CRUISE REPORT

R/V Aranda

Combine 3, leg 2 /2016

15 – 20 August 2016

Photo: Ilkka Lastumäki

This report is based on preliminary data and is subject to changes.

Monitoring cruise COMBINE 3, 15 – 20 August 2016, second leg.

Table 1. Scientific crew on Combine 3 cruise, 2. leg.

Chief scientist:	Maiju Lehtiniemi	SYKE MRC	15.08.2016 - 20.08.2016
Participants:	Panu Hänninen	SYKE MRC	15.08.2016 - 20.08.2016
	Pia Varmanen	SYKE MRC	15.08.2016 - 20.08.2016
	Heidi Hällfors	SYKE MRC	15.08.2016 - 20.08.2016
	Ilkka Lastumäki	SYKE MRC	15.08.2016 - 20.08.2016
	Susanna Hyvärinen	SYKE MRC	15.08.2016 - 20.08.2016
	Outi Setälä	SYKE MRC	15.08.2016 - 20.08.2016
	Janne Bruun	SYKE MRC	15.08.2016 - 20.08.2016
	Jere Riikonen	SYKE MRC	15.08.2016 - 20.08.2016
	Pekka Kosloff	FMI	15.08.2016 - 20.08.2016
	Jouni Hiltunen	Katharsis Films Oy	15.08.2016
	Timo Peltonen	Katharsis Films Oy	15.08.2016
	Irina Andreeva	HYDROMET, Russia	15.08.2016 - 20.08.2016
	Igor Shilov	HYDROMET, Russia	15.08.2016 - 20.08.2016

SYKE MRC: Finnish Environment Institute, Marine Research Centre, FMI: Finnish Meteorological Institute

Description of the cruise

The cruise is dedicated to monitoring of physical parameters (temperature, salinity, dissolved oxygen), general hydrography, nutrients, phycotoxins and phyto- and zooplankton of the Baltic Sea according to HELCOM Combine program. Leg 2 has special emphasis on the Gulf of Finland (Fig. 1).

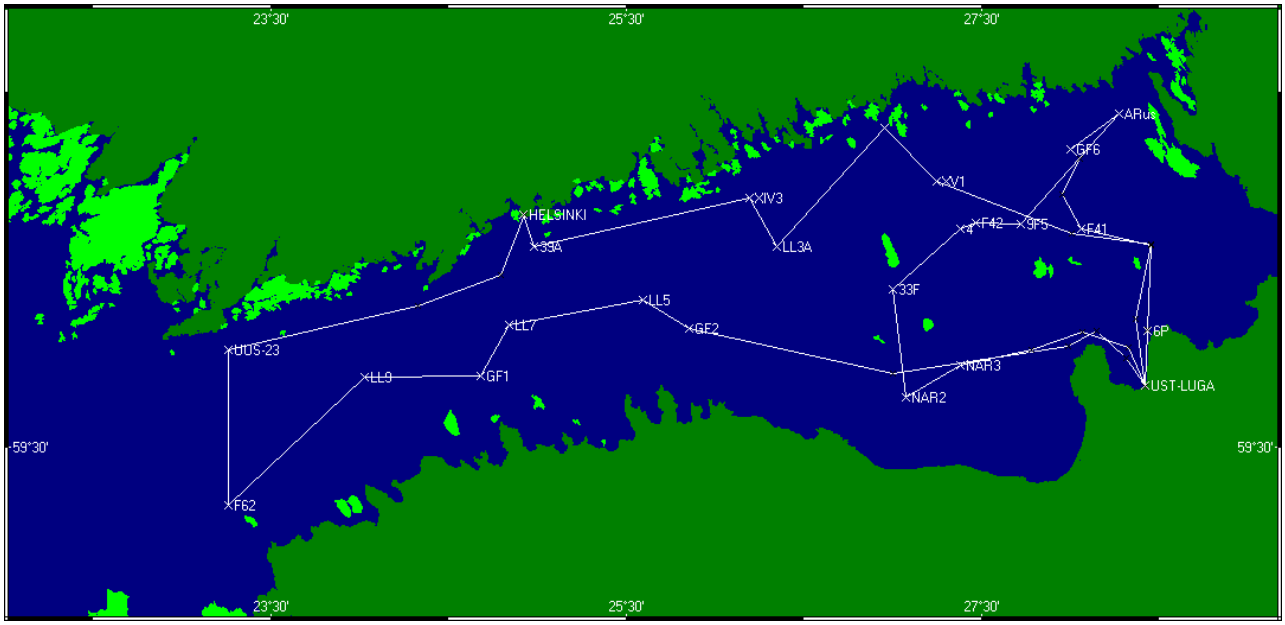

Figure 1. Route and sampling stations during COMBINE 3 leg 2 2016 cruise (15-20 August 2016).

