Oeresund marine environment in change: are major ecosystem changes reflected in the Benthic Quality Index?

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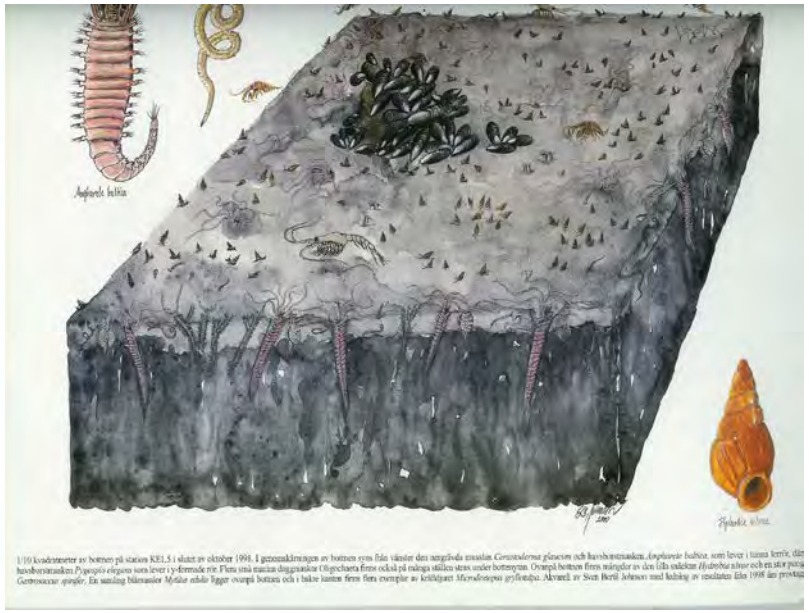
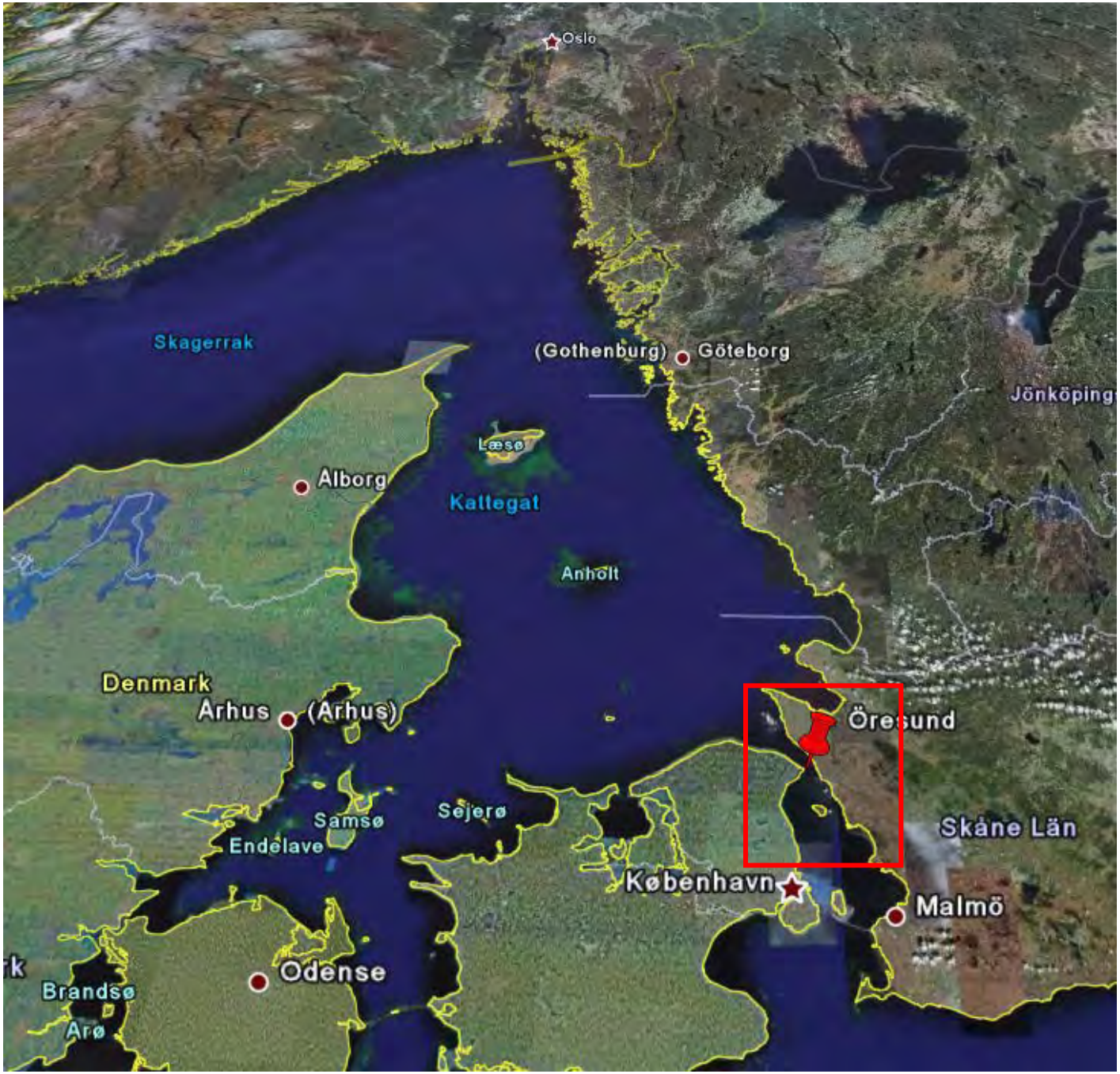
HELSINGBORG

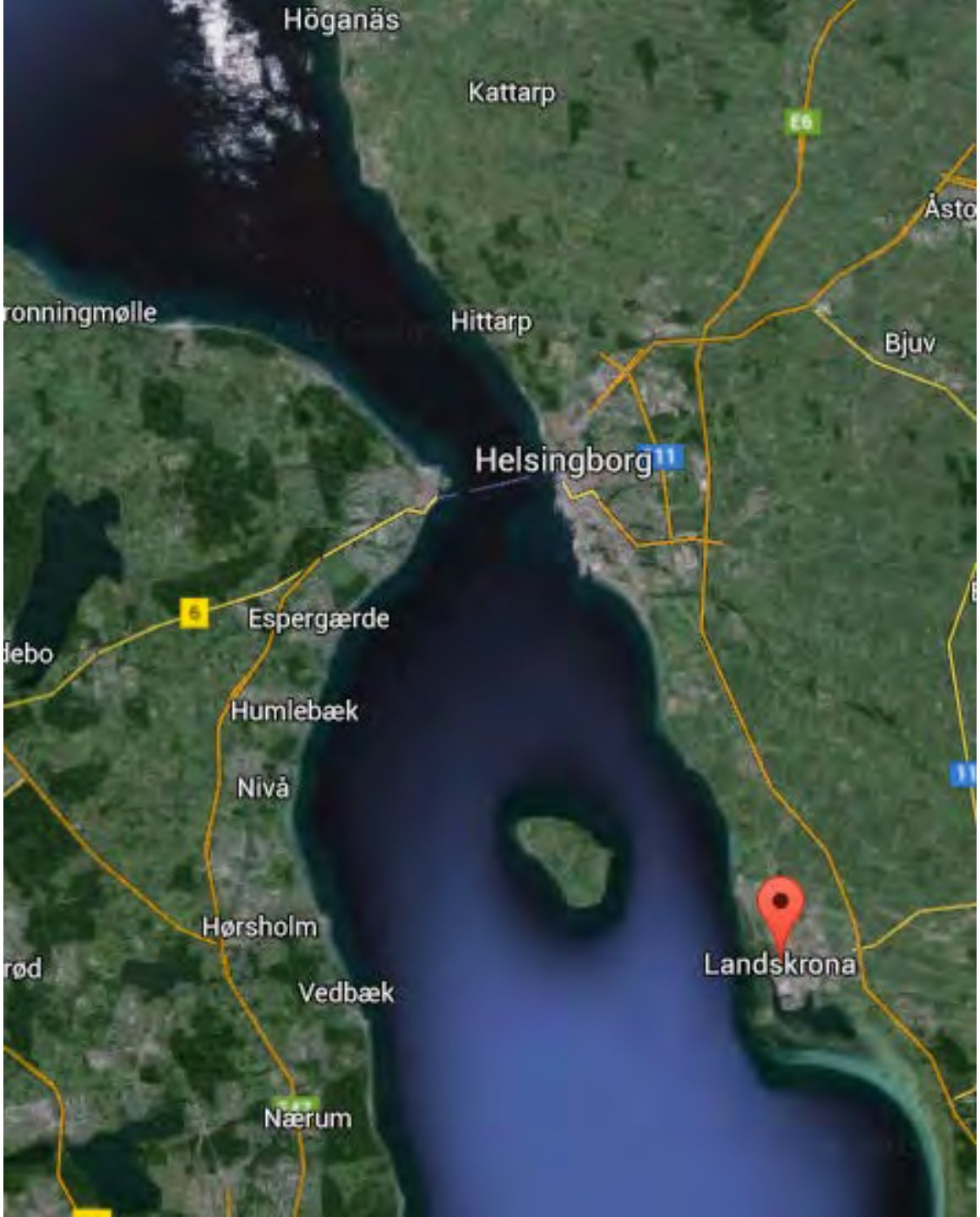
Landskrona stad

GÖTEBORG UNIVERSITY



Paintings by Sven Bertil Johnsson


Oslo
Skagerrak
(Gothenburg)
Göteborg
Jönköping
Læsø
Alborg
Kattegat
Anholt
Denmark
Arhus
(Arhus)
Öresund
Samsø
Sejerø
Endelave
Skåne Län
København
Malmö
Odense
Brandsø
Arø

