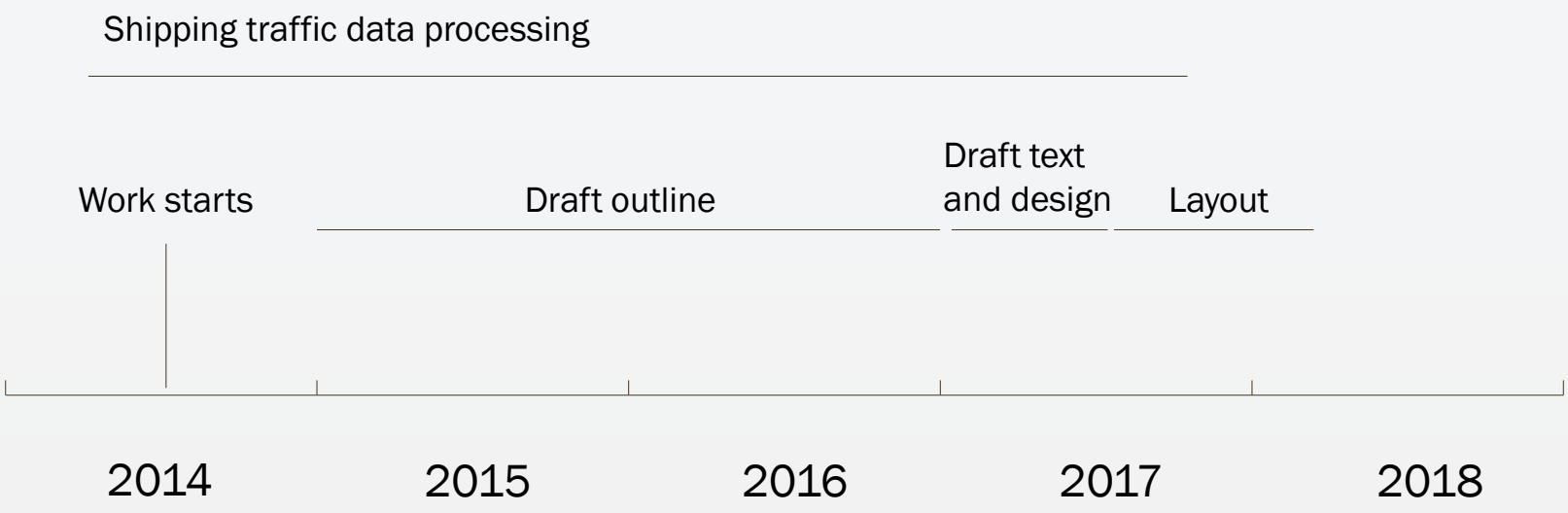
International cruise and ferry passengers



