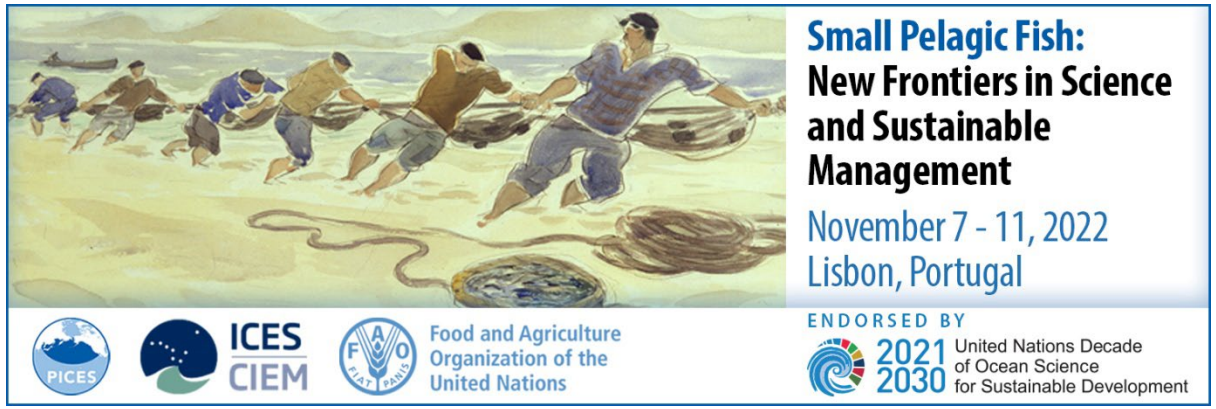

Calculations of spawning-stock biomass of sprat in the Eastern part of the Gotland Basin with the DEPM in the years 2019-2021