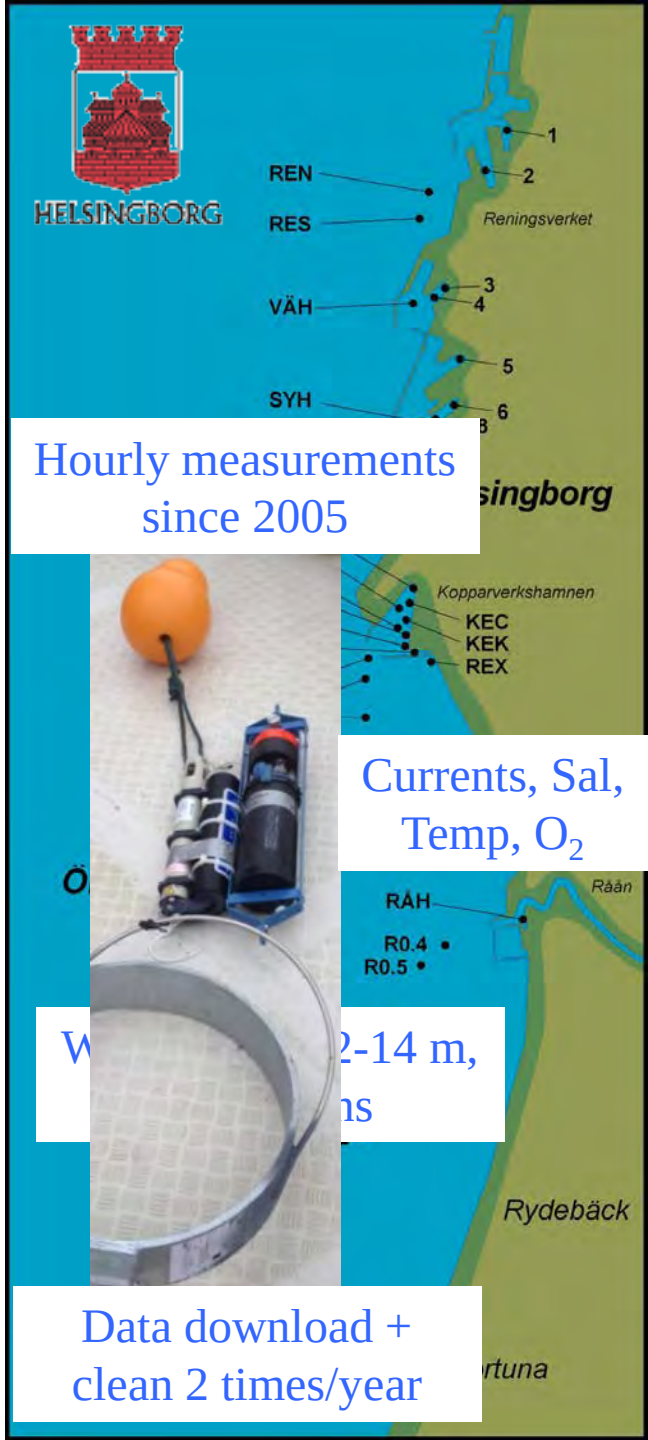

Höganäs
Kattarp
E6
Åsto
ronningmølle
Hittarp
Bjuv
Helsingborg
11
6
Espergærde
debo
Humlebæk
Nivå
Hørsholm
rød
Vedbæk
Landskrona
Nærum

Marine monitoring program

- +20 years, extensive monitoring Bottom fauna sampling and classification 2 times /year
- Sediment chemistry including pollutants 1 time/year
- Mussels for toxins ➔ stopped local pollution
- Frequent sample fishing
- Targeted studies e.g. toxins in eel
- River run-off
- Monthly water sampling, multiple depths by e.g. SMHI
- Hourly bottom water monitoring at 13 m since 2005
- Hourly bottom water monitoring at 30 m since 2012

Trends

- Pollutants are decreasing
- Nutrients are decreasing, eel grass is spreading deeper
- Water transparency is increasing
- Fish stock is stable (Öresund is a no trawling area)
- Biomass, individuals and number of spices decreasing