We designed this report ourselves

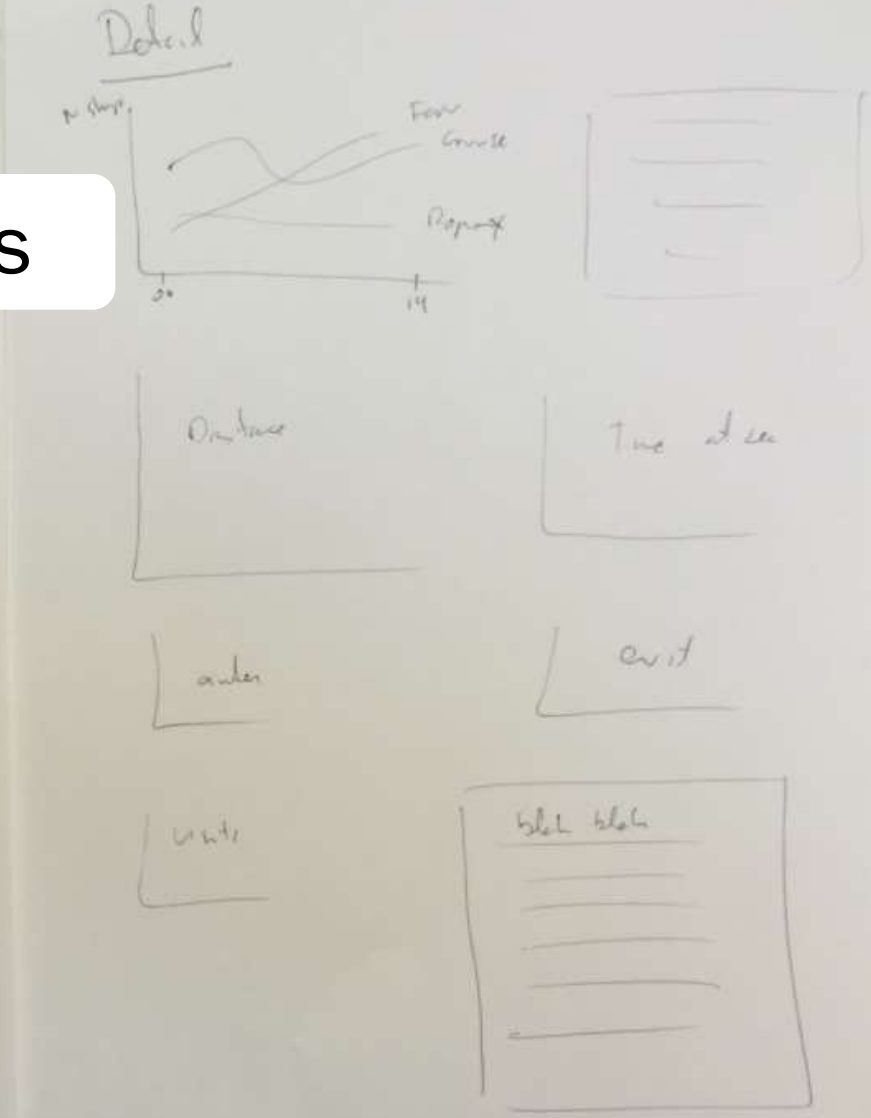


It took us a while…

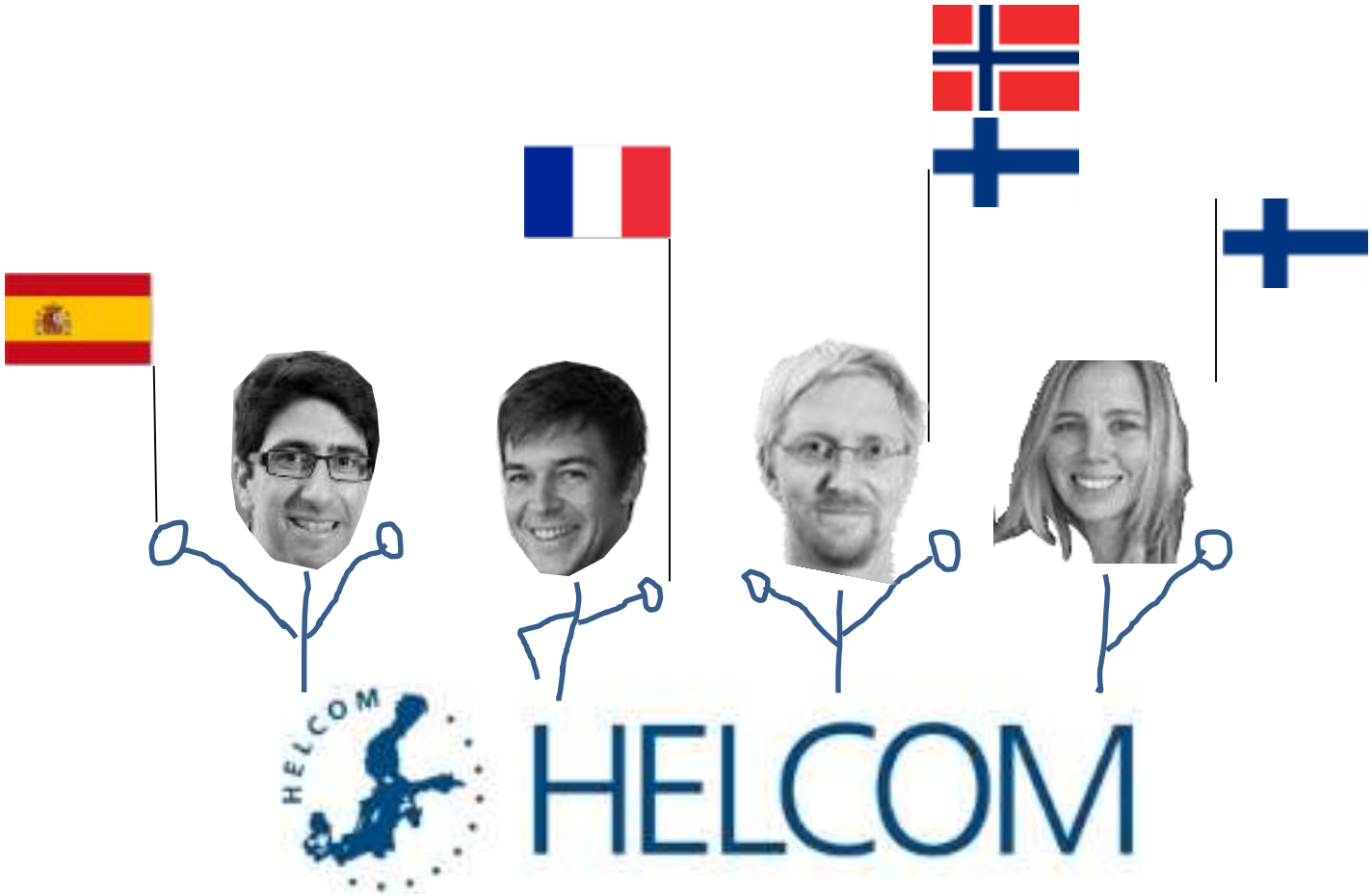


We made a lot of sketches





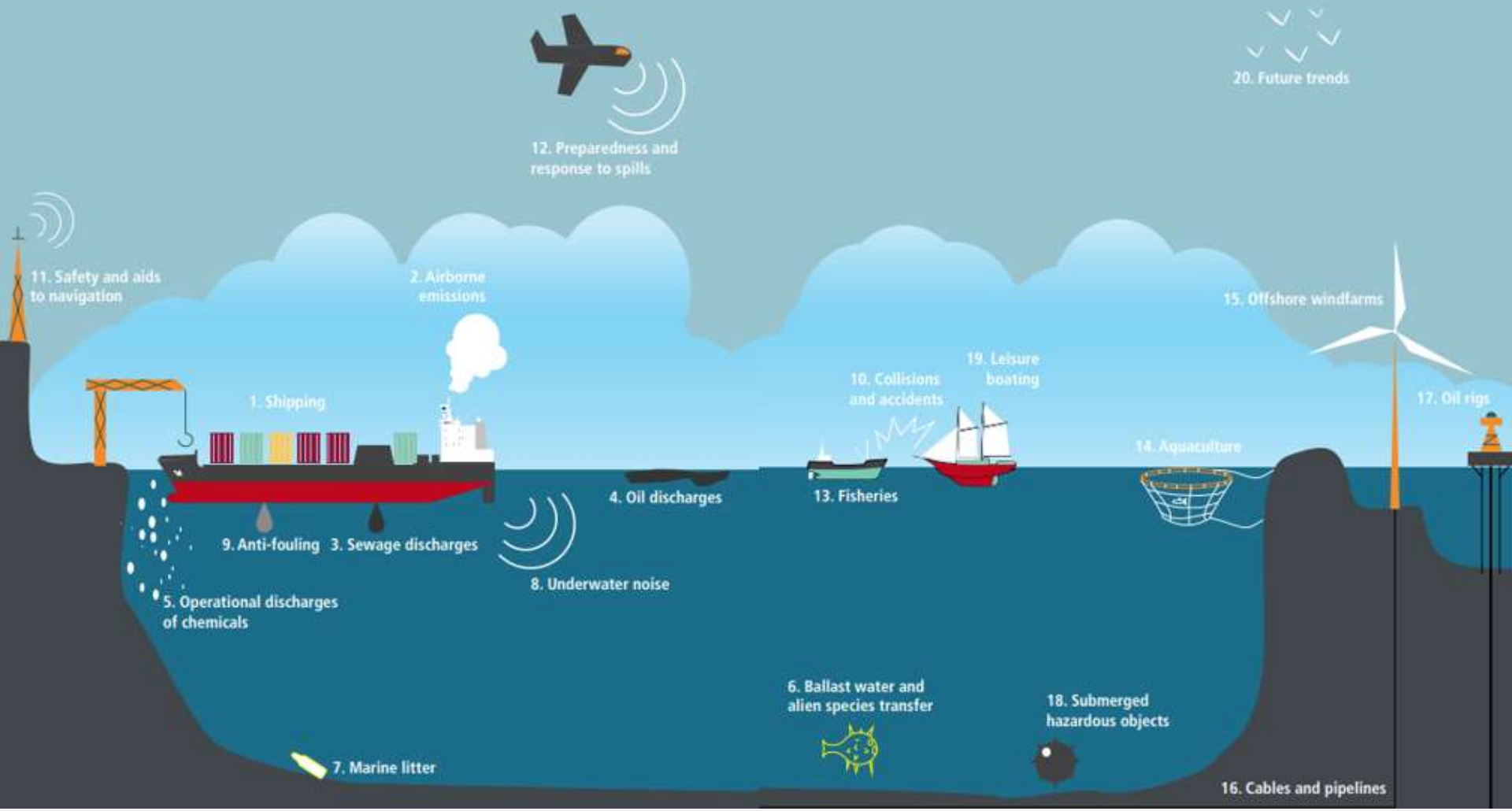
We were an international team



VISUAL CONTENTS

BALTIC MARINE ENVIRONMENT PROTECTION COMMISSION

We are very proud of the visual contents, an alternative to the classical table of contents



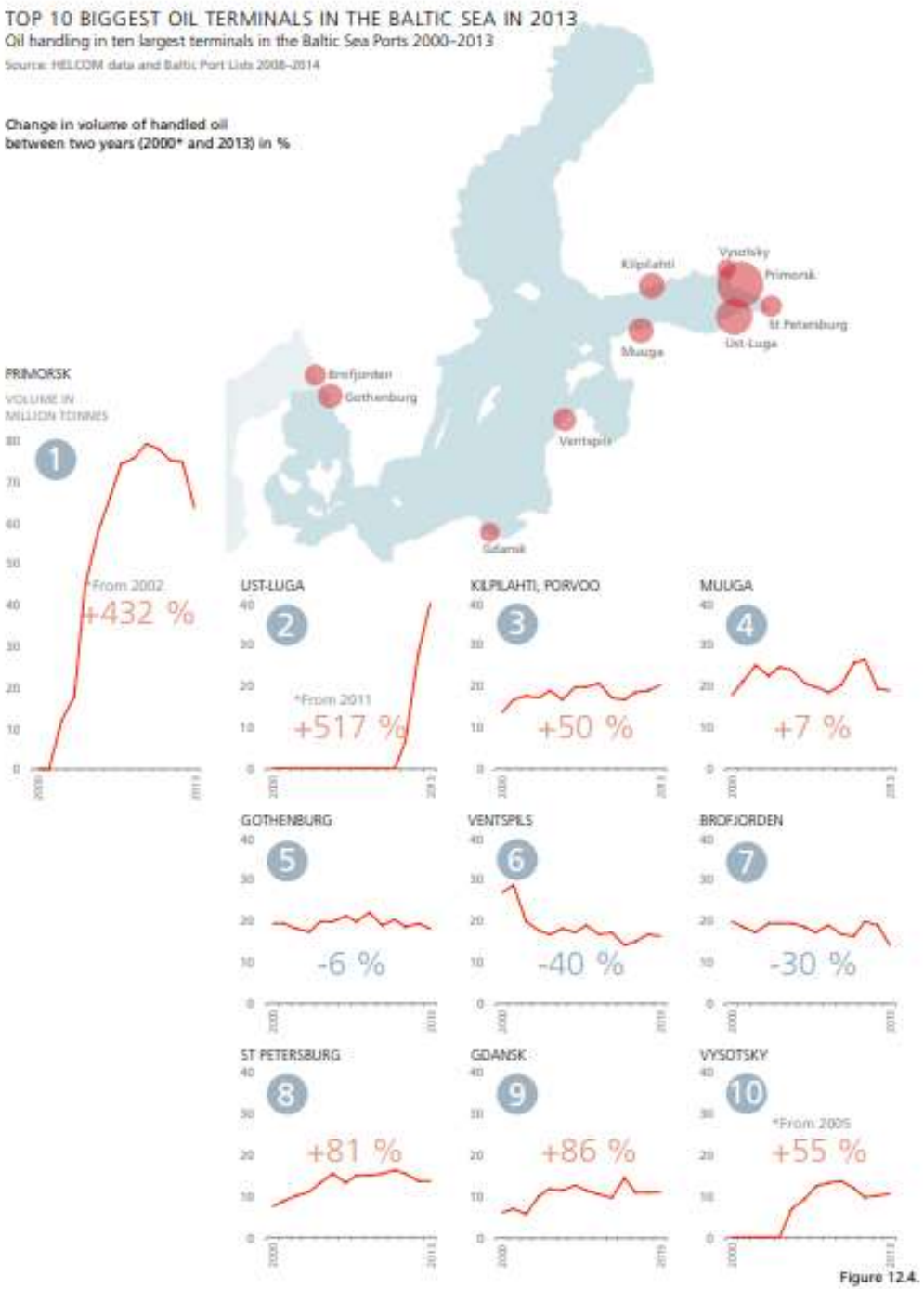

TOP 10 BIGGEST OIL TERMINALS IN THE BALTIC SEA IN 2013
Oil handling in ten largest terminals in the Baltic Sea Ports 2000–2013
Source: HELCOM data and Baltic Port Lists 2008–2014
Change in volume of handled oil
between two years (2000* and 2013) in %
Vysotsky
Kilpilahti
Primorsk
St Petersburg
Ust-Luga
Muuga
Brofjorden
Gothenburg
Ventspils
Gdansk
PRIMORSK
VOLUME IN MILLION TONNES
1
*From 2002
+432 %
UST-LUGA
2
*From 2011
+517 %
KILPILAHTI, PORVOO
3
+50 %
MUUGA
4
+7 %
GOTHENBURG
5
-6 %
VENTSPILS
6
-40 %
BROFJORDEN
7
-30 %
ST PETERSBURG
8
+81 %
GDANSK
9
+86 %
VYSOTSKY
10
*From 2005
+55 %

Figure 12.4.