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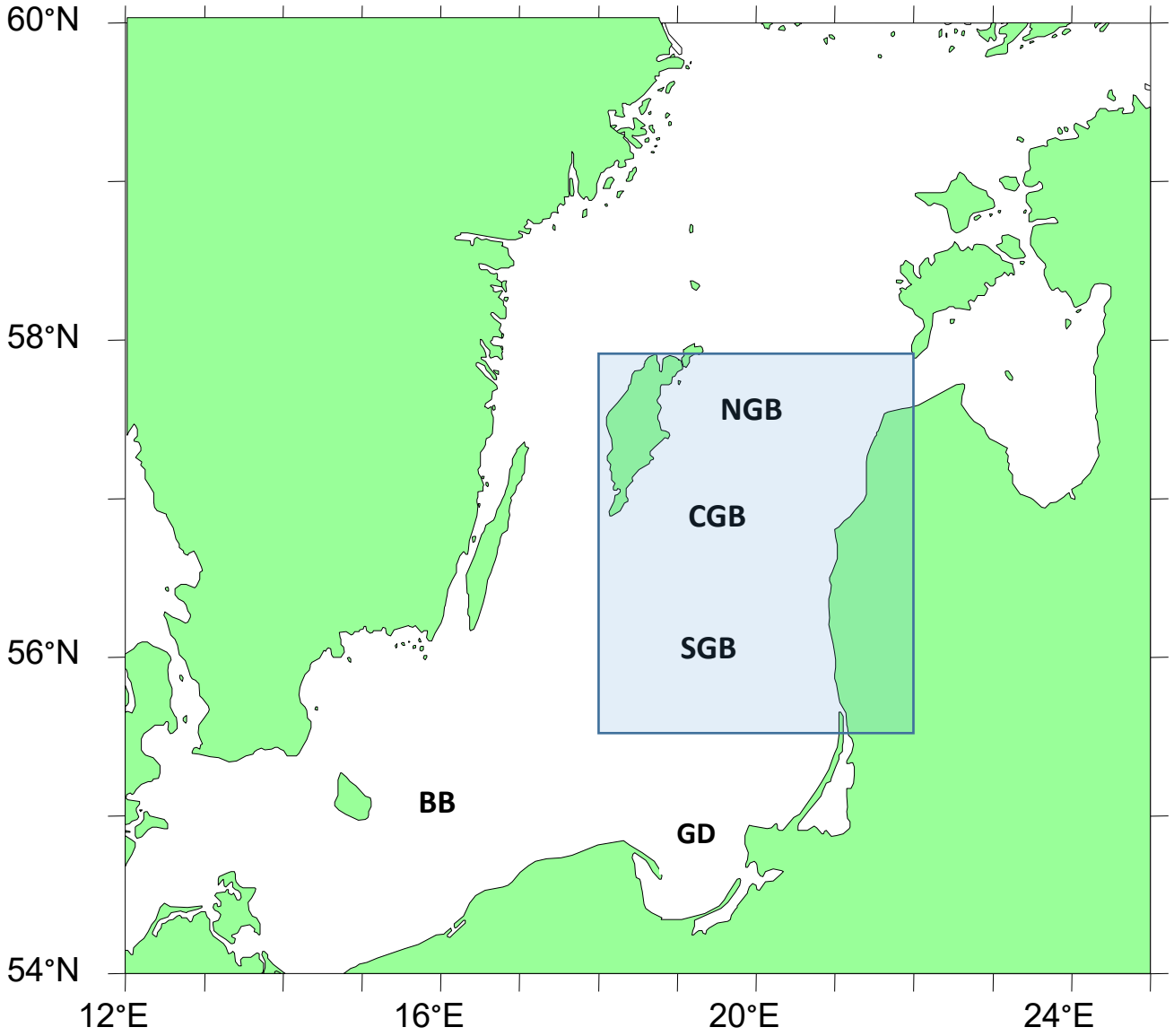