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In addition tests and sample collection for the development of microliter monitoring was conducted by vertical hauls of the WP-2 zooplankton net and a large water sampler (30L). Intercalibration samples for nutrients, phyto- and zooplankton were collected by the Russian scientists at the stations ARus, 6P and 4.

Combine 3, leg 2 sailed from Helsinki on Monday 15th August 2016 at 12 o'clock. During the cruise the HELCOM Combine pelagic monitoring stations were sampled (Fig. 1, Table 2 and 3).
The first day of the cruise was also participated by a small film team who took video footage and made interviews for the upcoming Gulf of Finland movie. During the first night a mussel cage was taken up and the mussels driven to Kotka harbor for further processing and biomarker analyses in the laboratory. This is part of the Finnish monitoring program for the Marine Strategy Framework Directive.

Table 2. Station information for the COMBINE 3, leg 2, 15-20.8.2016.

Index	Station	Lat.	Lon.	Depth	Date and time
0426	39A	N60.0401	E024.5881	43.00	20160815 1054
0427	XIV3	N60.1219	E026.1157	79.00	20160815 1550
0428	LL3A	N60.0403	E026.2080	69.00	20160815 1905
0429	M_KOTKA	N60.2404	E026.5720	21.00	20160816 0025
0430	XV1	N60.1500	E027.1482	66.00	20160816 0445
0431	6P	N59.4980	E028.2600	28.00	20160816 1820
0432	F41	N60.0704	E028.0355	51.00	20160817 0001
0433	GF6	N60.2031	E028.0011	46.00	20160817 0325
0434	ARUS	N60.2630	E028.1670	30.00	20160817 0550
0435	9F5	N60.0790	E027.4350	49.00	20160817 0930
0436	F42	N60.0804	E027.2794	63.00	20160817 1145
0437	4	N60.0700	E027.2300	58.00	20160817 1510
0438	33F	N59.5700	E027.0000	70.00	20160817 1725
0439	NAR2	N59.3861	E027.0461	57.00	20160817 2020
0440	NAR3	N59.4413	E027.2288	68.00	20160817 2246
0441	GF2	N59.5031	E025.5141	85.00	20160818 2055
0442	GF2	N59.5031	E025.5141	85.00	20160818 2125
0443	LL5	N59.5501	E025.3582	69.00	20160818 2355
0444	LL7	N59.5079	E024.5027	102.00	20160819 0320
0445	GF1	N59.4230	E024.4093	84.00	20160819 0640
0446	LL9	N59.4201	E024.0181	66.00	20160819 0952
0447	F62	N59.2001	E023.1581	98.00	20160819 1425
0448	LANGDEN	N59.4642	E023.1570	59.00	20160819 1850

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Observations

The effects of the large salt water intrusions of 2014, 2015 and 2016 were visible in the Central Baltic Sea on the eastern and southern sides of Gotland as improved oxygen conditions near the bottom. Intrusions have pushed the deep old nutrient rich waters towards the Gulf of Finland and these effects were observed in the entrance to the Gulf of Finland in August. It seems however unlikely that the influence of the intrusions would affect the status of the Gulf significantly.