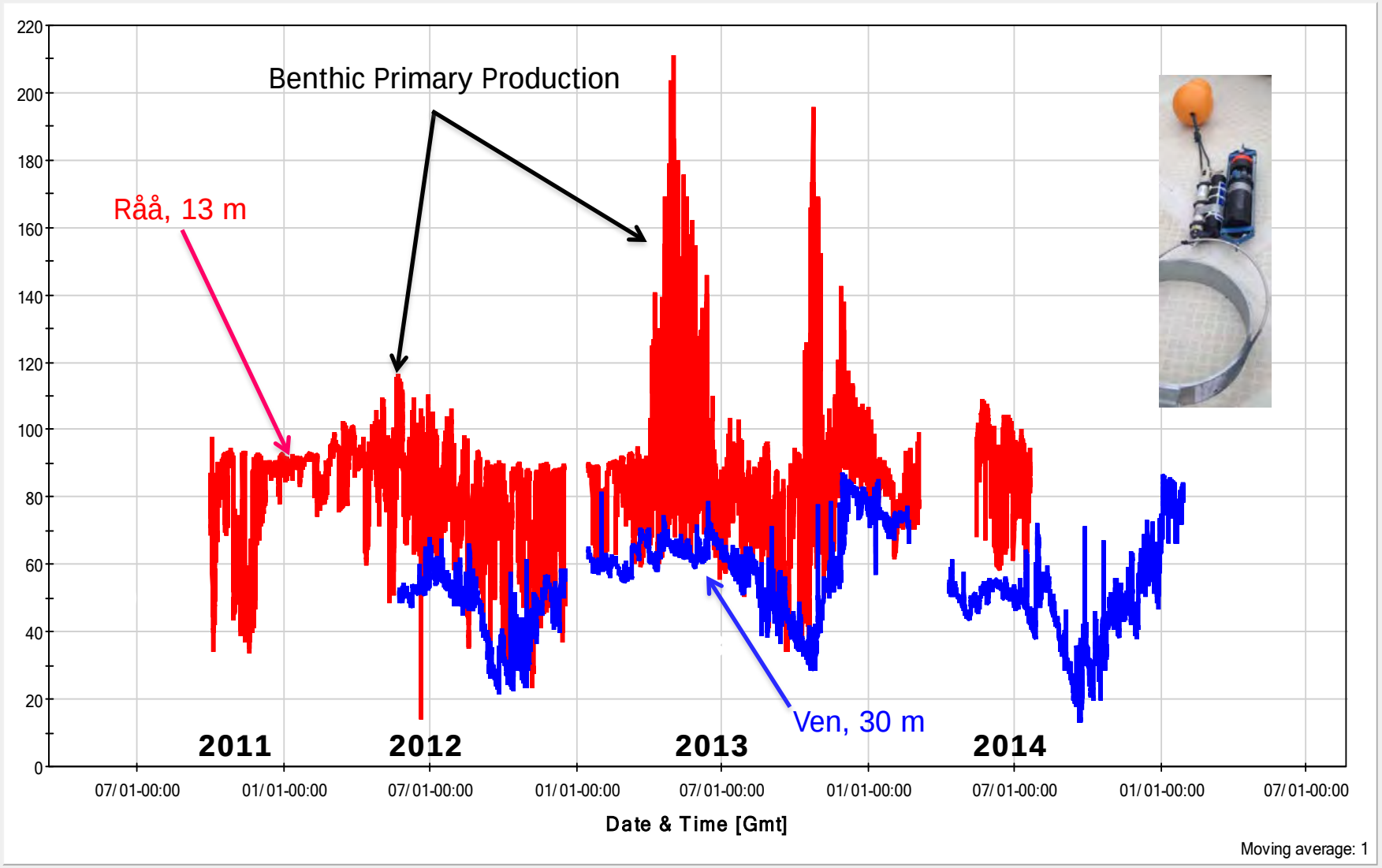


Hourly measurements since 2005

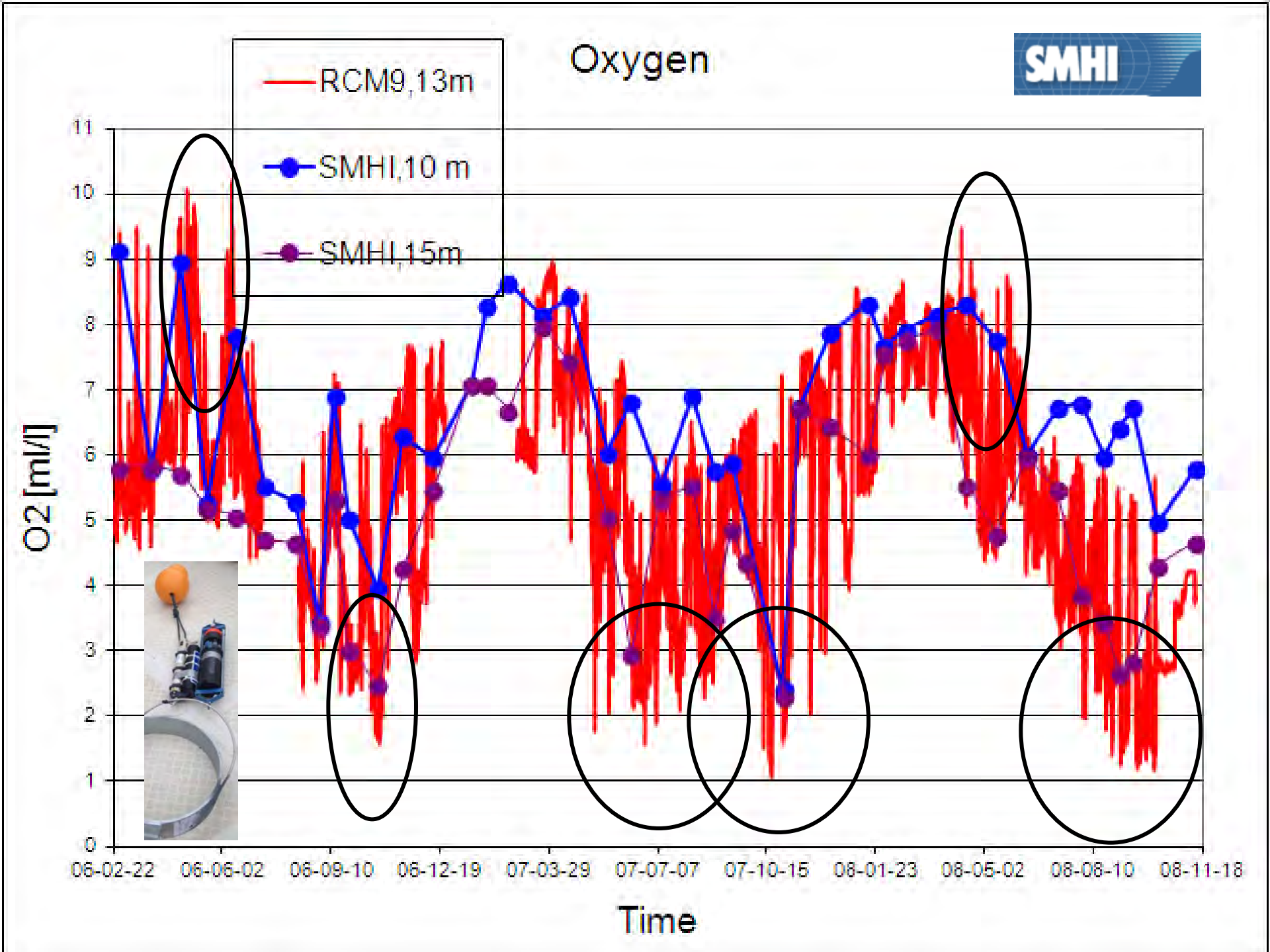
Currents, Sal, Temp, O_2

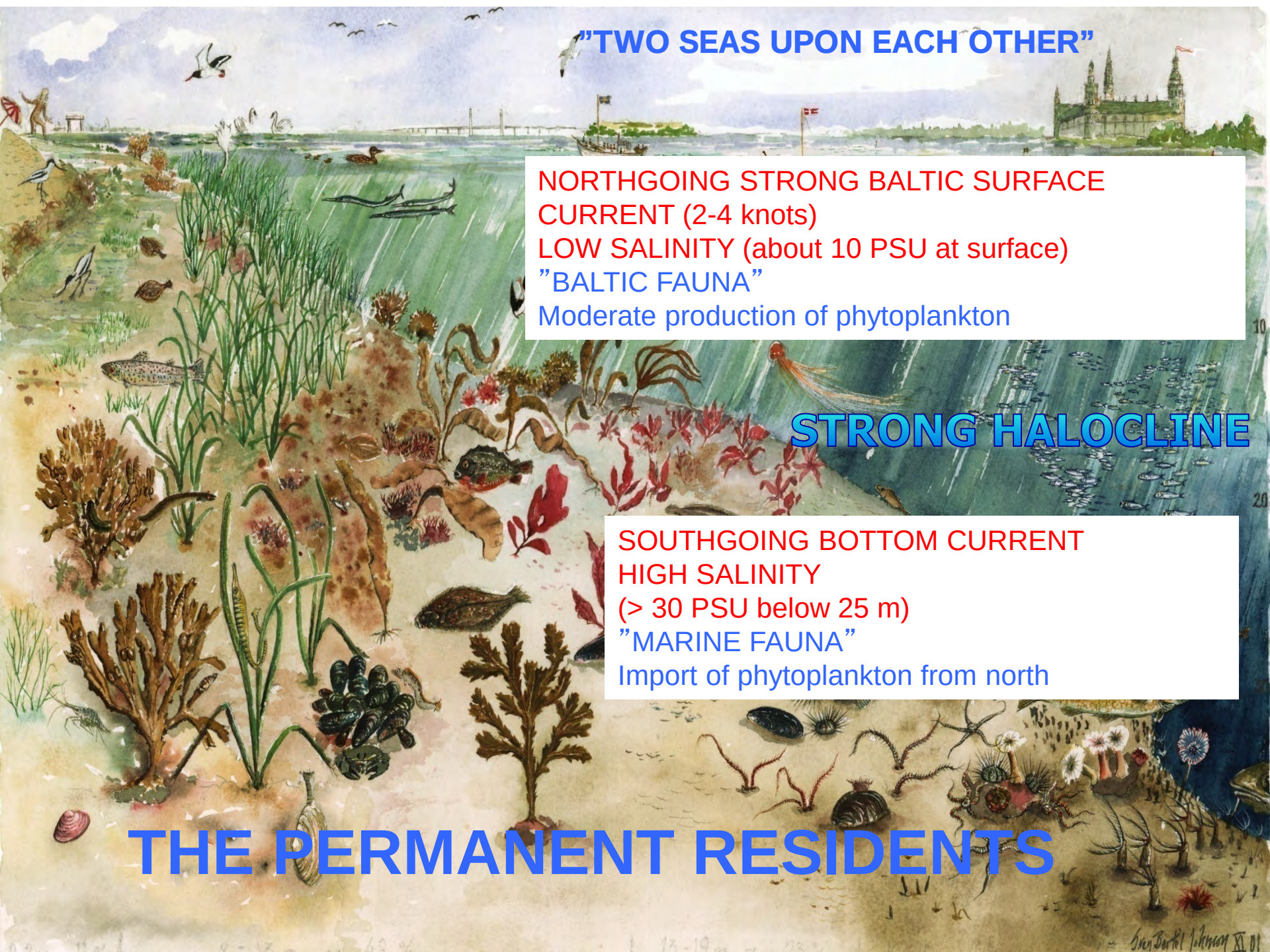
Data download + clean 2 times/year

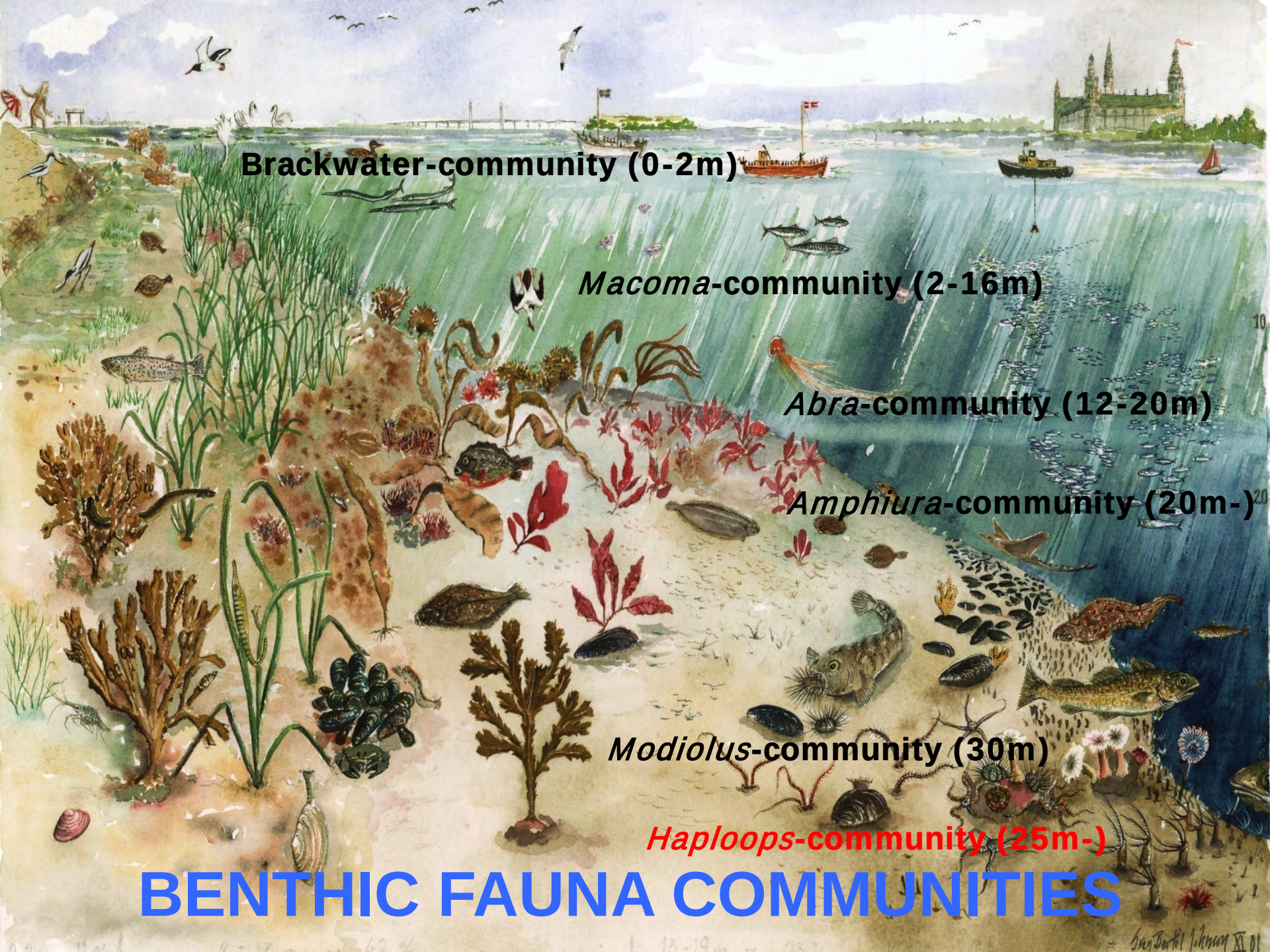
2011-2104, Oxygen at 13 and 30 m



AirSaturation [%] AirSaturation [%] | AirSaturation [%] AirSaturation [%] | AirSaturation [%] AirSaturation [%] | AirSaturation [%] AirSaturation [%]

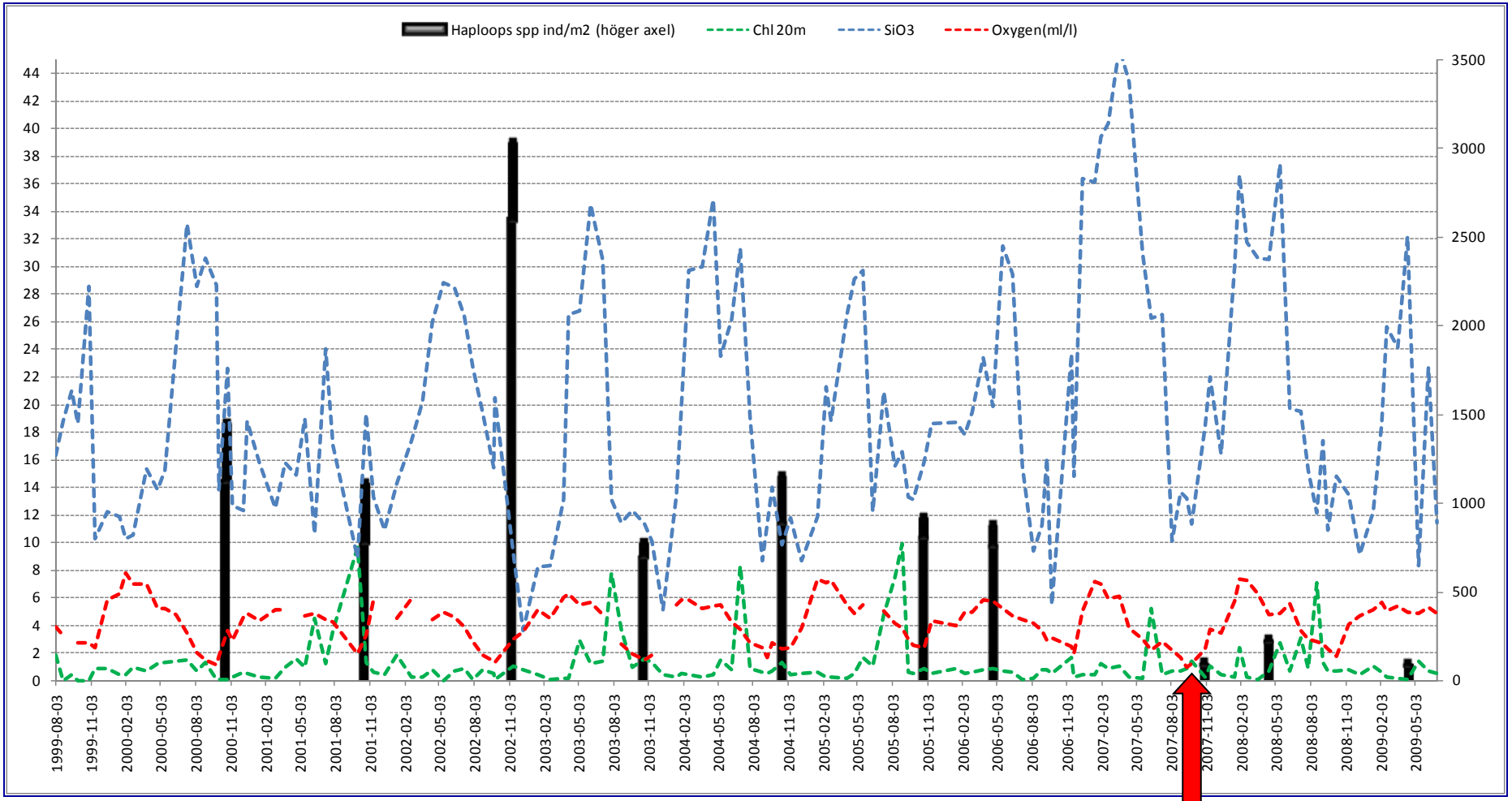

Oxygen
SMHI
RCM9,13m
SMHI,10 m
SMHI,15m
O2 [ml/l]
11
10
9
8
7
6
5
4
3
2
1
0
06-02-22
06-06-02
06-09-10
06-12-19
07-03-29
07-07-07
07-10-15
08-01-23
08-05-02
08-08-10
08-11-18
Time


”TWO SEAS UPON EACH OTHER”
NORTHGOING STRONG BALTIC SURFACE CURRENT (2-4 knots)
LOW SALINITY (about 10 PSU at surface)
”BALTIC FAUNA”
Moderate production of phytoplankton
STRONG HALOCLINE
SOUTHGOING BOTTOM CURRENT
HIGH SALINITY
(> 30 PSU below 25 m)
”MARINE FAUNA”
Import of phytoplankton from north
THE PERMANENT RESIDENTS



BENTHIC FAUNA COMMUNITIES


Haploops-community (25m-, Silt, >5% LOI)