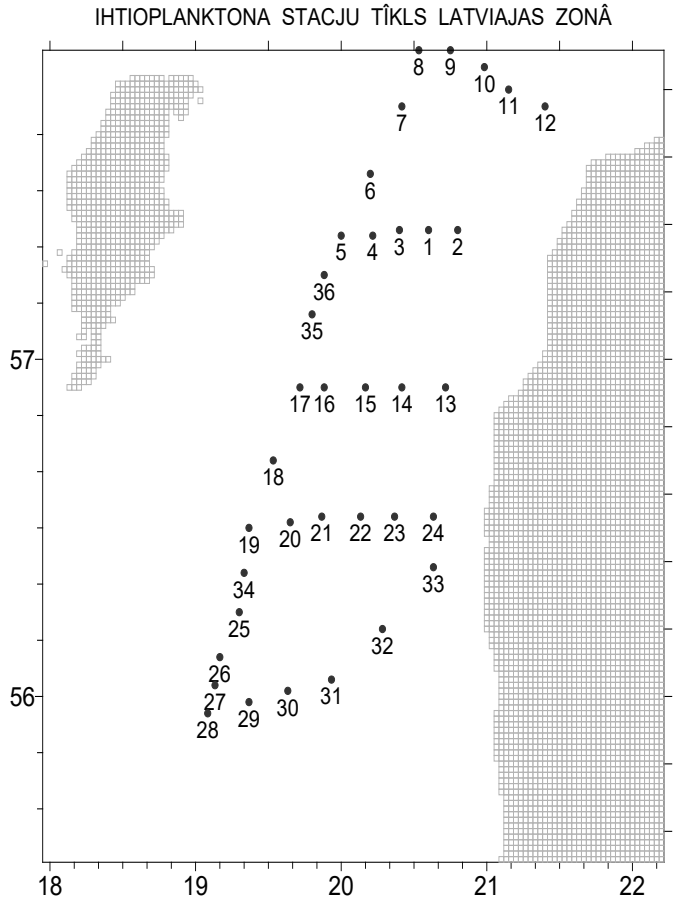
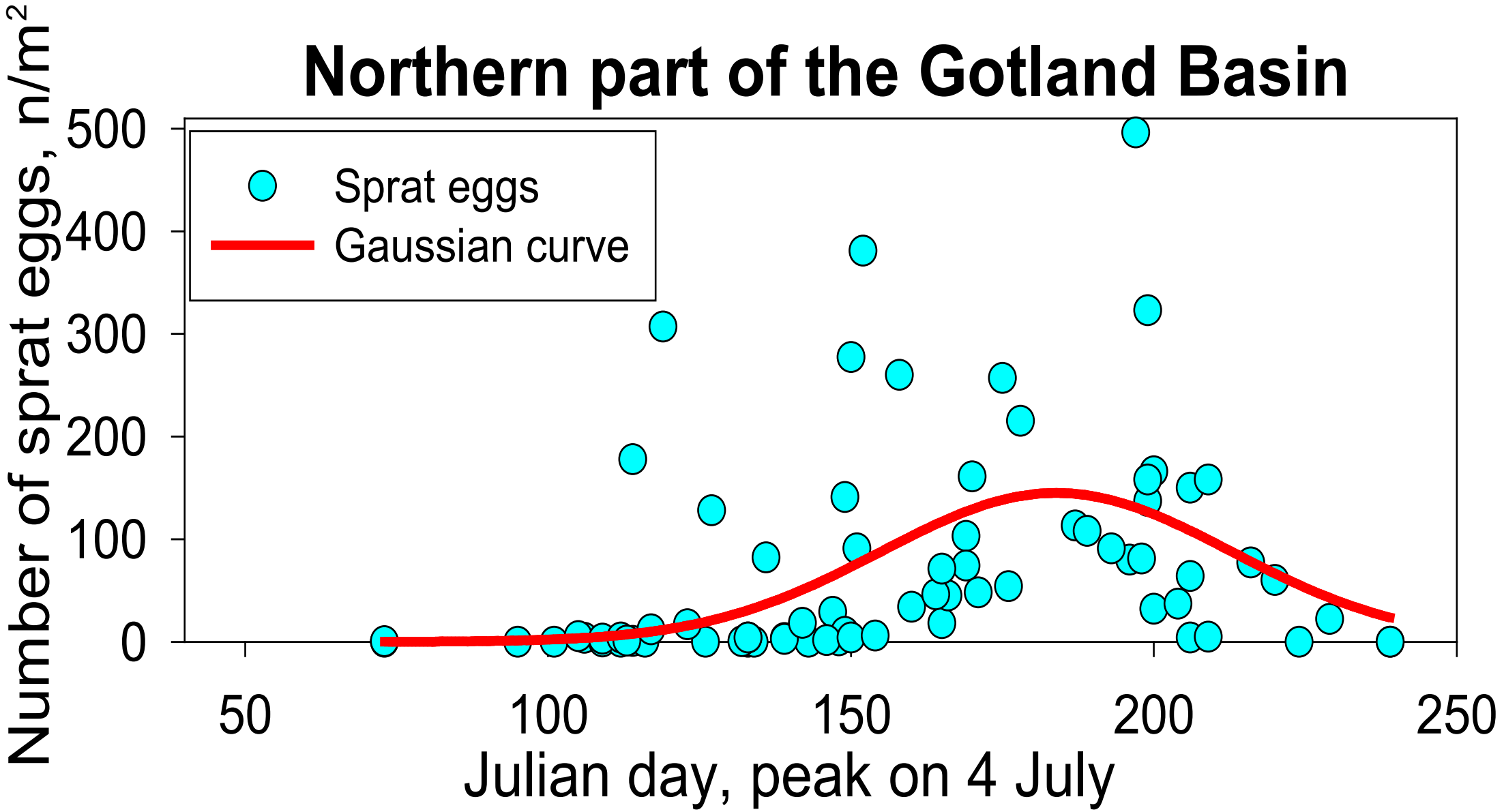
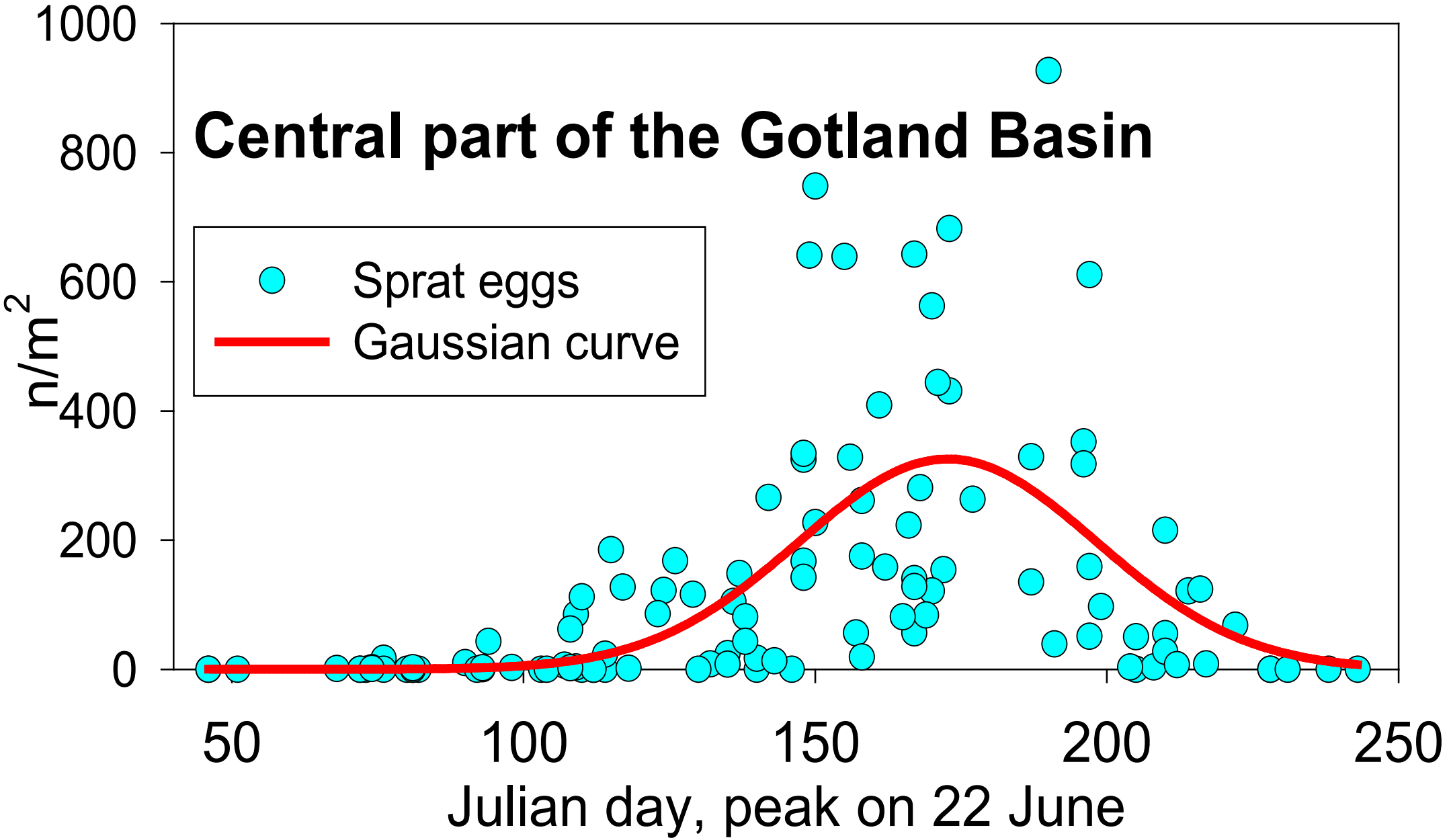