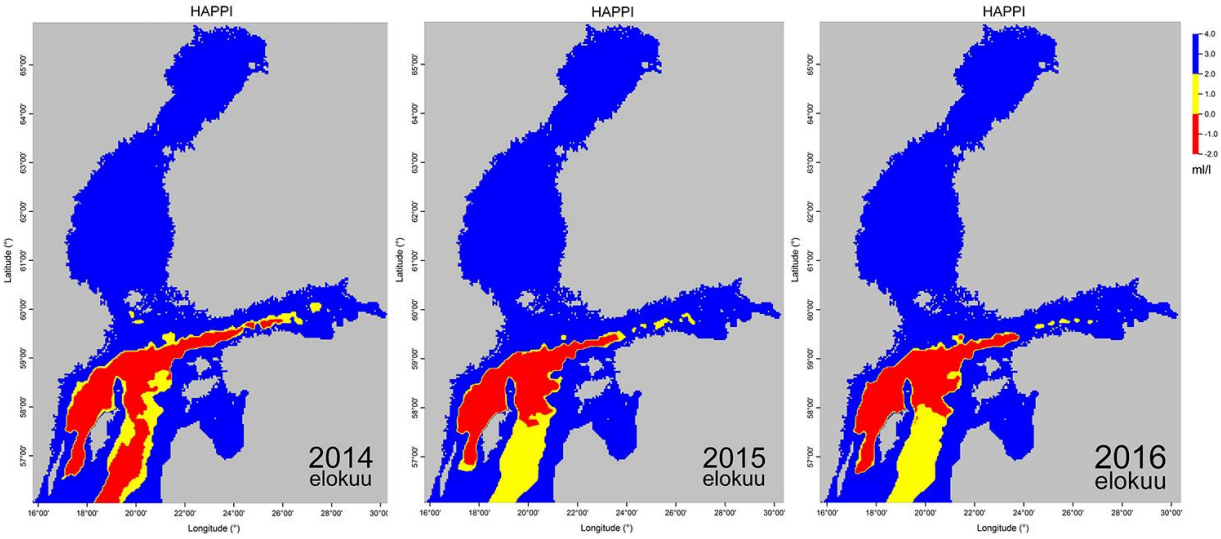

Figure 2. Oxygen conditions on the bottom in August 2014, 2015 and 2016. Blue indicates good oxygen conditions, yellow depleted oxygen and red anoxia.

Deep water oxygen conditions of the Gulf of Finland depend on the water exchange between the northern Baltic Proper and the Gulf and thus annual fluctuations in the oxygen conditions in the entrance to the Gulf of Finland can be large (Fig 2.). The deep water oxygen conditions were similar to the ones in 2015 but a bit better than 2014.

Hydrogen sulfide was measured only on the southern stations near the Estonian coast (Fig 3.) where phosphate concentrations were observed to be higher compared to previous years. In the eastern Gulf of Finland better oxygen conditions can be seen close to the bottom, which reflects to the lower nutrient concentrations compared to oxygen depleted bottoms (Fig. 4).

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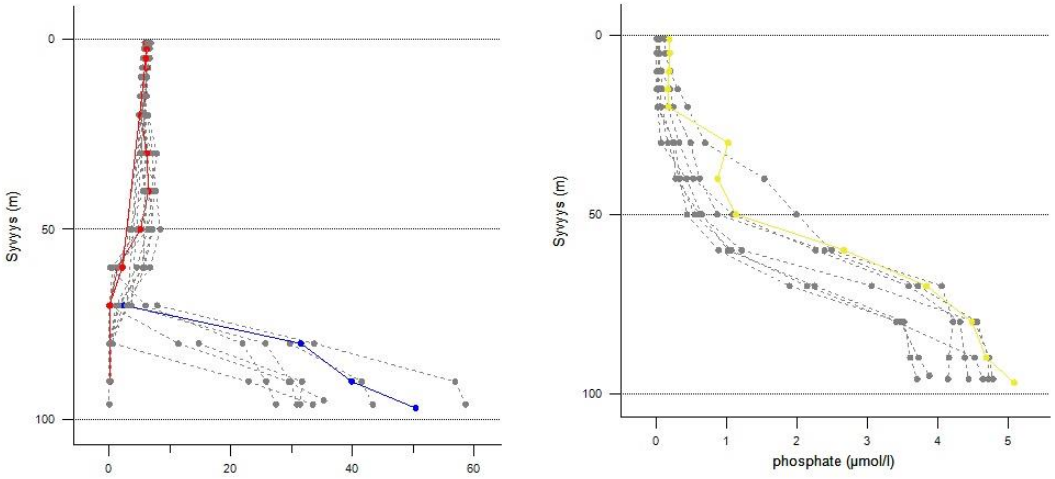

Figure 3. Oxygen and hydrogen sulfide profiles on the station F62 on the southwestern coast of the Gulf of Finland 2005-2016 (left). Profile of the present cruise is shown with red (oxygen) or blue (hydrogen sulfide) color. Depth (m) on y-axis, oxygen level (ml $^{-1}$l) and hydrogen sulfide on the x-axis. Phosphate levels at the southwestern station F62 2008-2016 (right). Profile of the present cruise is shown with yellow color. Depth (m) on y-axis, phosphate level (µmol $^{-1}$l) on the x-axis.