LOCATION OF MAJOR ACCIDENTAL OIL SPILLS IN THE BALTIC SEA 1969–2016

Spills over 50 tonnes

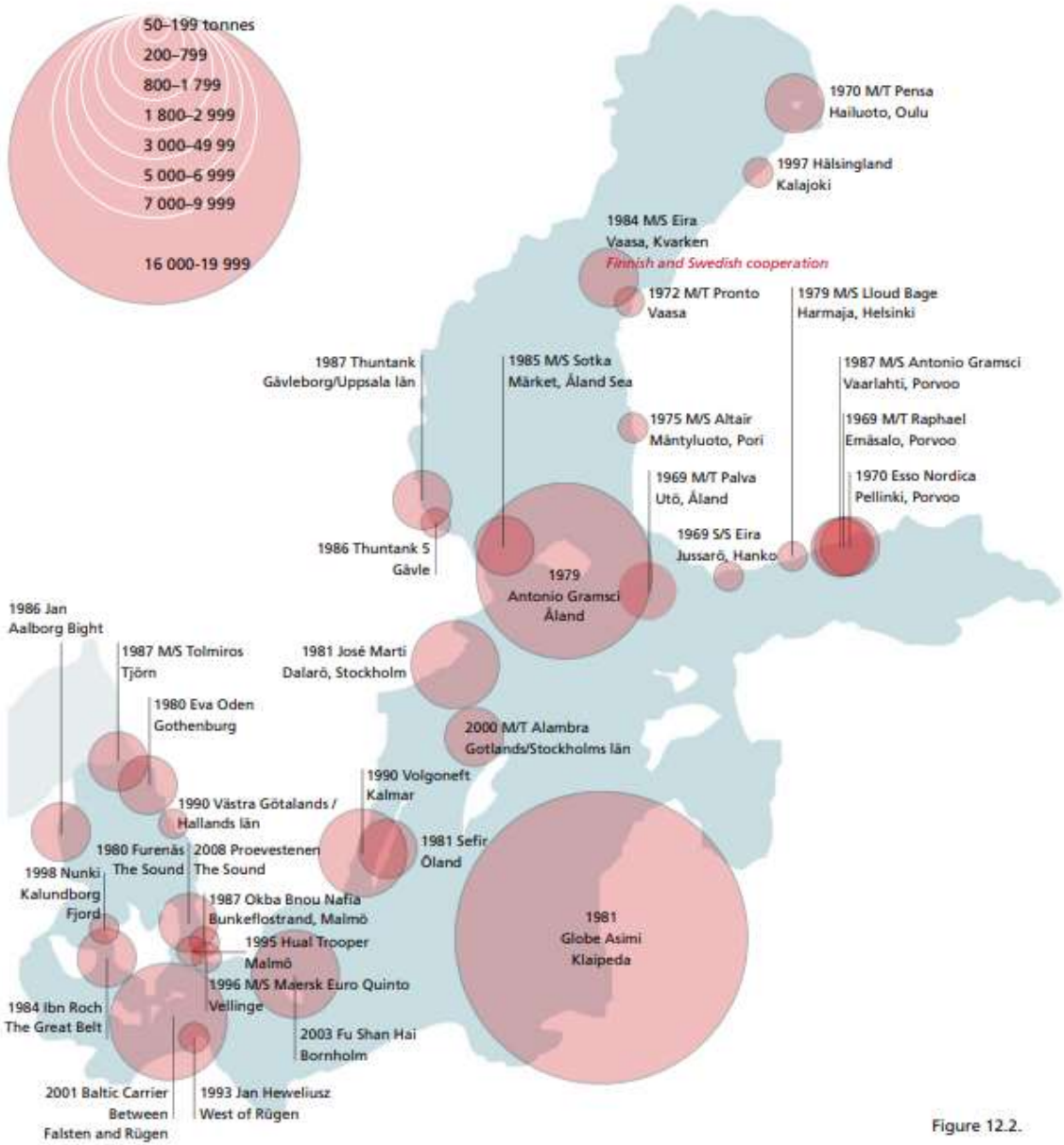


Figure 12.2.

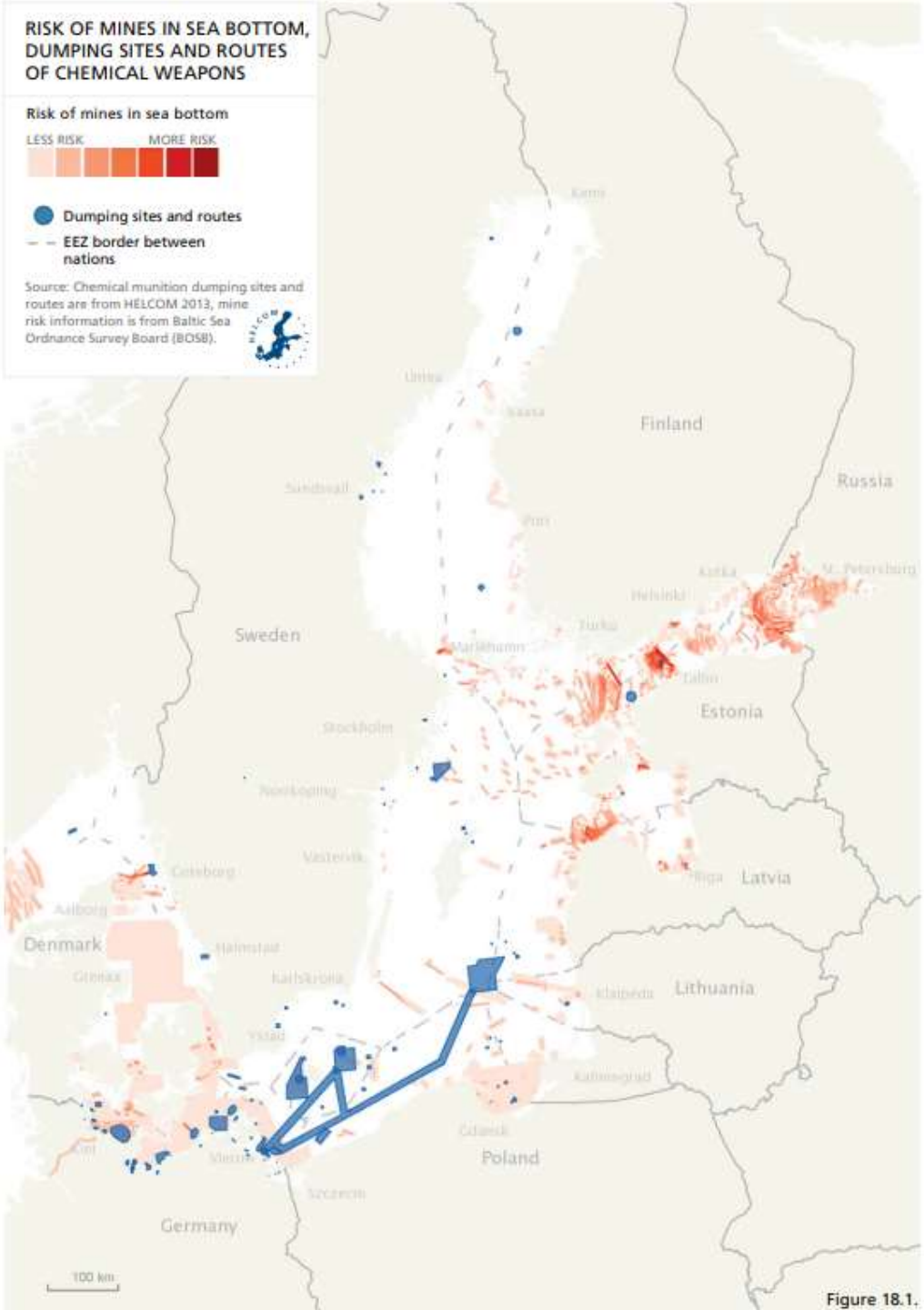
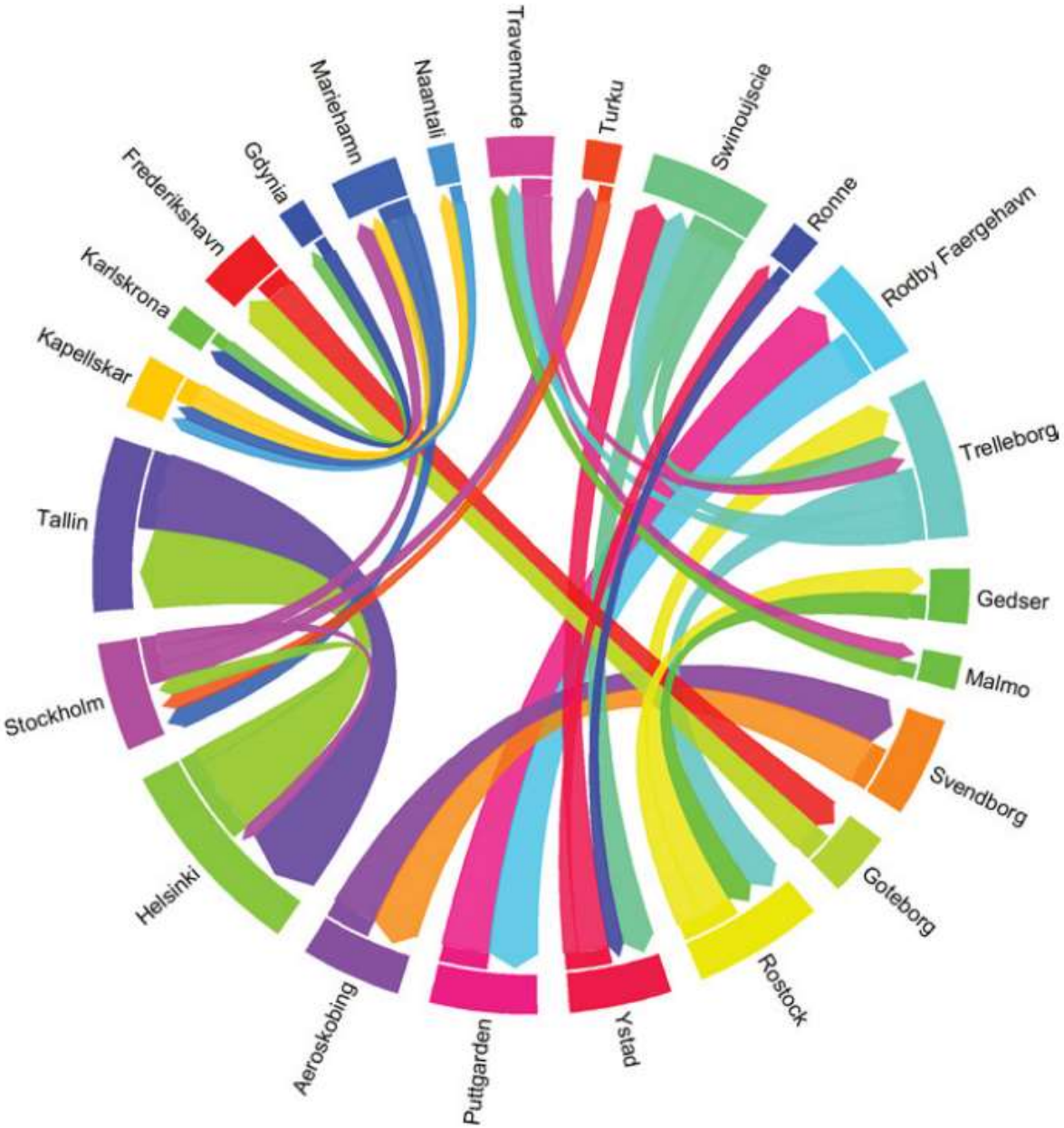

RISK OF MINES IN SEA BOTTOM, DUMPING SITES AND ROUTES OF CHEMICAL WEAPONS
Risk of mines in sea bottom
LESS RISK
MORE RISK
Dumping sites and routes
EEZ border between nations
Source: Chemical munition dumping sites and routes are from HELCOM 2013, mine risk information is from Baltic Sea Ordnance Survey Board (BOSB).
HELCOM
Finland
Russia
Sweden
Estonia
Latvia
Lithuania
Denmark
Poland
Germany
100 km

Figure 18.1.