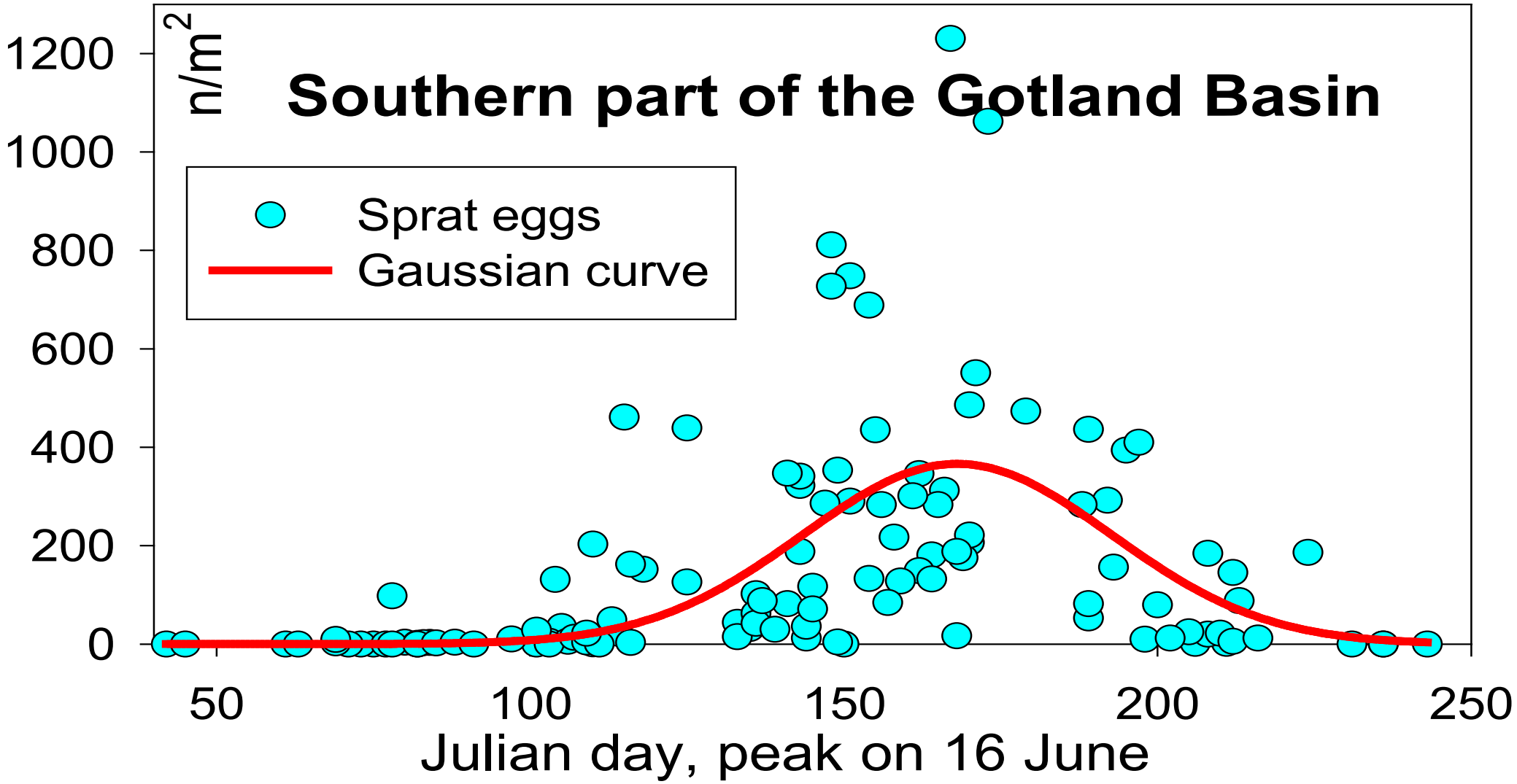
The investigated regions in the Baltic Sea.