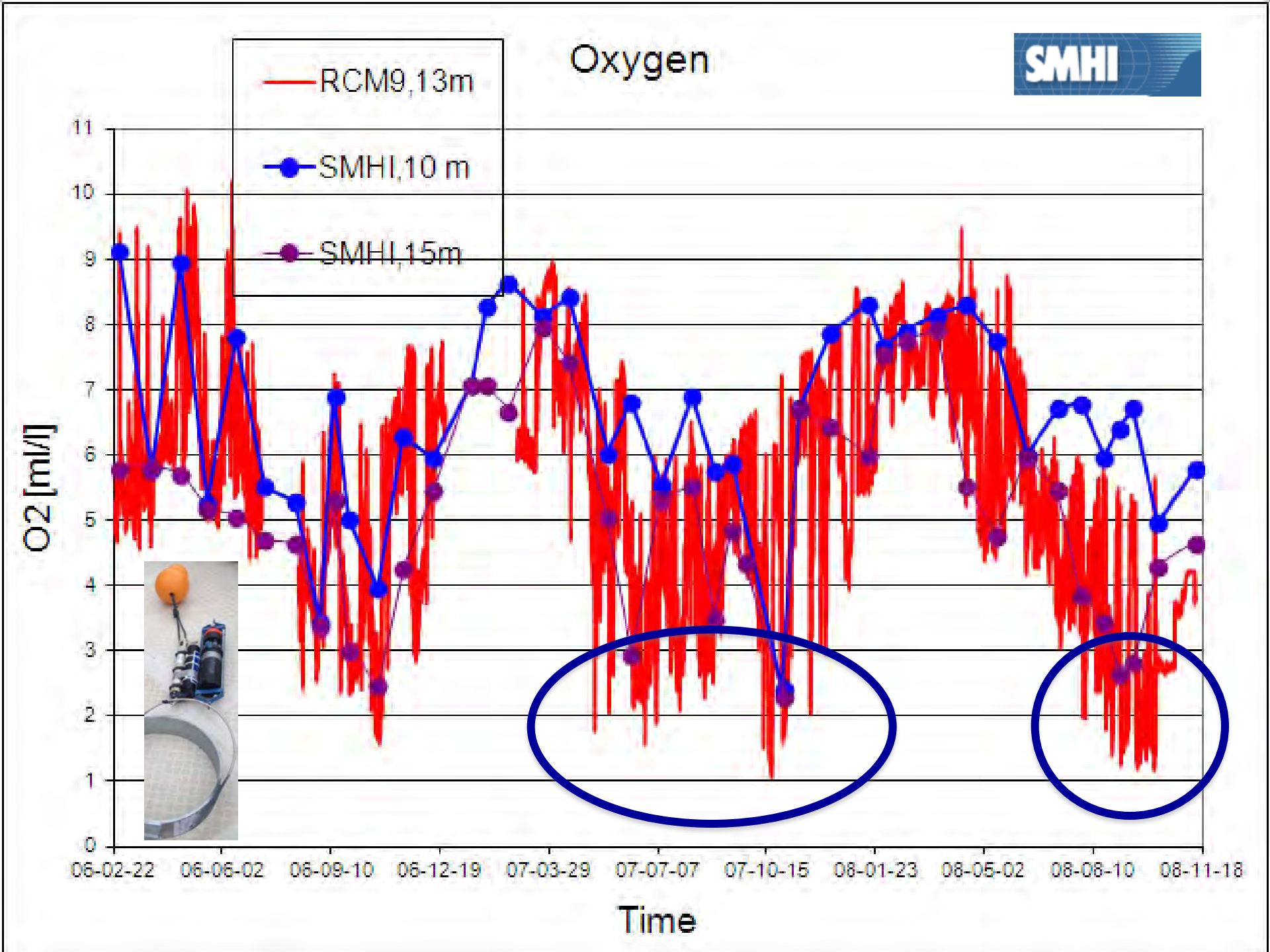


Ox min 0,91 ml/l = 1,3 mg/l = 40 umol/l

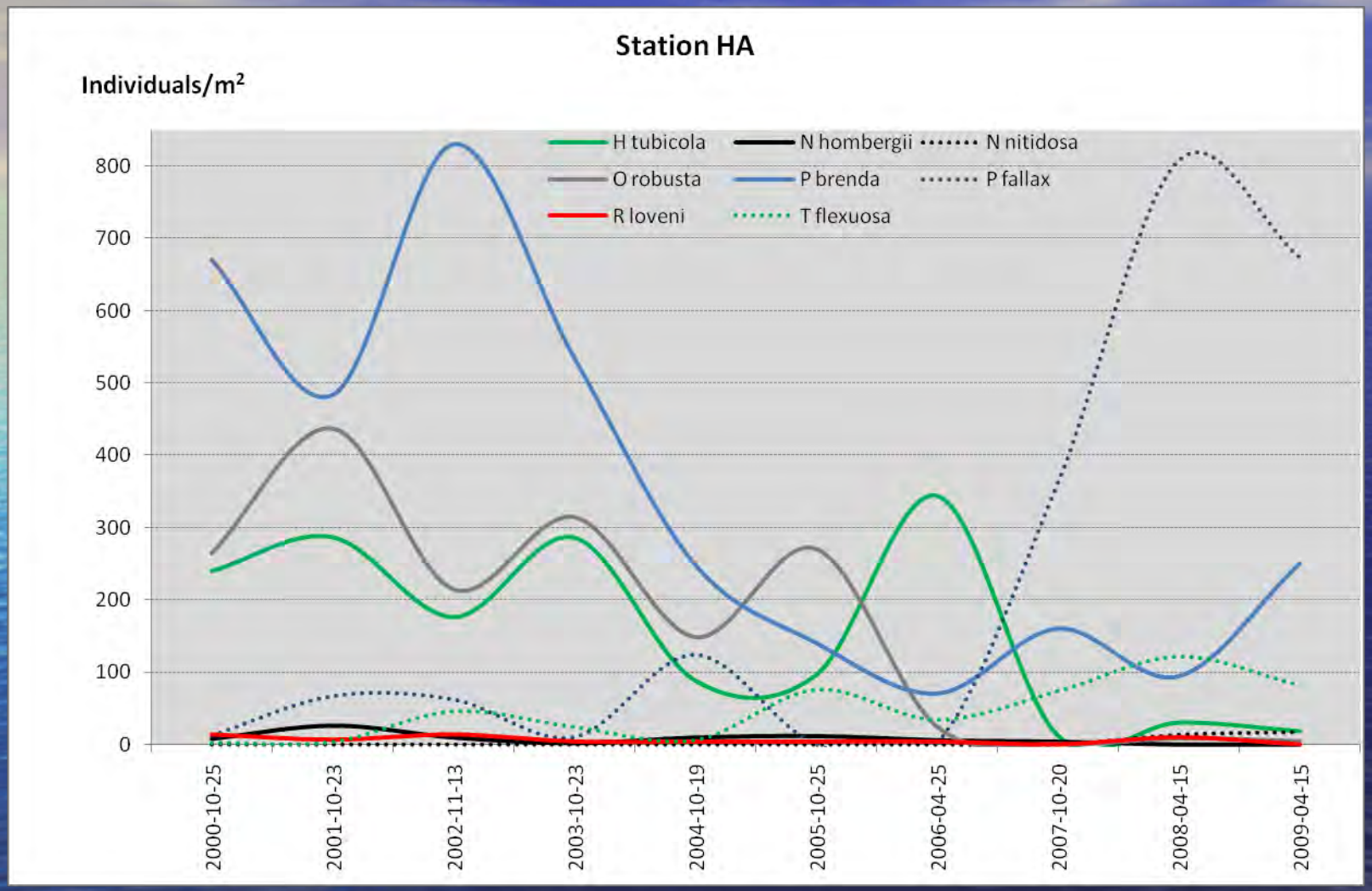
Haploops has not recovered since 2007

Abundance for *Haploops* spp in the Sound during different timeperiods.

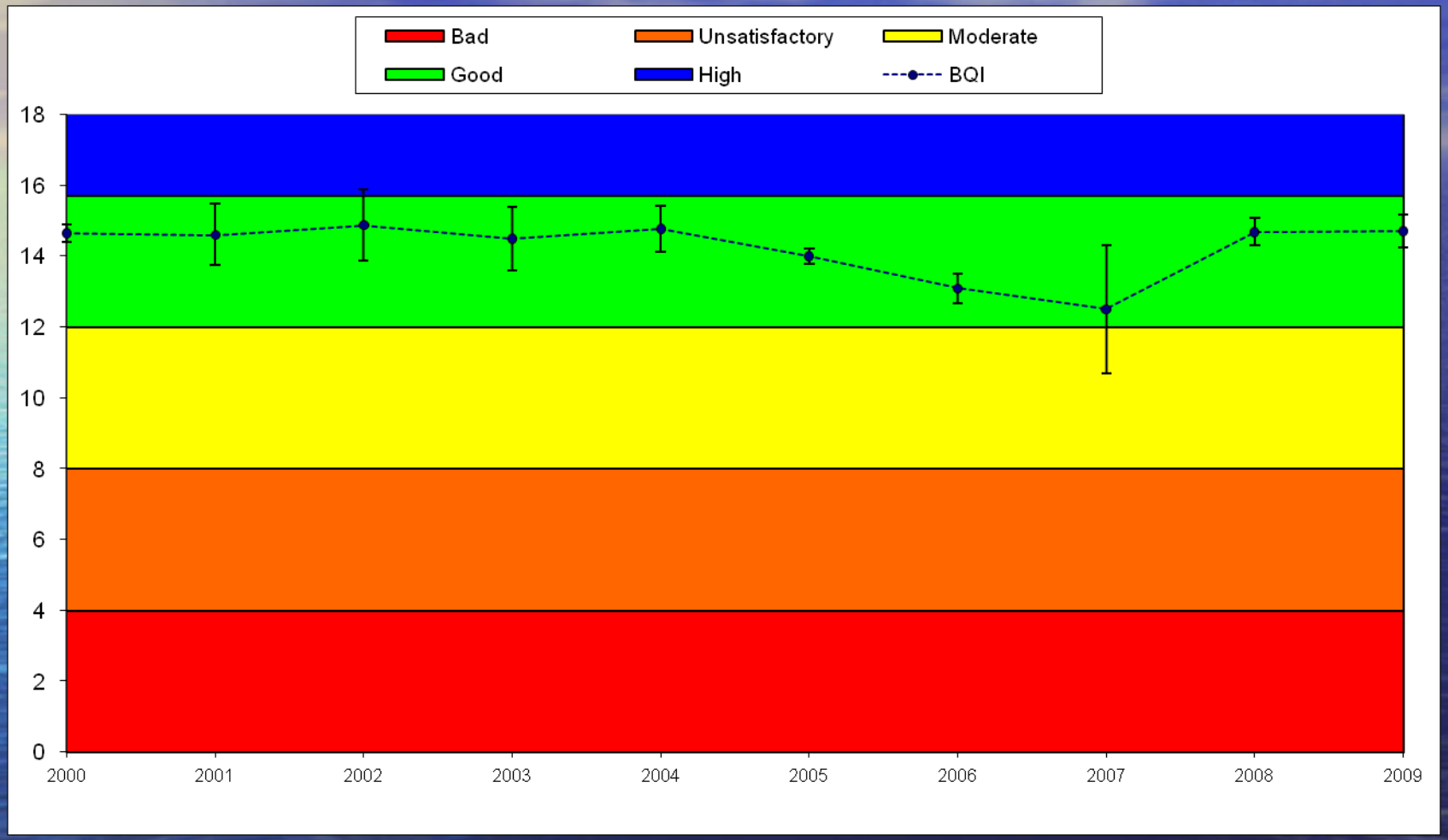
Timeperiod (Station)	1910, 1914 (P22) 1936-46 (HA)	1990 (P22) 1992(HA)	2000-2009 (HA)
Individuals /m^2	ca 4000	0-1500	97