Figure 1.15. INTERACTION BETWEEN PORTS (ARRIVALS AND DEPARTURES) IN THE BALTIC SEA
Passenger ship traffic in 2015: 50 biggest ports, minimum of 500 trips



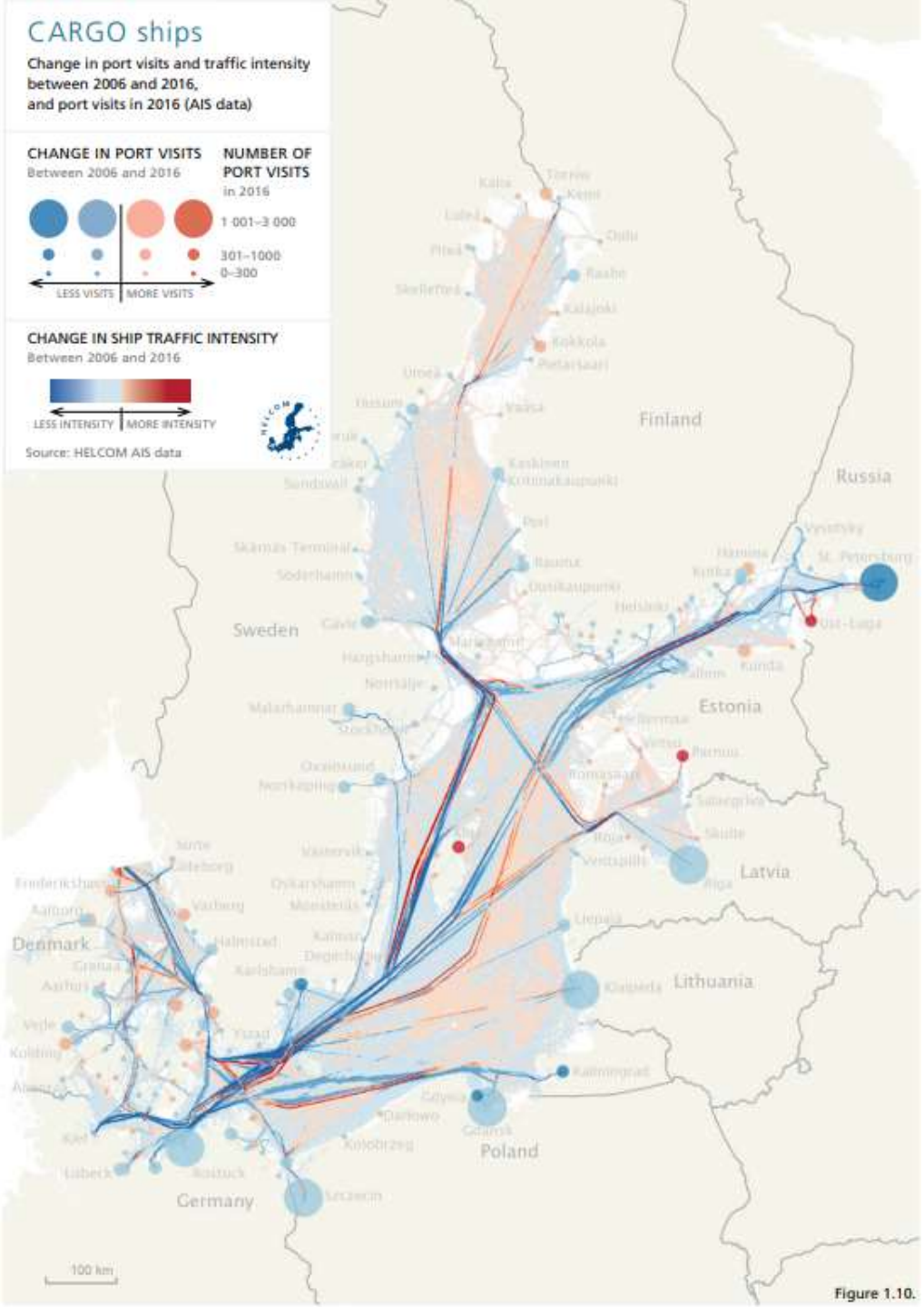

CARGO ships
Change in port visits and traffic intensity between 2006 and 2016, and port visits in 2016 (AIS data)
CHANGE IN PORT VISITS
Between 2006 and 2016
NUMBER OF PORT VISITS
in 2016
1 001–3 000
301–1000
0–300
LESS VISITS
MORE VISITS
CHANGE IN SHIP TRAFFIC INTENSITY
Between 2006 and 2016
LESS INTENSITY
MORE INTENSITY
Source: HELCOM AIS data
HELCOM
Finland
Russia
Sweden
Estonia
Latvia
Lithuania
Poland
Germany
Denmark
100 km

Figure 1.10.

That’s all folks! To sum up, we think it’s worthy taking the effort to visualize data properly.





But it’s challenging! It requires some skills but, above all, will and motivation.





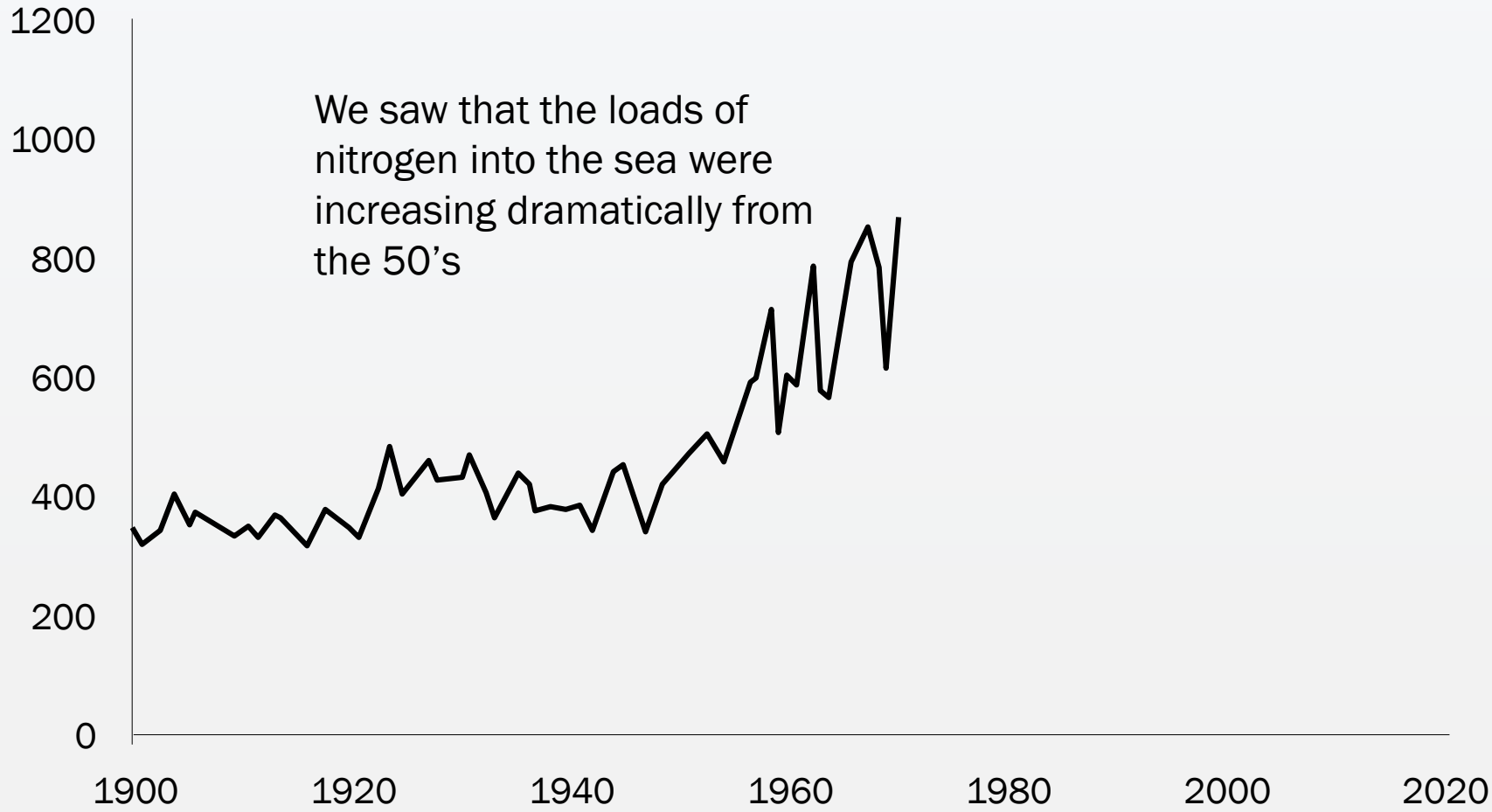
Before we finish let’s have a look a those graphs you saw earlier about the status of the Baltic Sea.