BB - Bornholm Basin, GD - Gdansk Deep, SGB, CGB and NGB are Southern, Central, and Northern parts of the Gotland Basin.

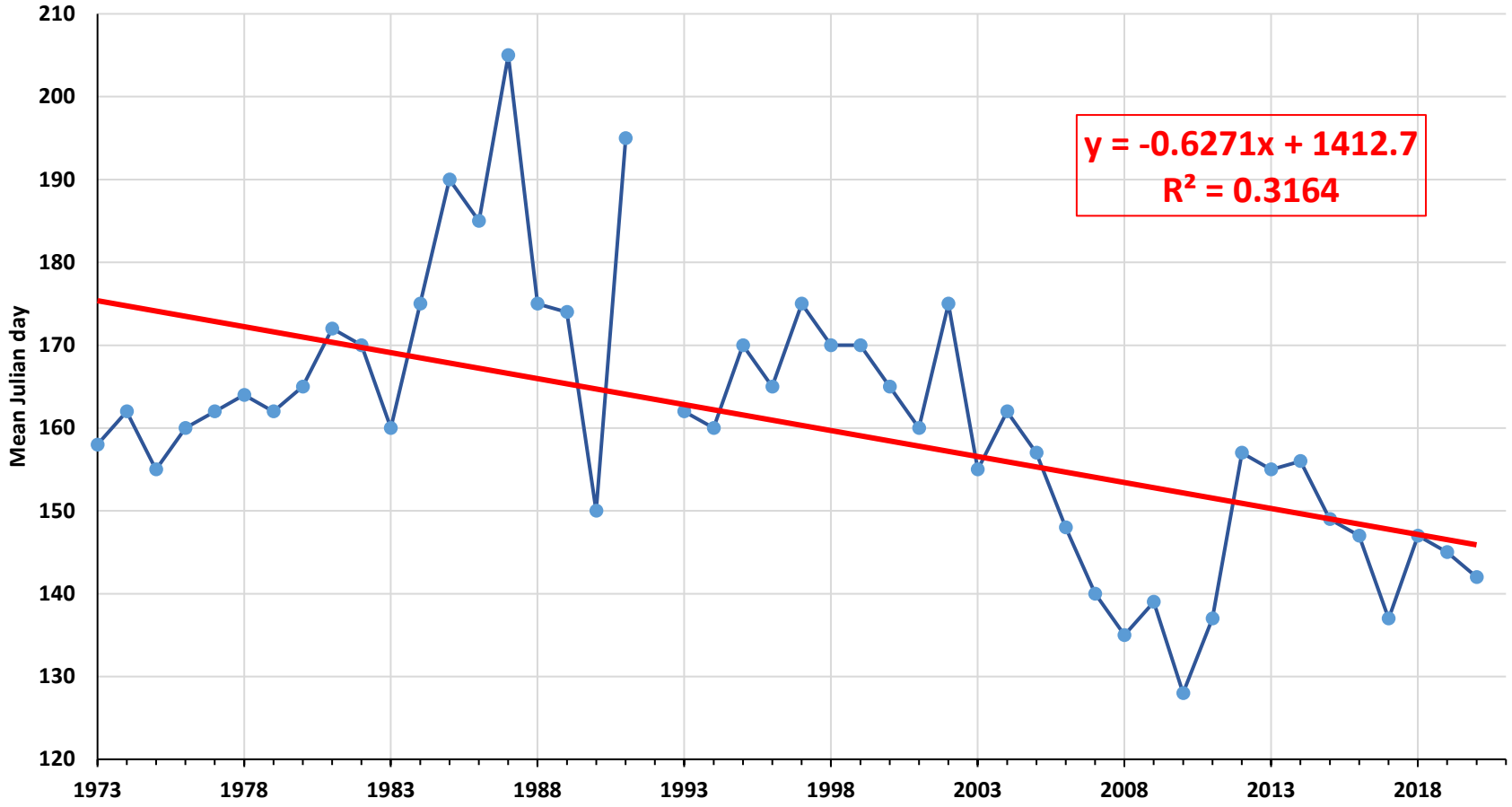



Northern part of the Gotland Basin
Number of sprat eggs, n/m²
500
400
300
200
100
0
Sprat eggs
Gaussian curve
50
100
150
200
250
Julian day, peak on 4 July