Oxygen
SMHI
RCM9,13m
SMHI,10 m
SMHI,15m
O2 [ml/l]
11
10
9
8
7
6
5
4
3
2
1
0
06-02-22
06-06-02
06-09-10
06-12-19
07-03-29
07-07-07
07-10-15
08-01-23
08-05-02
08-08-10
08-11-18
Time

Statistically significant change of abundance for separate taxa 2000-2009

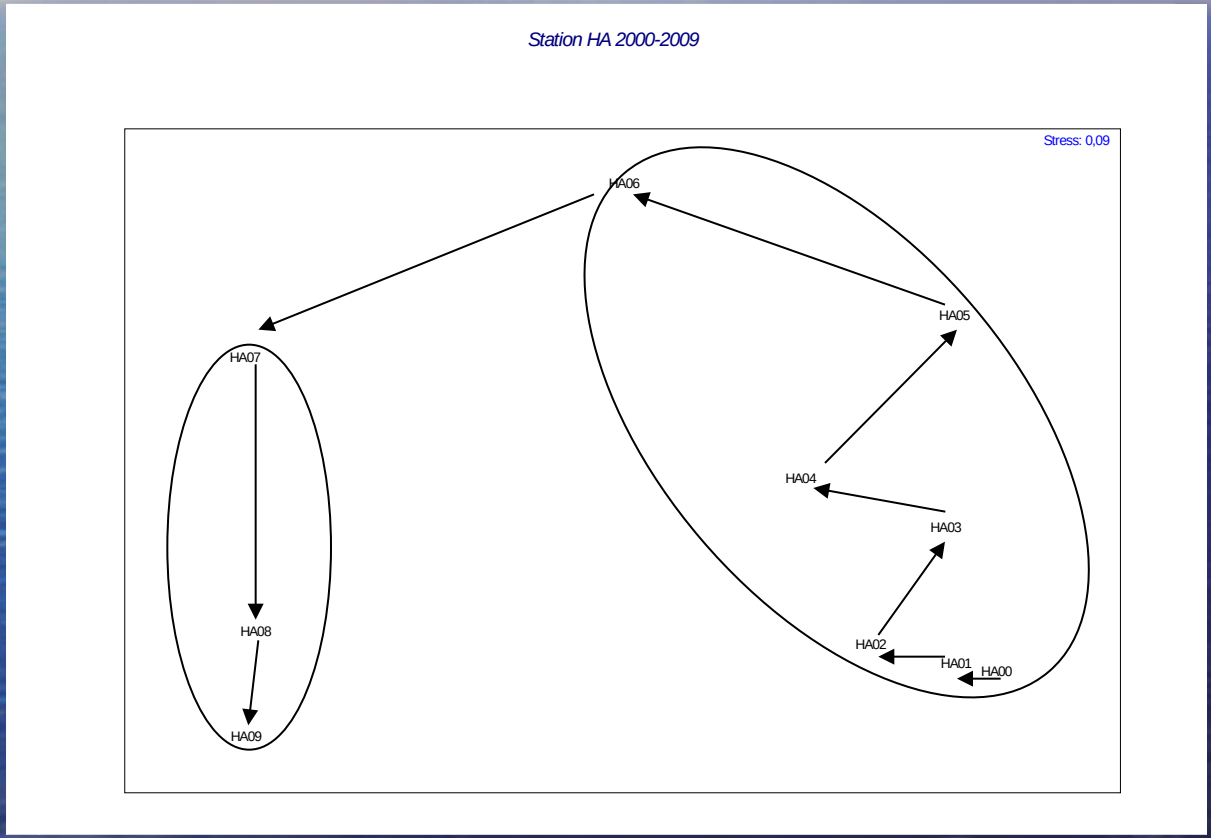


BENTHIC QUALITY INDEX*, 2000-2009



* =(Rosenberg et al 2004)

MDS* 2000-2009



* = according to PRIMER

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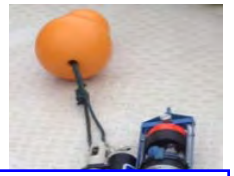
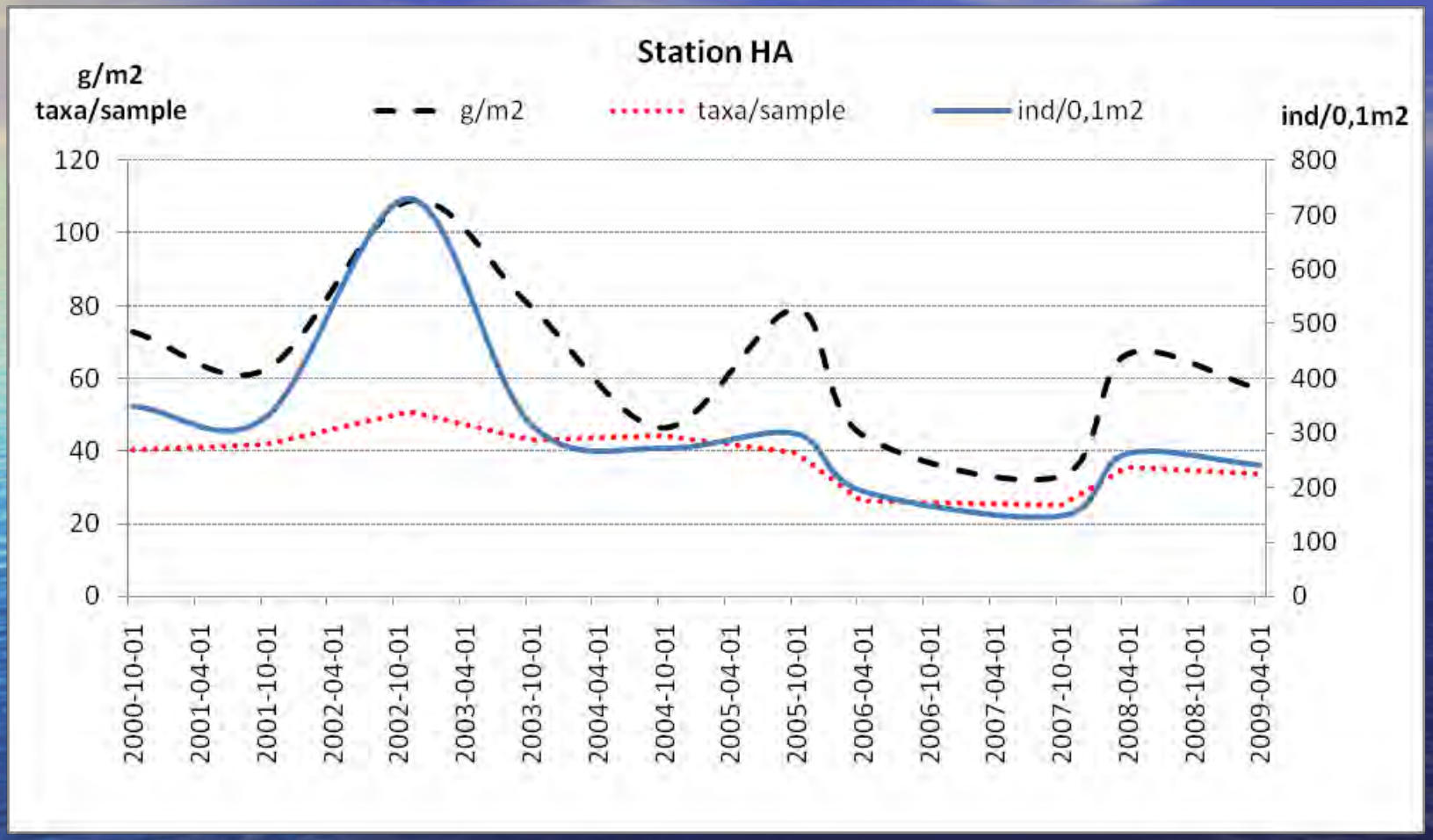
CONCLUSIONS