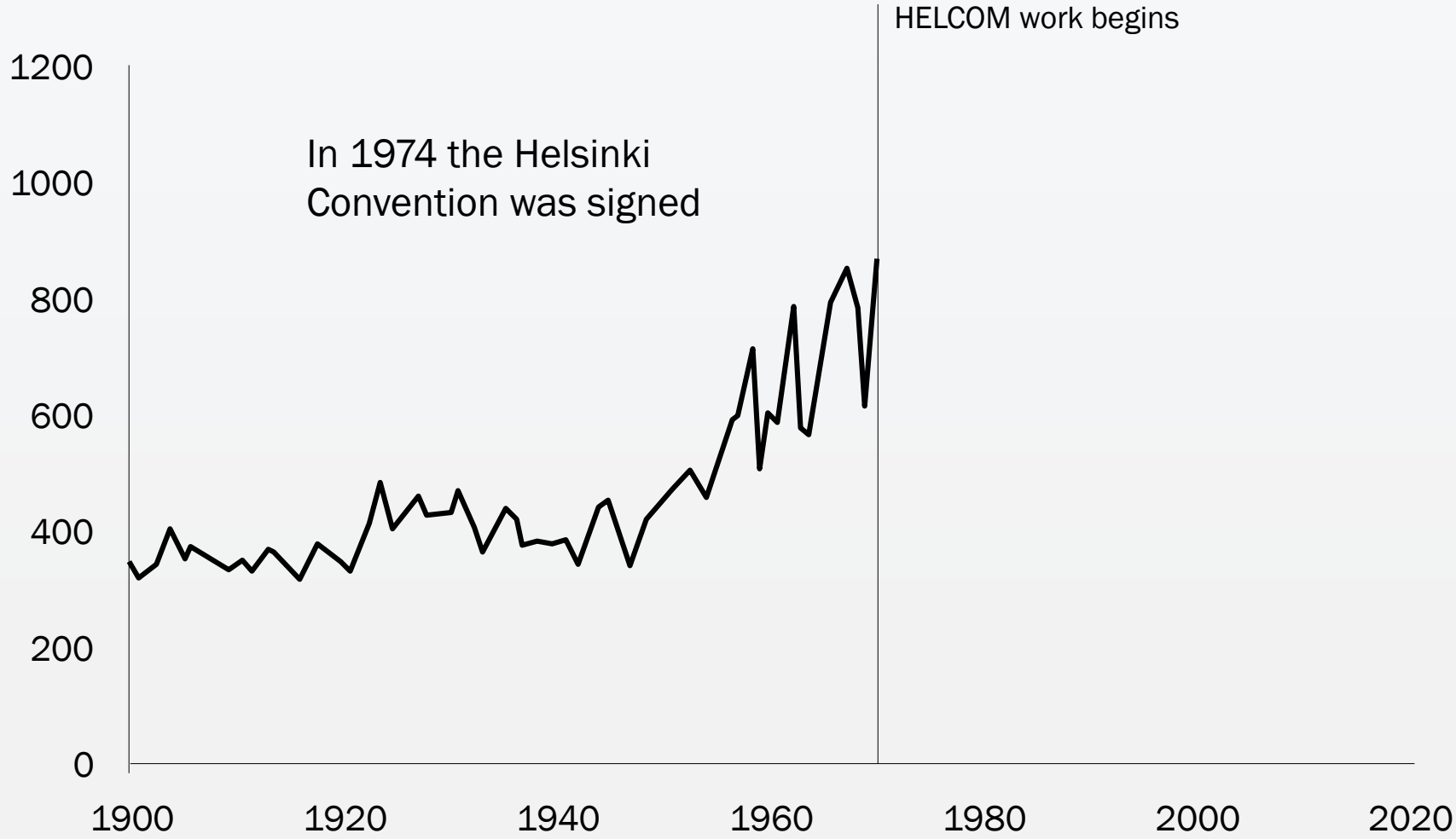
NITROGEN waterborne inputs via waterways

Tons per year (t/a) in .000



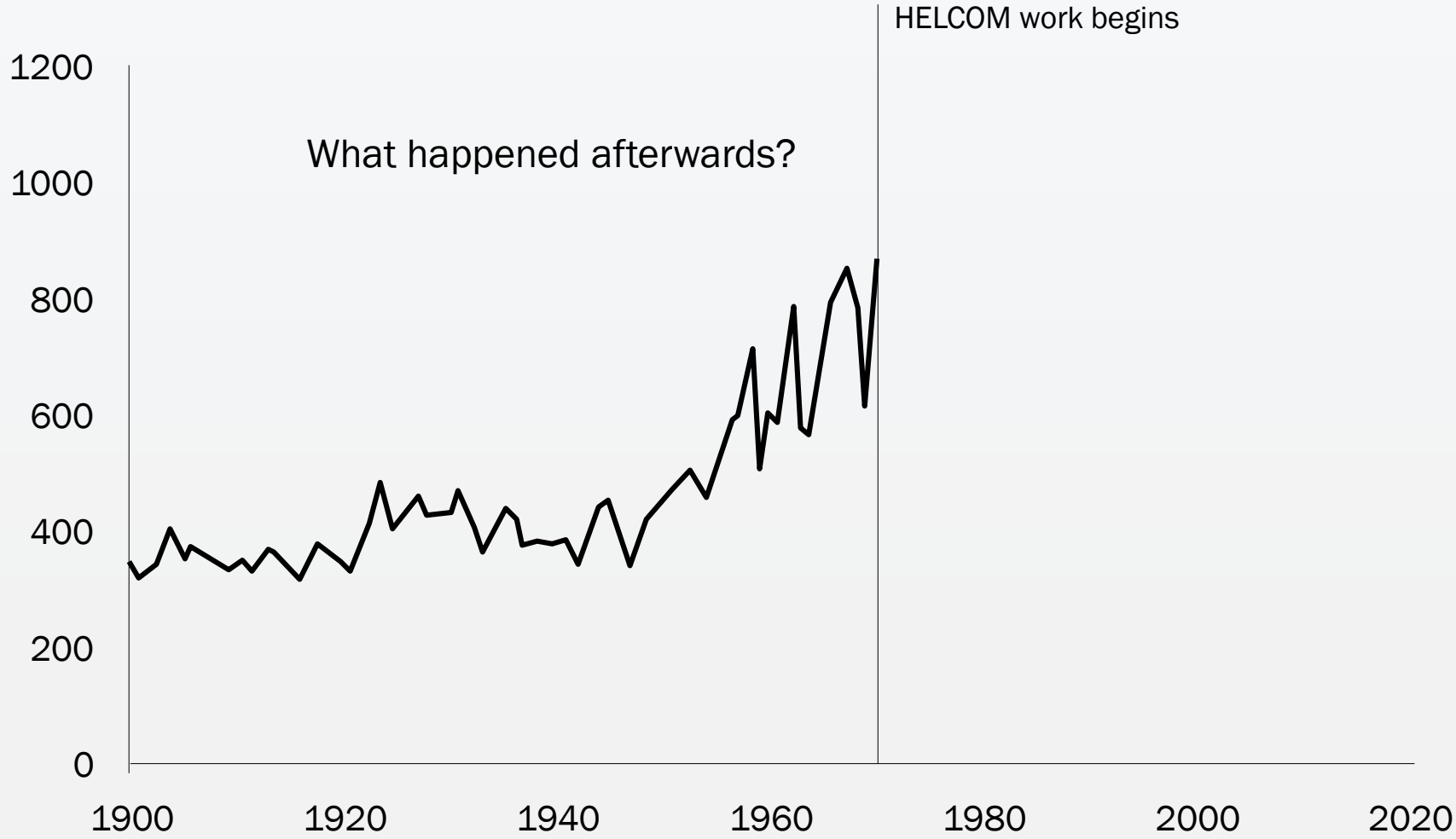
NITROGEN waterborne inputs via waterways

Tons per year (t/a) in .000



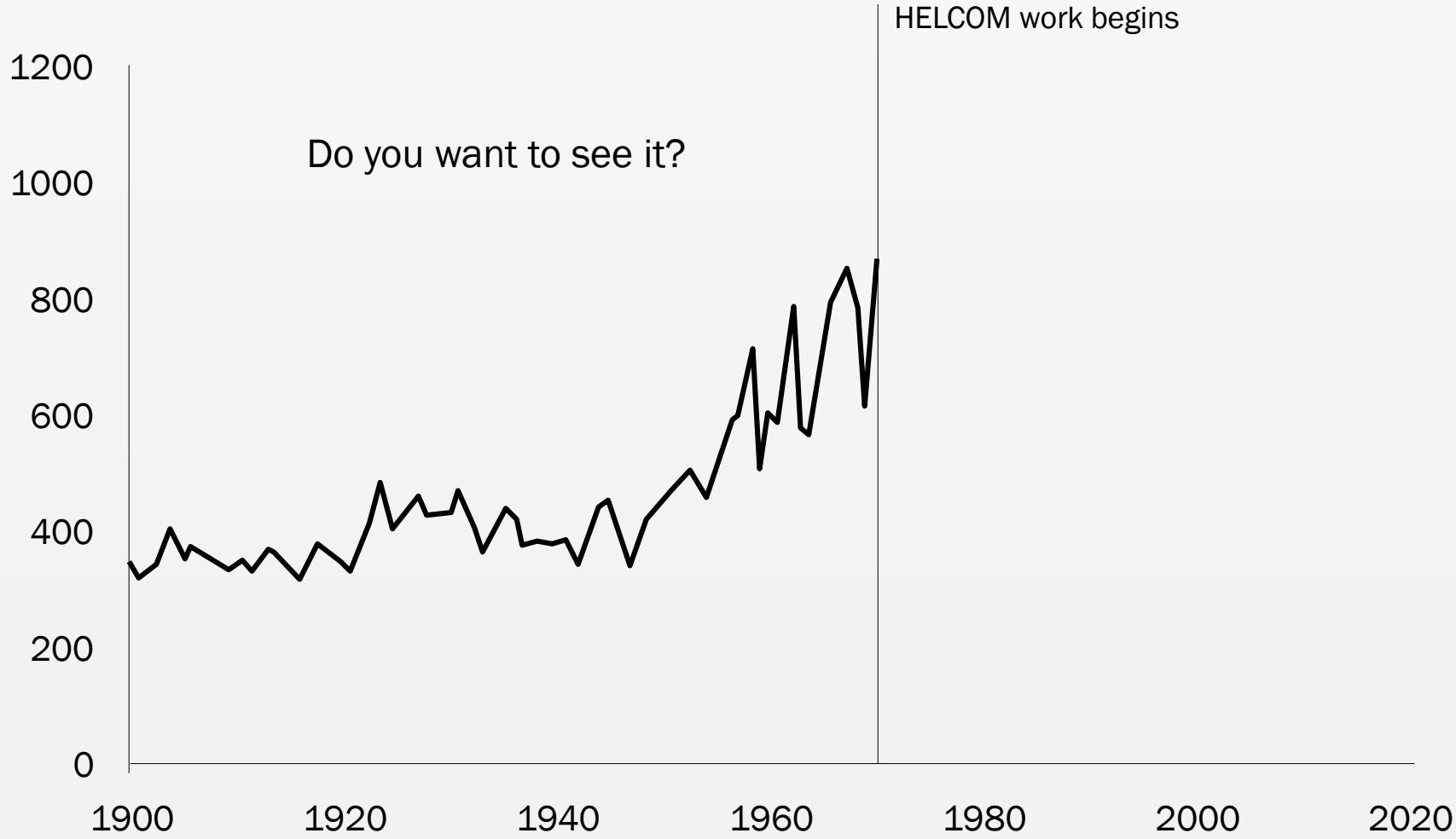
NITROGEN waterborne inputs via waterways