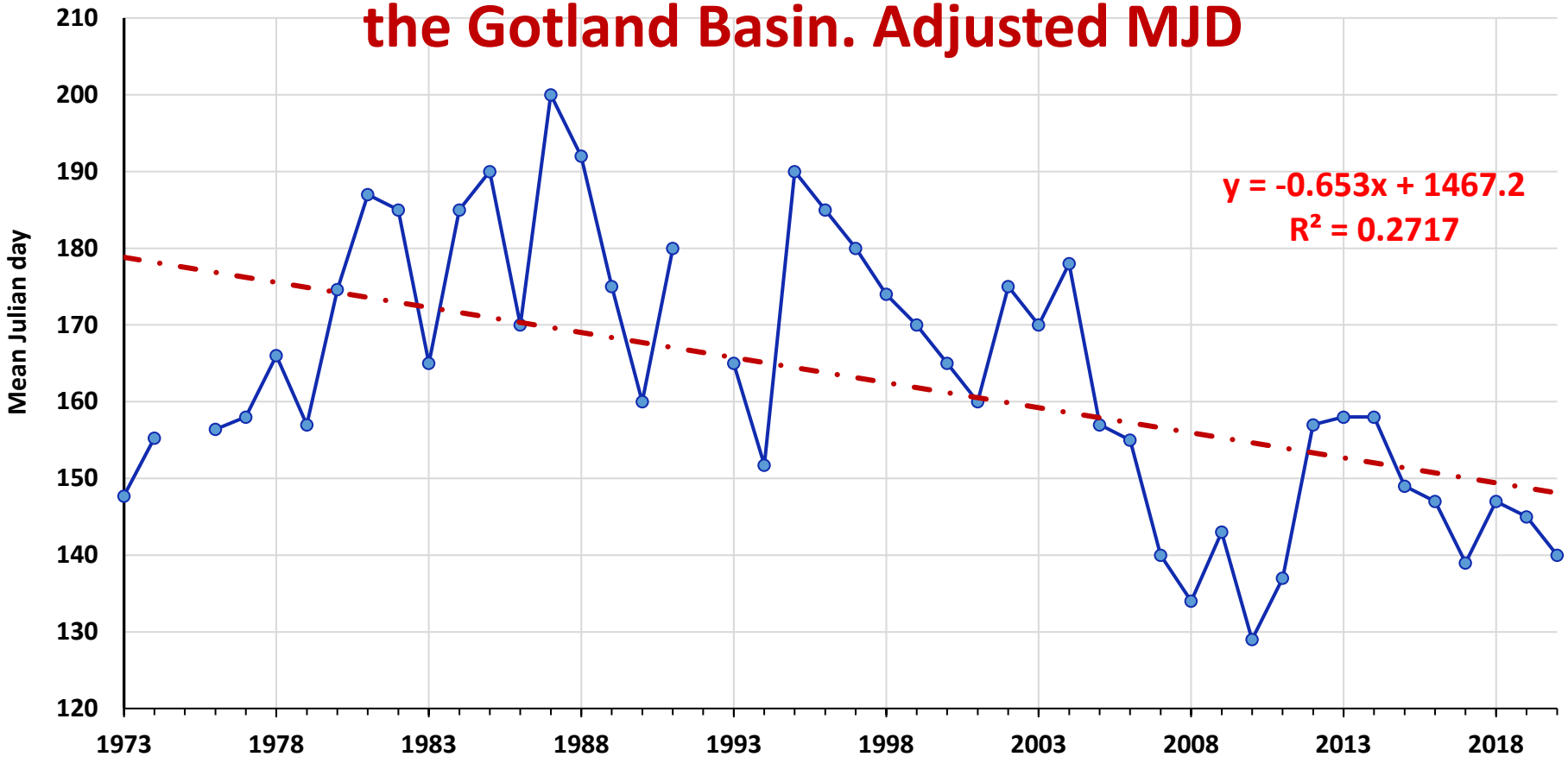

Central part of the Gotland Basin
Sprat eggs
Gaussian curve
n/m2
1000
800
600
400
200
0
50
100
150
200
250
Julian day, peak on 22 June


Southern part of the Gotland Basin
n/m2
1200
1000
800
600
400
200
0
Sprat eggs
Gaussian curve
50
100
150
200
250
Julian day, peak on 16 June

Peak of spawning of sprat in the southern part of the Gotland Basin. Adjusted MJD.



Peak of spawning of sprat in the central part of the Gotland Basin. Adjusted MJD



Methods

- **IKS-80 ichthyoplankton net (operated vertically, 500 µm mesh size).**
- **Ichthyoplankton surveys in the middle of June according to historical data. 36 stations on the constant grid.**
- **Relative batch fecundity: from Haslob *et al*., 2011.**
- **Spawning interval also from Haslob *et al*., 2011, in 2 versions: 4 and 4.5 days.**
- **Vertical distribution of eggs: from the empirical equation (data used for the years with good hydrographic situation, which occurred mainly in the late 1990-s).**

$$\sigma_t = 0.01254 * (t°_{10m})^2 - 0.40167 * t°_{10m} + 9.8436$$

- **Duration of stages: from Thompson *et al.*, 1981.**
- **Hydrology: from direct measurements.**
- **Individual weight: from hydroacustic surveys in May and from ICES report.**

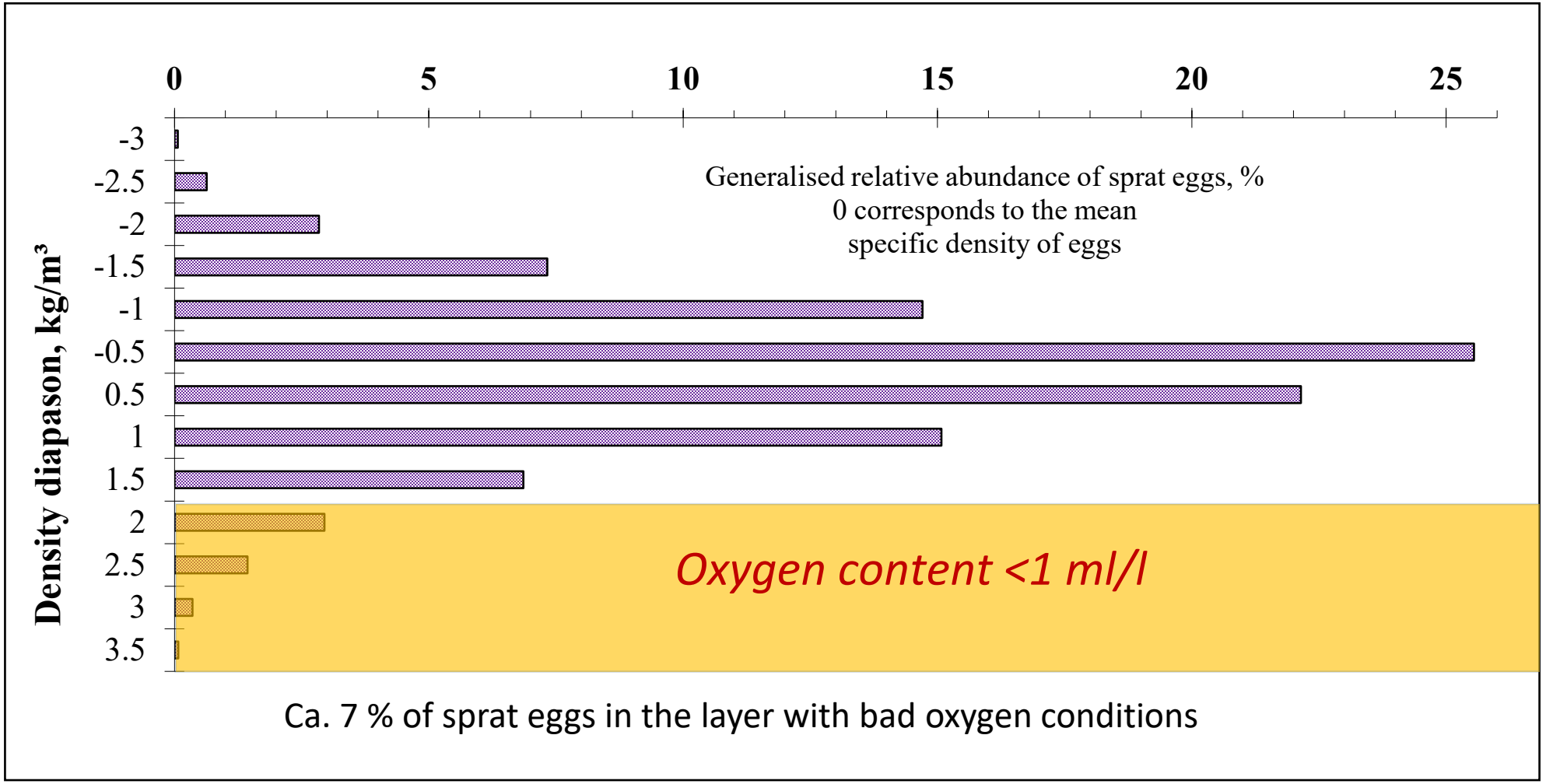
Ichthyoplankton surveys at the time of peak spawning:
2019: FV “Vergi”, 17 – 19 June.
2020: FV “Priedaine”, 15 – 17 June.
2021: FV “Albatross 1”, 16 – 18 June.