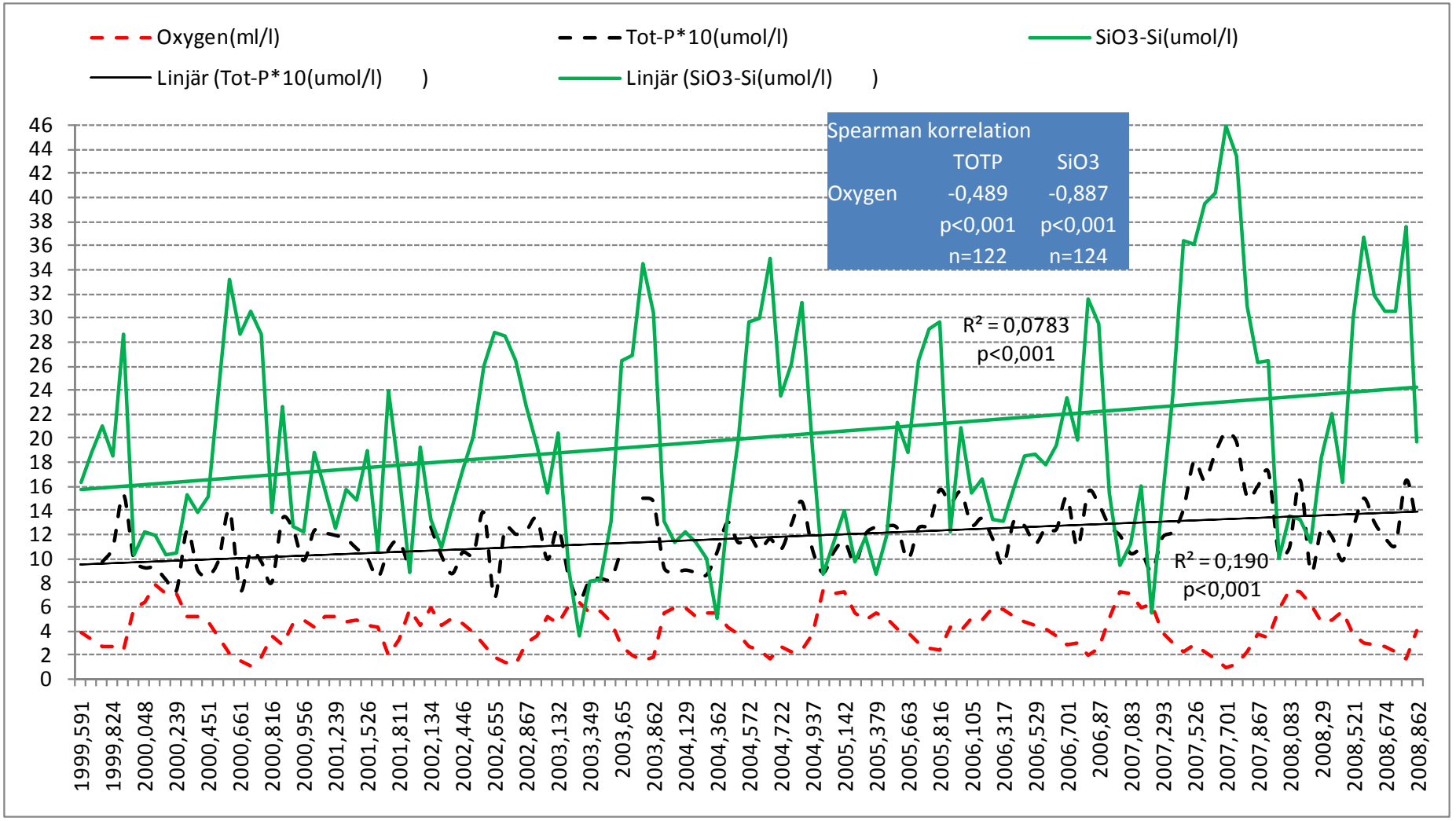


- **Disappearance of Haploops from Oeresund is not reflected in BQI. H. is gone also from other areas in Kattegat/Skagerrak**
- **With simplified indexes it is difficult to mirror ecosystem changes**
- **MDS indicate ecosystem change but not if it is better/worse**
- **O_2 and hydrographic parameters variable in coastal environments, monthly sampling serve for quality control of sensors, can not be used to understand the hydrography**
- **Low O_2 conditions is overestimated from water samples. Contamination from sampling PVC sampling bottles.**
- **Warmer climate will lead to lower O_2**

Paintings by Sven Bertil Johnsson

SPECIES-ABUNDANCE-BIOMASS 2000-2009




Oxygen(ml/l)
Tot-P*10(umol/l)
SiO3-Si(umol/l)
Linjär (Tot-P*10(umol/l))
Linjär (SiO3-Si(umol/l))
Spearman korrelation
TOTP SiO3
Oxygen -0,489 -0,887
p<0,001 p<0,001
n=122 n=124
R² = 0,0783
p<0,001
R² = 0,190
p<0,001
46 44 42 40 38 36 34 32 30 28 26 24 22 20 18 16 14 12 10 8 6 4 2 0
1999,591 1999,824 2000,048 2000,239 2000,451 2000,661 2000,816 2000,956 2001,239 2001,526 2001,811 2002,134 2002,446 2002,655 2002,867 2003,132 2003,349 2003,65 2003,862 2004,129 2004,362 2004,572 2004,722 2004,937 2005,142 2005,379 2005,663 2005,816 2006,105 2006,317 2006,529 2006,701 2006,87 2007,083 2007,293 2007,526 2007,701 2007,867 2008,083 2008,29 2008,521 2008,674 2008,862

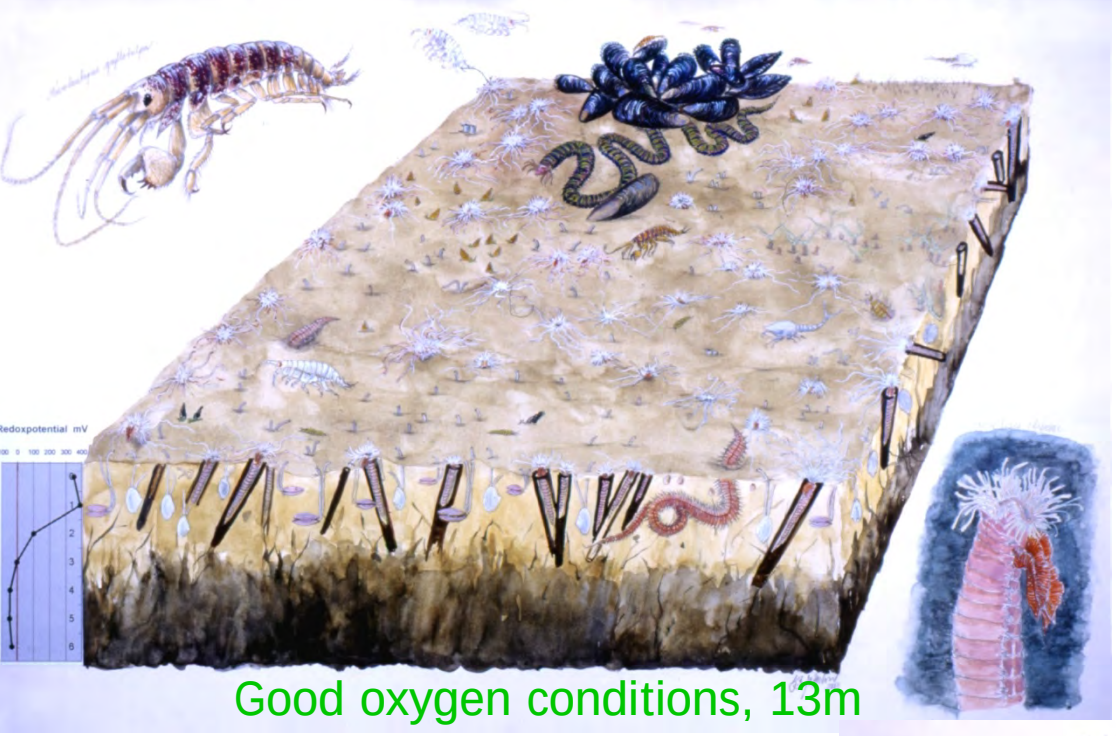
STATISTICAL TRENDS IN HYDROGRAPHY 2000-2009

SURFACEWATER

Variable	Change (+/-) Level of significance	r^2	k
Temperature n=90	+ p = 0,048	0,0437	0,103
PO4-P (jan-feb) n=90	+++ p<0,001	0,183	0,0169
TOT-P (jan-feb) n=87	+++ p<0,001	0,372	0,035
NO3-N (jan-feb) n=90	--- p<0,001	0,210	-0,239
TOTN (jan-feb) n=87	--- p<0,001	0,131	-0,271

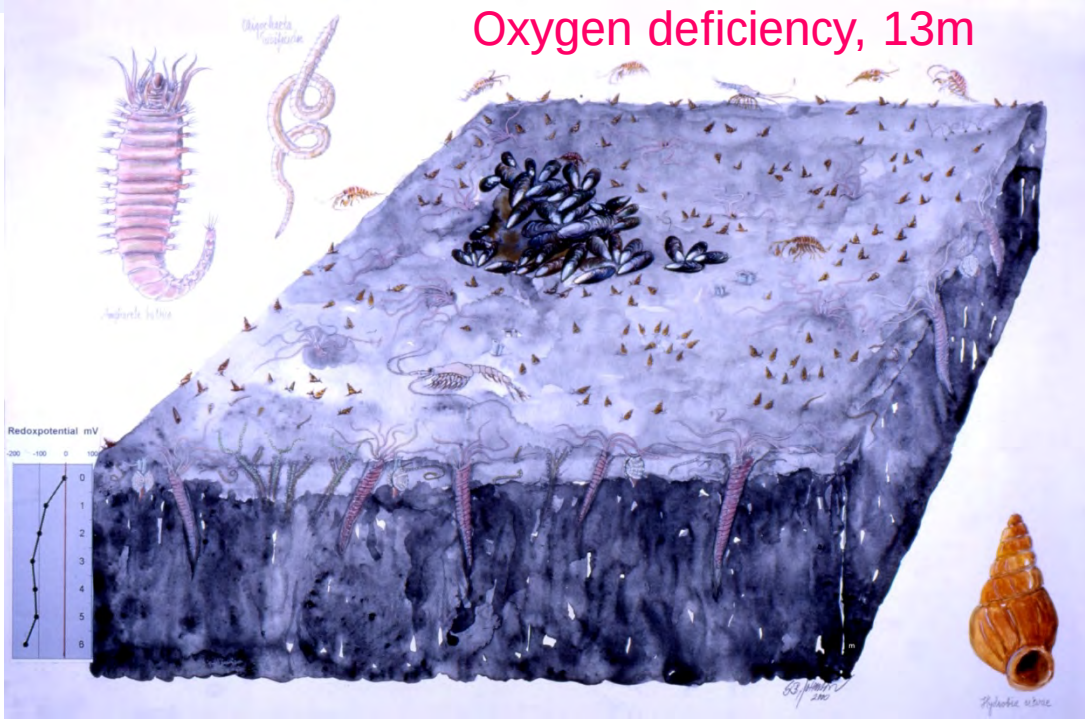
BOTTOMWATER

Variable	Change (+/-) Level of significance	r^2	k
Temp , year mean n=10	+ p = 0,026	0,516	0,0637
PO4-P n=122	+++ p = 0,001	0,0842	0,0272
TOT-P n=122	+++ p < 0,001	0,206	0,0448
SiO3 n=123	+ p = 0,004	0,0653	0,652