Tons per year (t/a) in .000



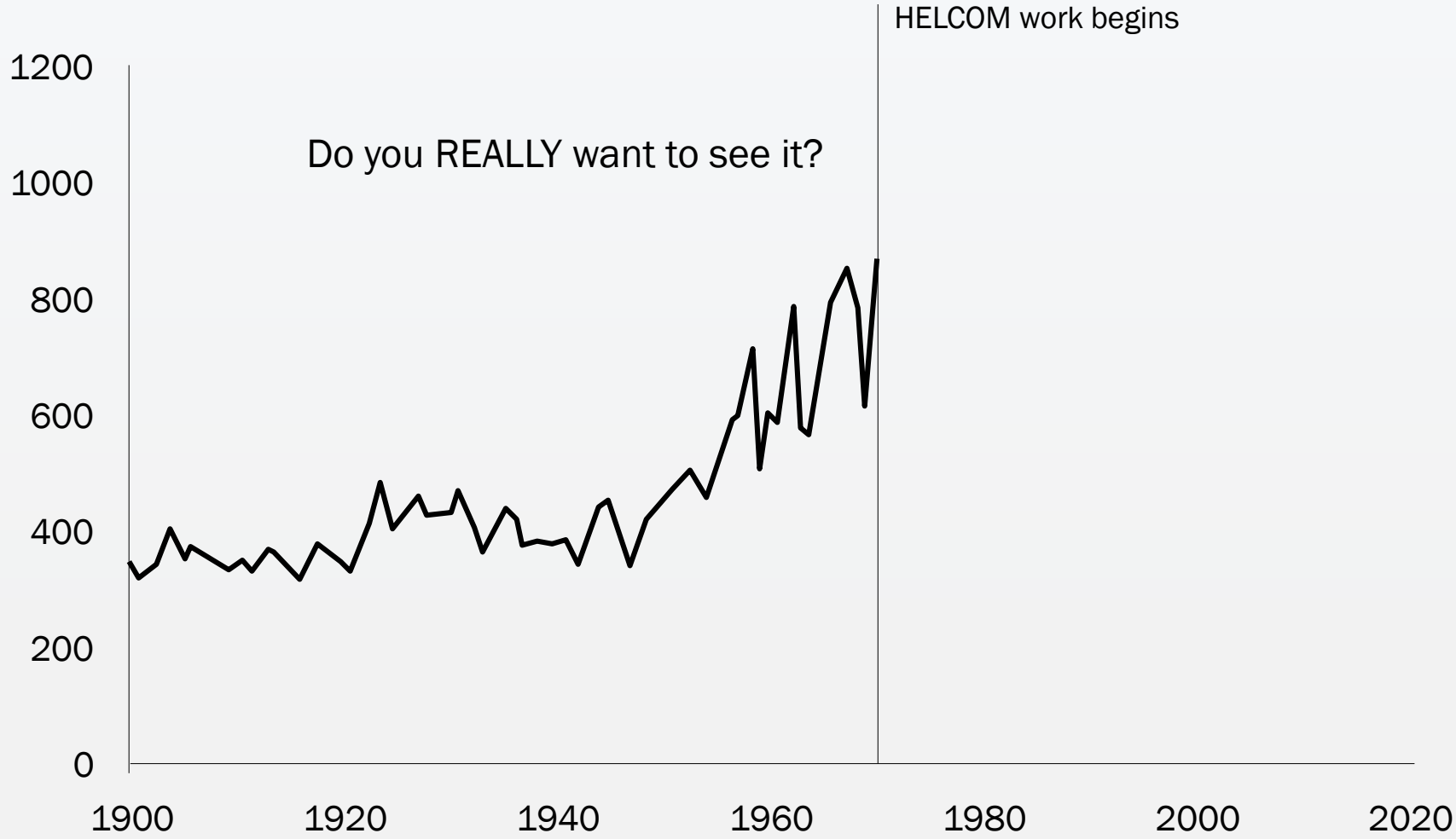
NITROGEN waterborne inputs via waterways

Tons per year (t/a) in .000



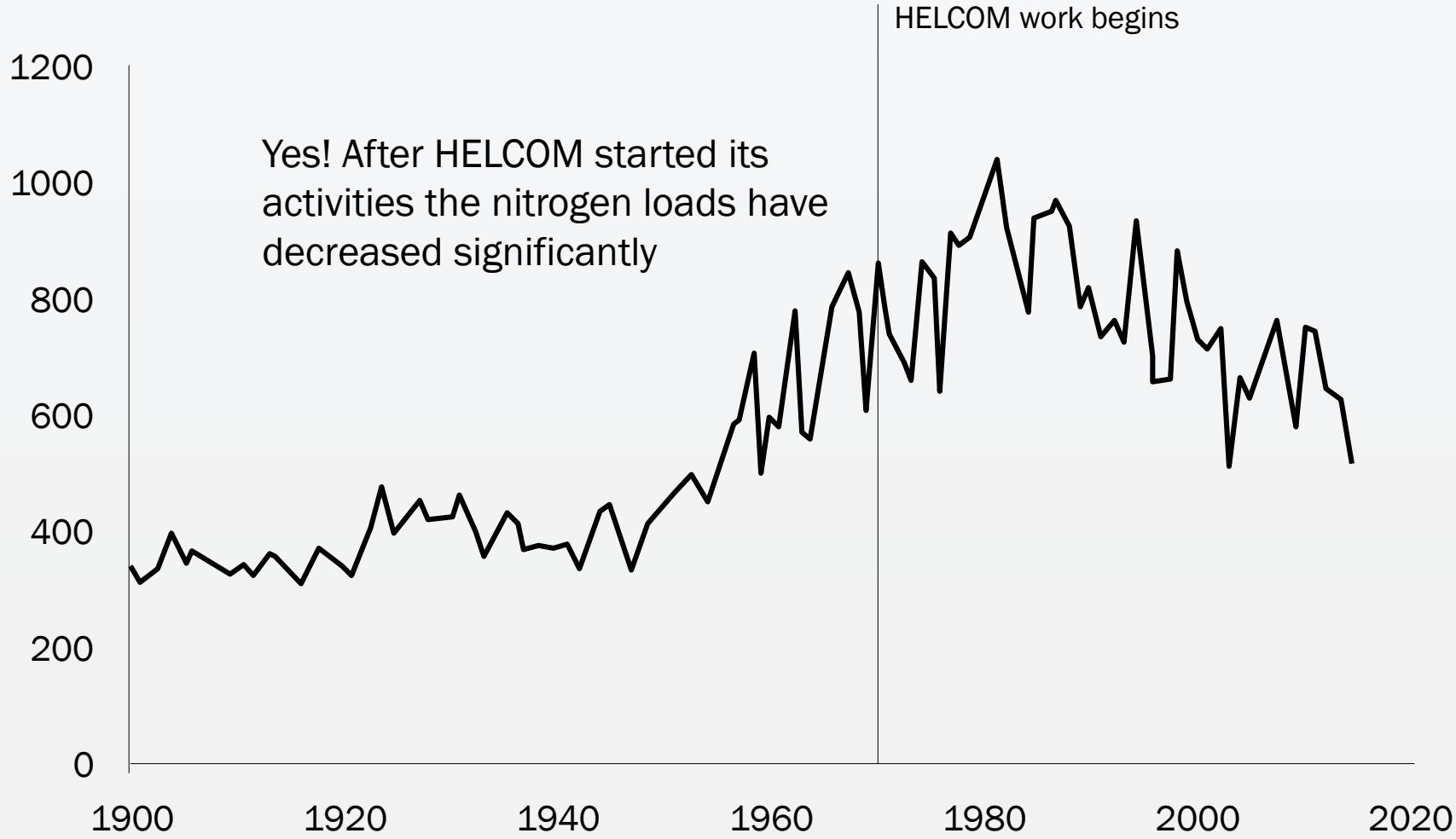
NITROGEN waterborne inputs via waterways

Tons per year (t/a) in .000



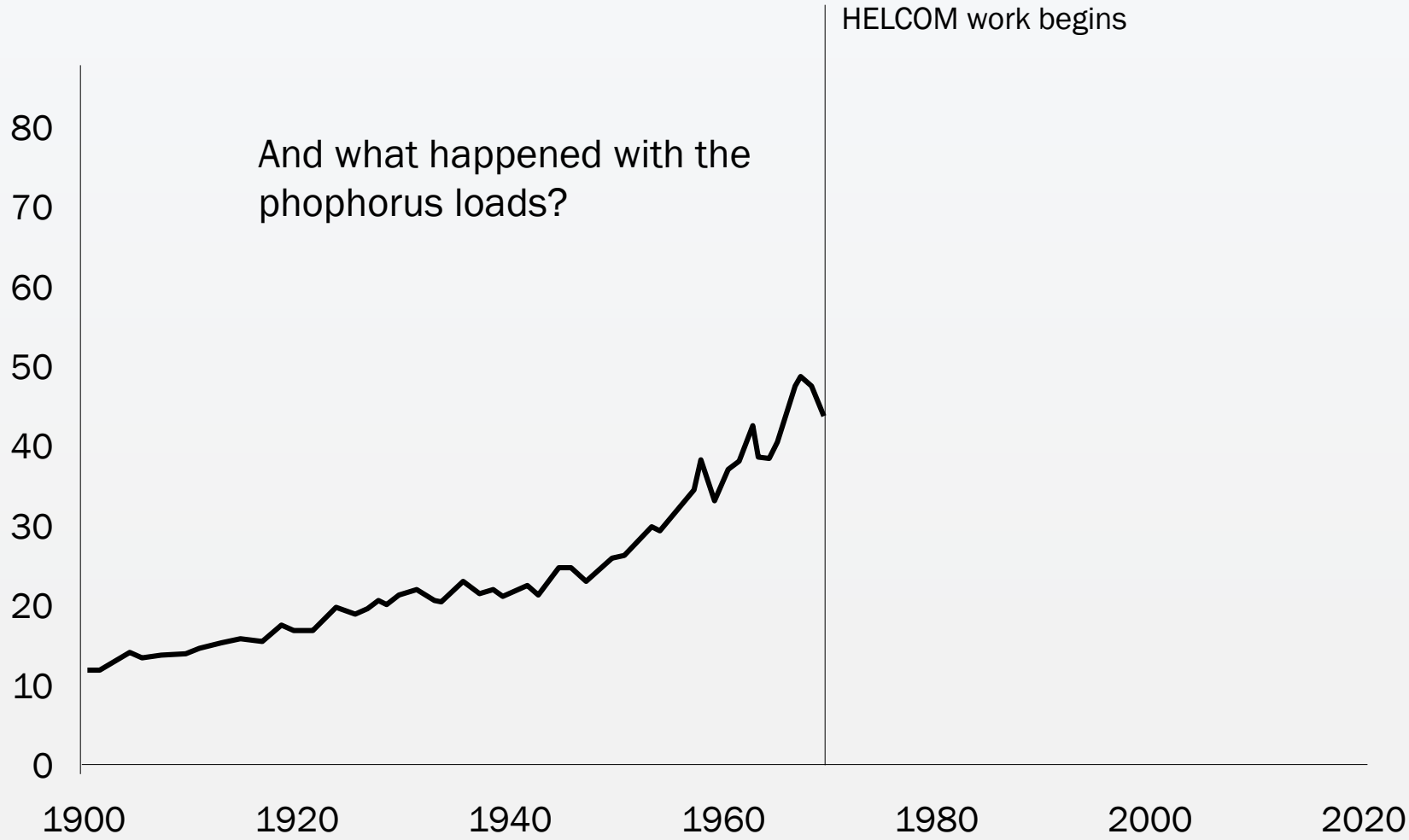
NITROGEN waterborne inputs via waterways