$N_+ = N_o * e^{z*t/2}$, $Z = 1/t_{1-2} * \ln(N_2/N_1)$.

1. Maps of the distribution of eggs/day on the 1st and 2nd stages of development using program “Surfer”.
2. Absolute numbers with the function ”Volume”.
3. Z calculated separately for different areas dependently on ambient water temperature.

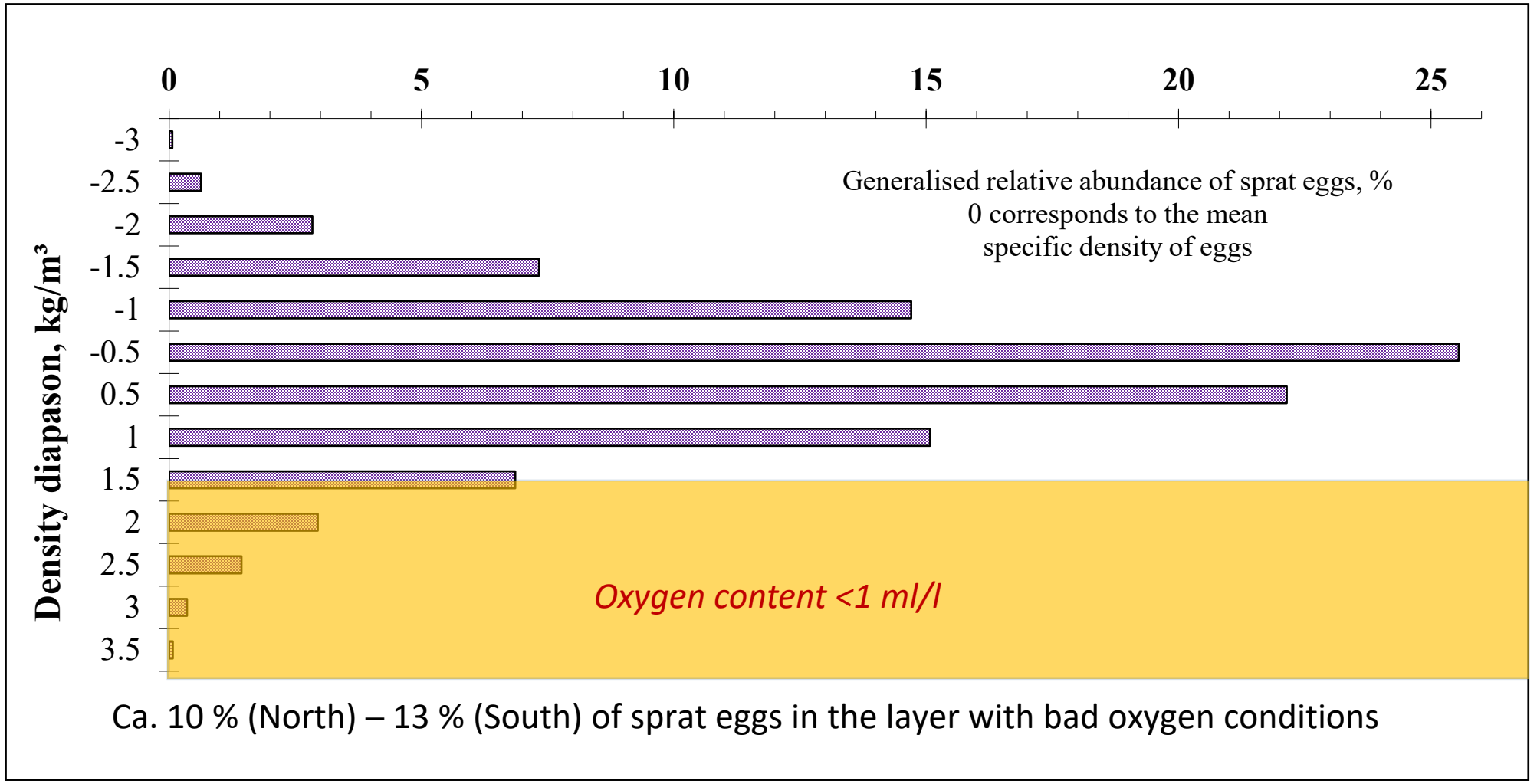
Number of eggs was raised for the layer with oxygen content < 1 ml/l.