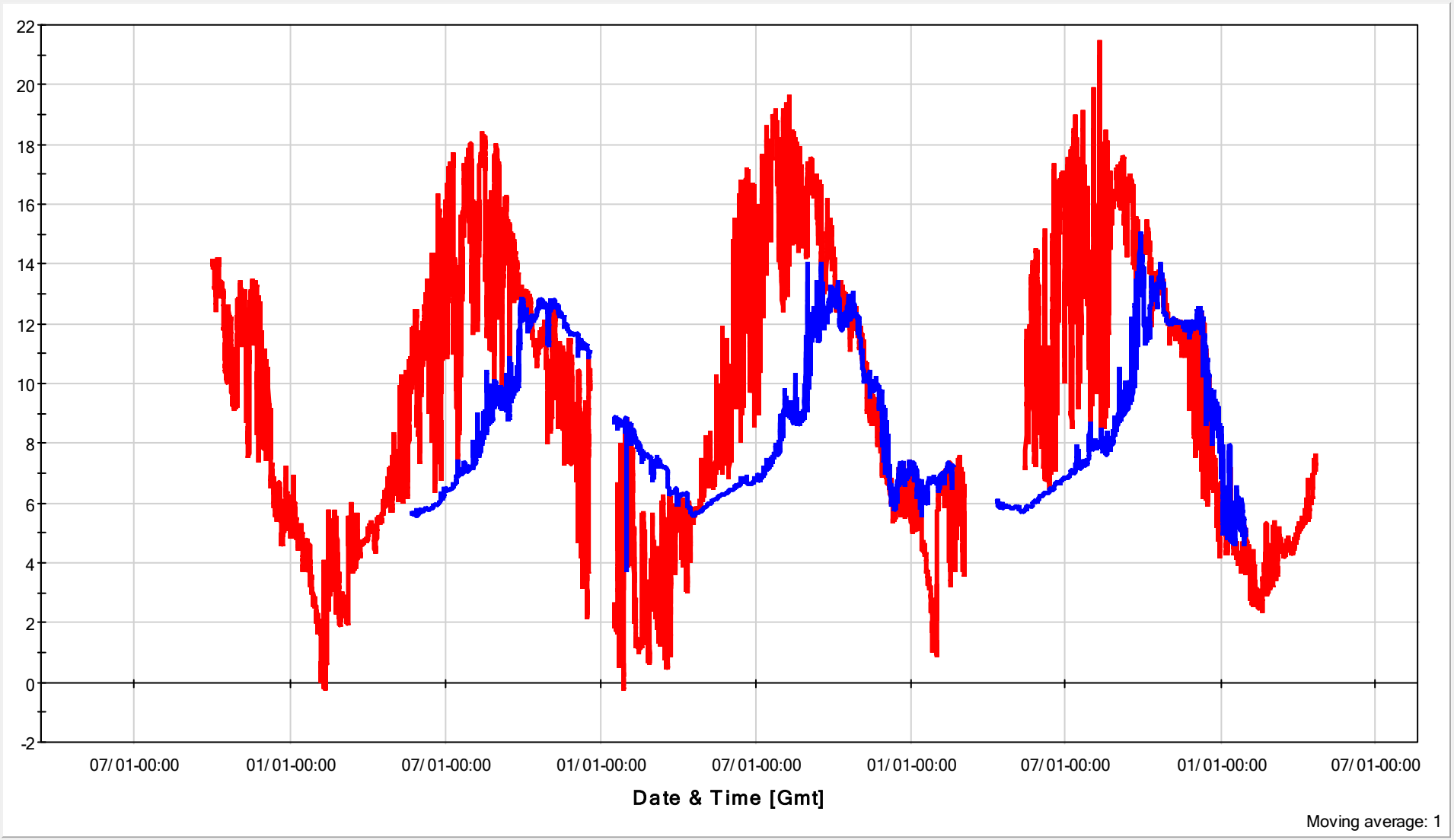


Good oxygen conditions, 13m

Oxygen deficiency, 13m

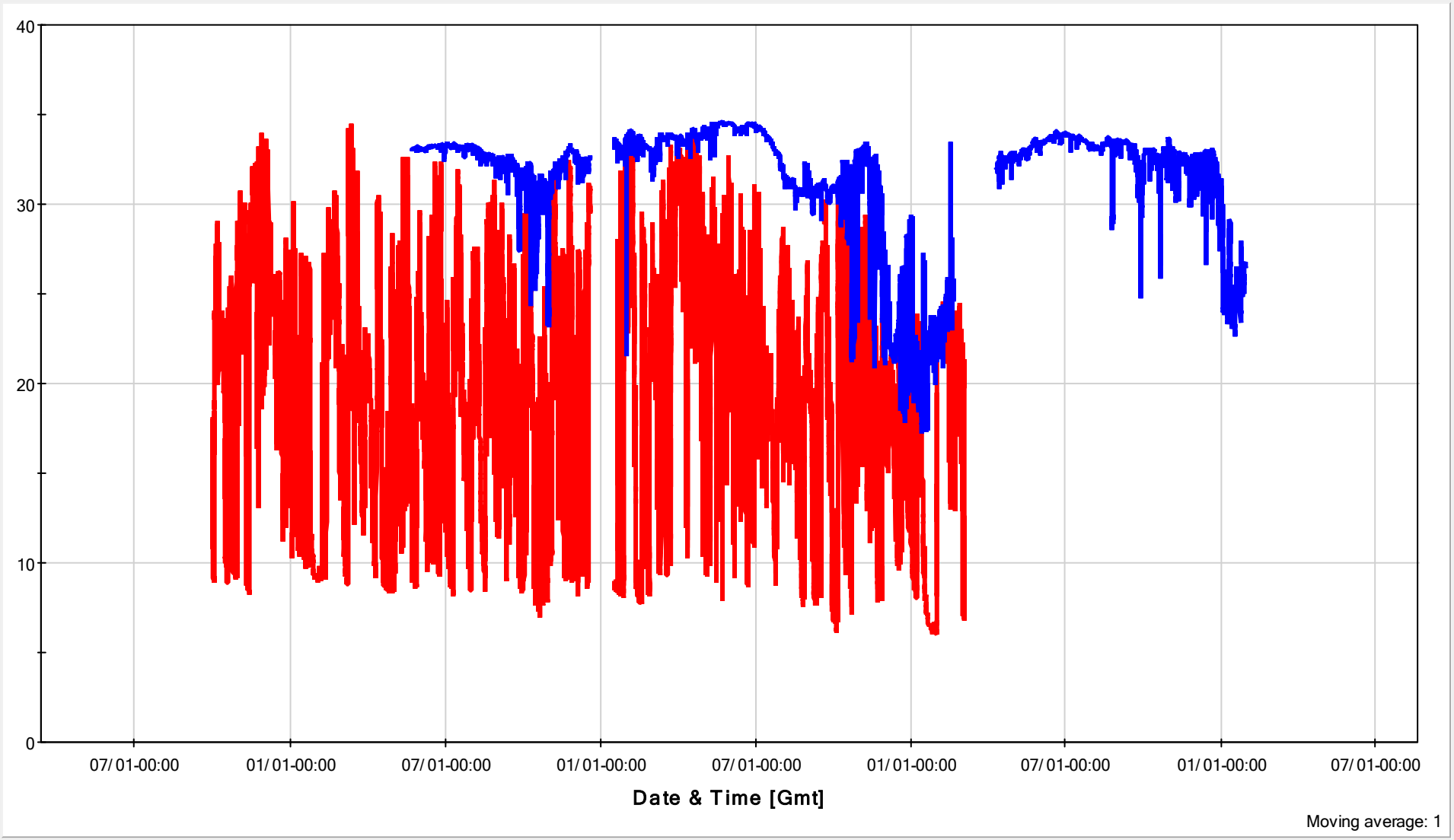


2011-2104, Temperature at 13 and 30 m



Temperature [Deg.C]
Temperature [DegC]
Temperature [Deg.C]
Temperature [DegC]
Temperature [DegC]
Temperature [DegC]
Temperature [Deg.C]
Temperature [DegC]

2011-2104, Salinity at 13 and 30 m



Salinity [PSU]
Salinity [PSU]
Salinity [PSU]
Salinity [PSU]
Salinity [PSU]
Salinity [PSU]
Salinity [PSU]

2011-2104, Oxygen at 13 and 30 m