Tons per year (t/a) in .000



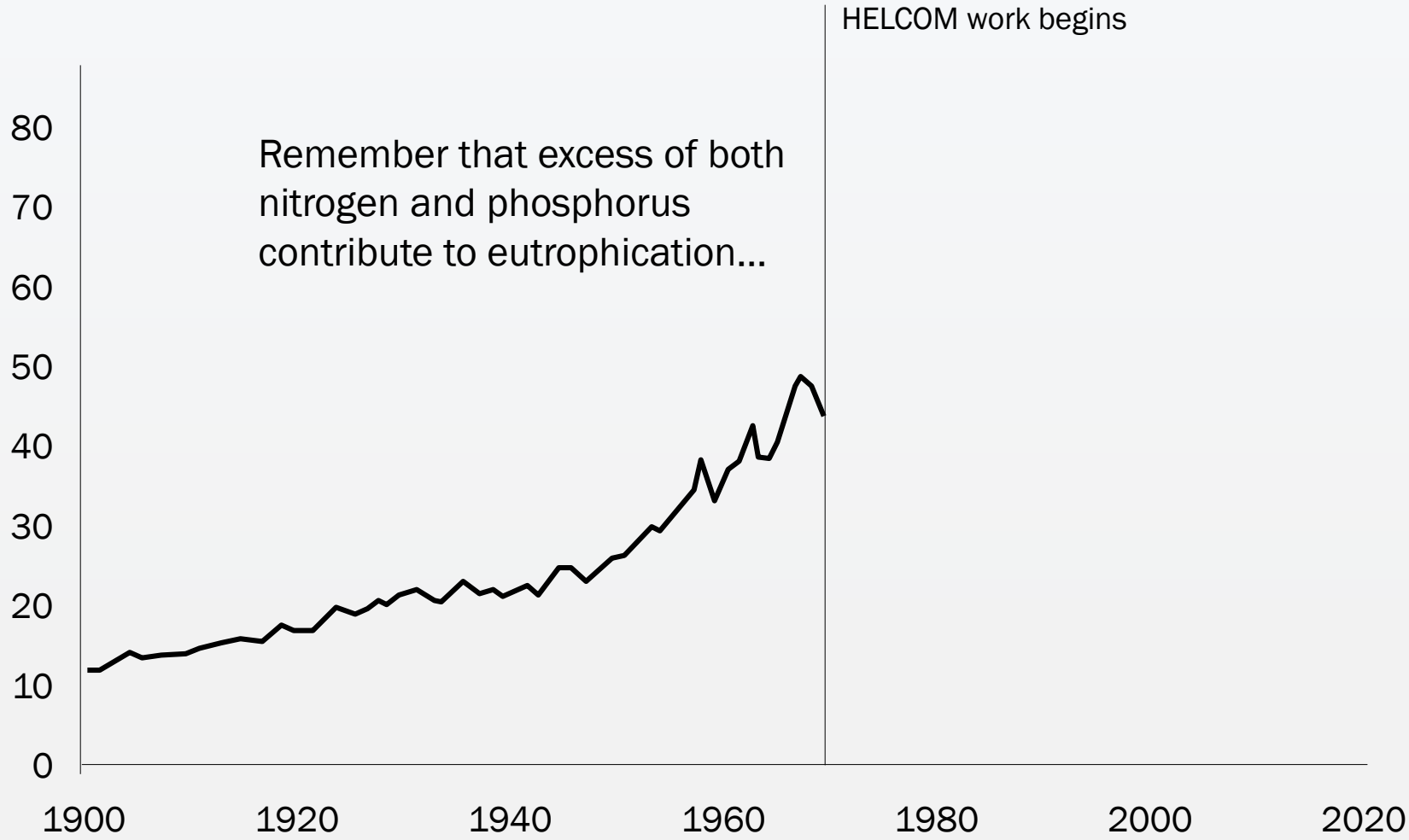
PHOSPHORUS waterborne inputs via waterways

Tons per year (t/a) in .000



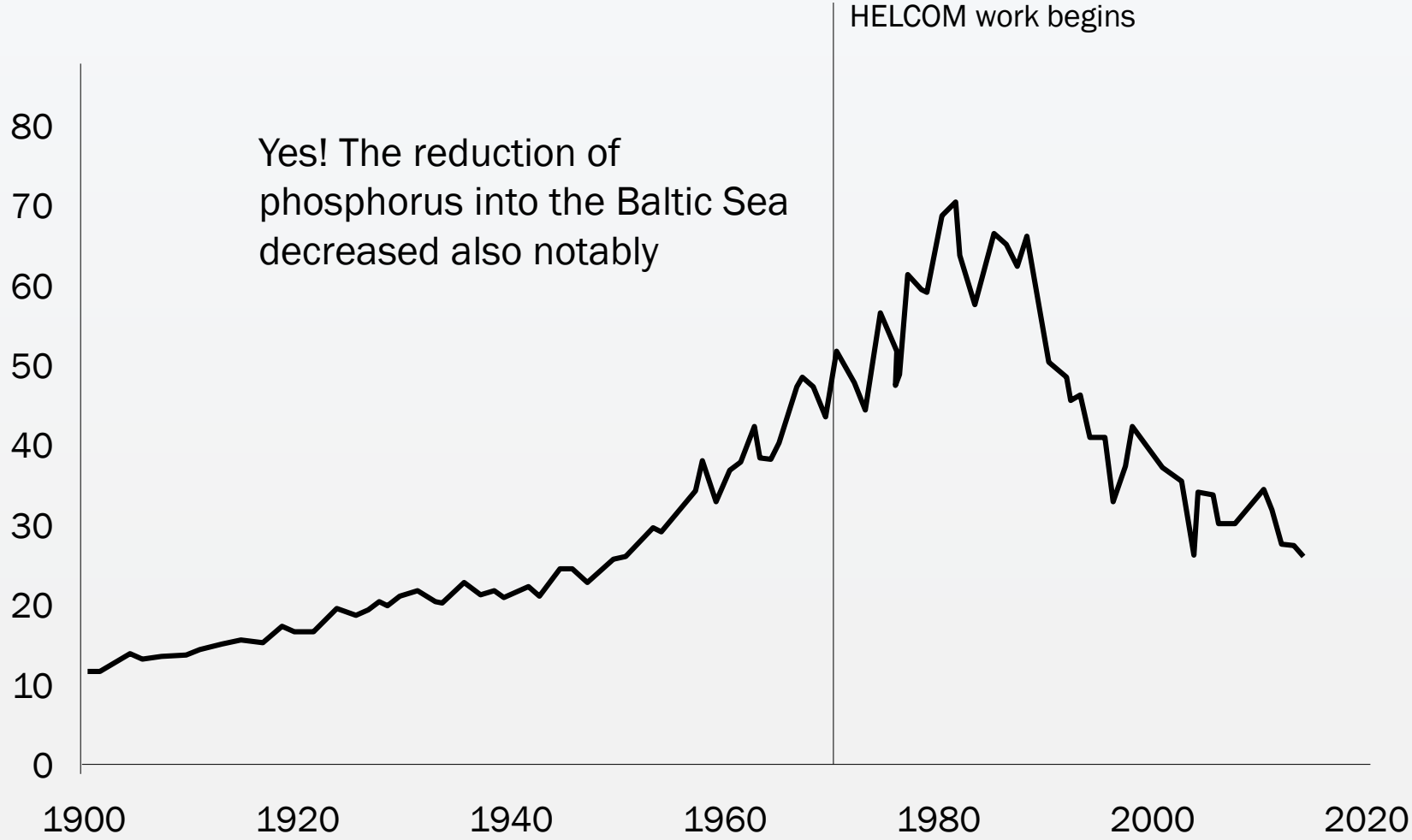
PHOSPHORUS waterborne inputs via waterways