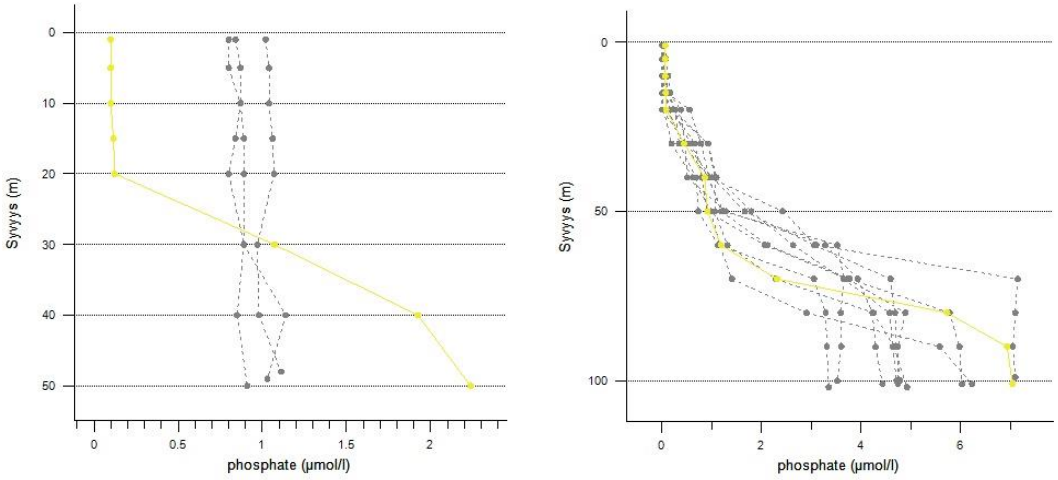

Figure 4. Phosphate levels at the eastern station F41 in the Russian territorial waters (left) and in the middle of the Gulf of Finland at station LL7 (right) 2007-2016. Profile of the present cruise is shown with yellow color. The grey

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profiles show previous measurements. Depth (m) on y-axis, phosphate level (µmol $^{-1}$l) on the x-axis.'

The newer monitoring parameters include phycotoxins and surface microlitter. Phycotoxins are concentrated from water samples collected with a 30L water sampler (Fig. 5) from 10, 7.5, 5, 2.5 m and surface water. Phycotoxins were sampled from 4 stations in the Gulf of Finland (Table 3).

Microliter monitoring is generally conducted with a Manta trawl by horizontal tows in the water surface. During the monitoring development it has been decided that manta samples will be collected during spring time (Combine 2 cruise) when cyanobacterial surface blooms or ice do not cause problems for the sampling or samples. During the August cruise we tested how well the traditional zooplankton WP-2 net (100 µm) would work for collection of vertical microliter samples. In additional we took samples with a 30 L water sampler below the thermo- and haloclines to see whether the microplastics concentrate to the clines (Fig. 5). Microliter samples were collected from 11 stations during the Gulf of Finland cruise (Table 3).

Figure 5. 30 L water sampler was used for monitoring of phycotoxins from different water layers (between 0-10m) and for microliter just below the clines. Photo: Maiju Lehtiniemi.

Phytoplankton, zooplankton, phycotoxins and microliter samples were transported to the laboratory of the Marine Research Center and will be analysed during the next year.

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Table 3. Summary of parameters collected at sampling stations during 15th-20th August 2016.

Index	426	527	428	429	*430*	431	432	433	434	435	436	437	438	439	440
Parametres/ Station	39A	XIV 3	LL3A	Mussel cage	XV1	6P	F41	GF6	ARus	9F5	F42	4	33F	NAR2	NA R3
Oil sample			X								X				
CTD-Salinity	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
CTD-Temperature	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
CTD-Oxygen	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
CTD-Fluorescence	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Bottom salinity	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Secchi depth	x	x						x	x	x	x	x	x		
Bottom oxygen	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
H_2S															
pH	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
PO_4-P	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
NO_3-N	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
NO_2-N	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
SiO_4	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
TN	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
TP	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
a-Chlorophyll	x	x	x		x	x	x	x	x		x		x	x	x
Phytopl. Integr.			x		x	x	x	x	x		x		x	x	x
Phycotoxins			x		x						x				
Zoopl.- net		x	x		x	x					x				
Microlitter		x			x				x	x	x			x	

Index	441 /442	443	444	445	446	447	448
Parametres/ Station	GF2	LL5	LL7	GF1	LL9	F62	LÄNGDEN/ UUS23
Oil sample			x				
CTD-Salinity	x	x	x	x	x	x	x
CTD-Temperature	x	x	x	x	x	x	x
CTD-Oxygen	x	x	x	x	x	x	x
CTD-Fluorescence	x	x	x	x	x	x	x
Bottom salinity	x	x	x	x	x	x	x
Secchi depth			x	x	x		
Bottom oxygen	x	x	x	x	x	x	x
H_2S						x	
pH	x	x	x	x	x	x	x
PO_4-P	x	x	x	x	x	x	x
NO_3-N	x	x	x	x	x	x	x
NO_2-N	x	x	x	x	x	x	x
SiO_4	x	x	x	x	x	x	x
TN	x	x	x	x	x	x	x
TP	x	x	x	x	x	x	x
a-Chlorophyll	x	x	x	x	x	x	x
Phytopl. Integr.	x		x			x	x
Phycotoxins			x				
Zoopl.- net			x	x	x	x	x
Microlitter	x		x		x	x	x

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