Tons per year (t/a) in .000



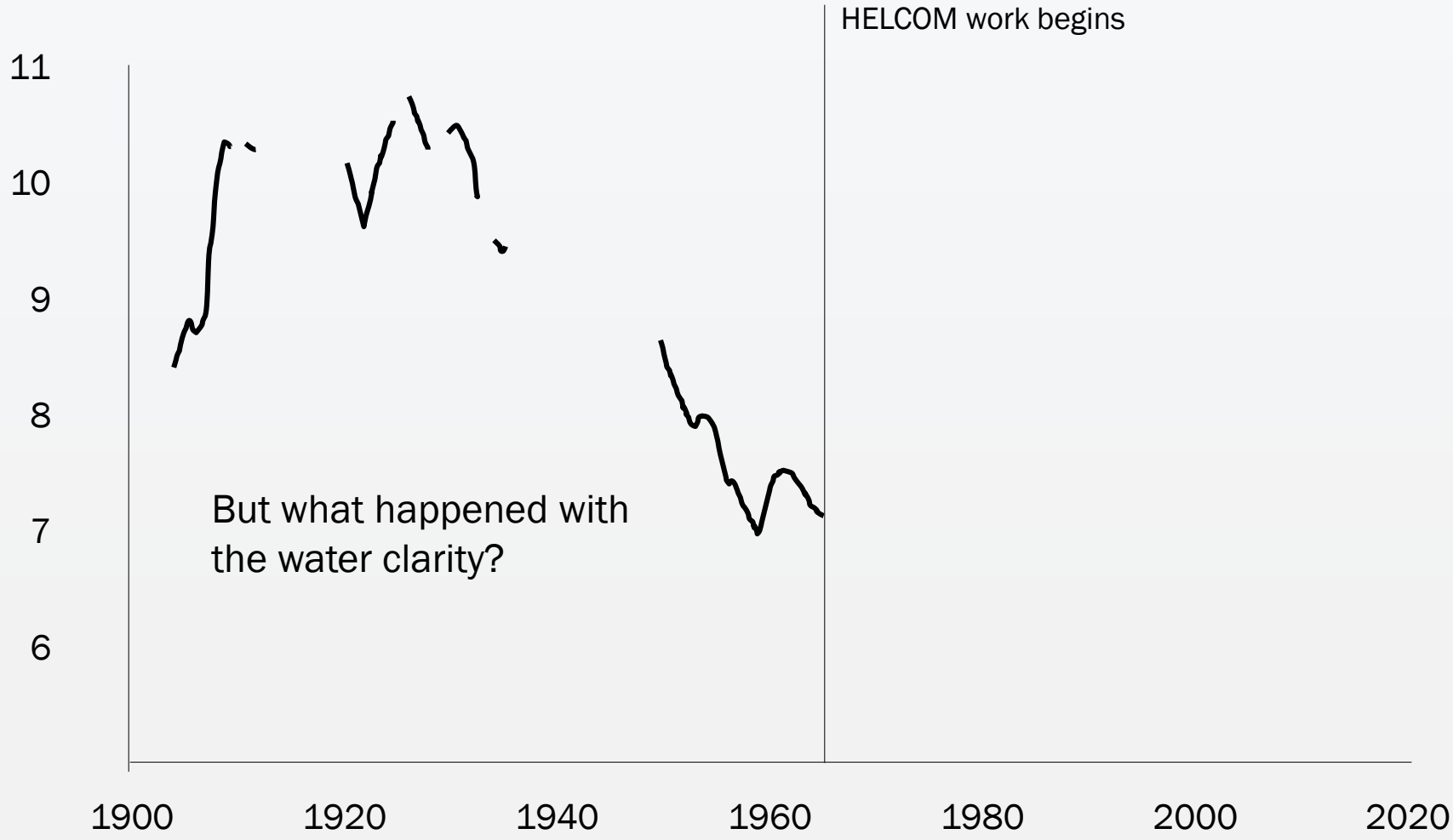
PHOSPHORUS waterborne inputs via waterways

Tons per year (t/a) in .000



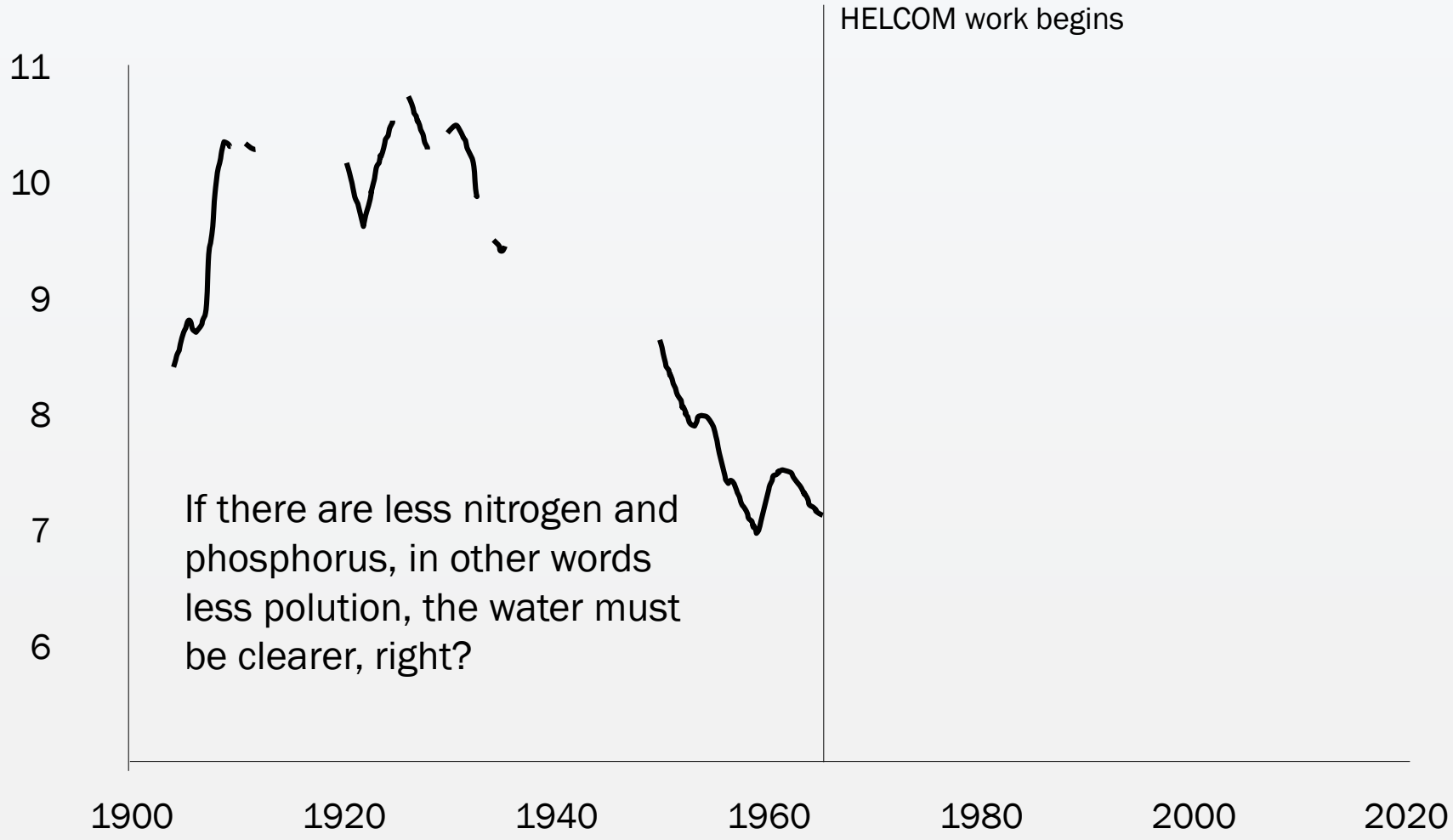
WATER CLARITY summer Secchi depth

In meters



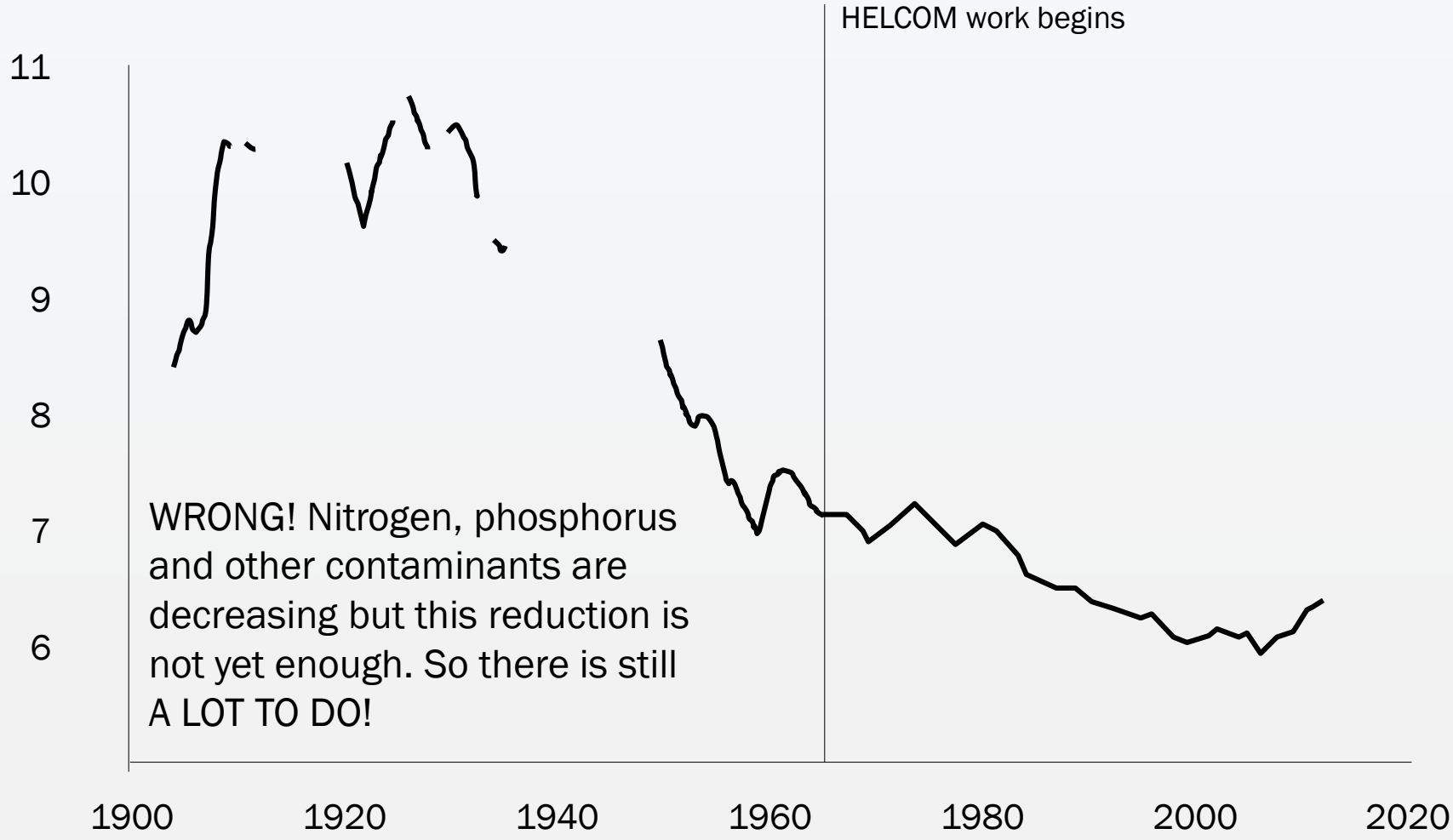
WATER CLARITY summer Secchi depth

In meters



WATER CLARITY summer Secchi depth

In meters




HELCOM