17 – 19 June 2019



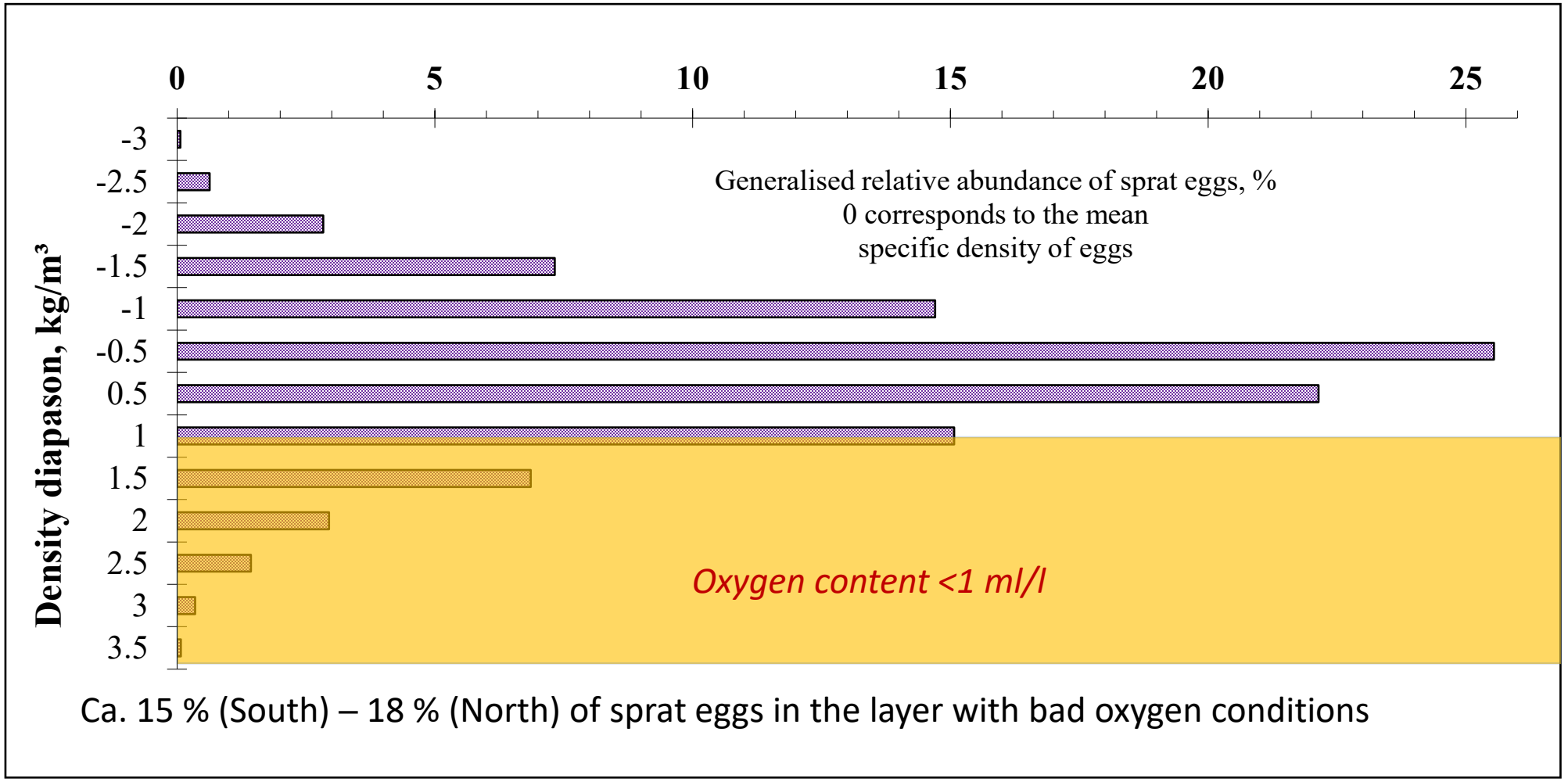
Ca. 7 % of sprat eggs in the layer with bad oxygen conditions

15 – 17 June 2020



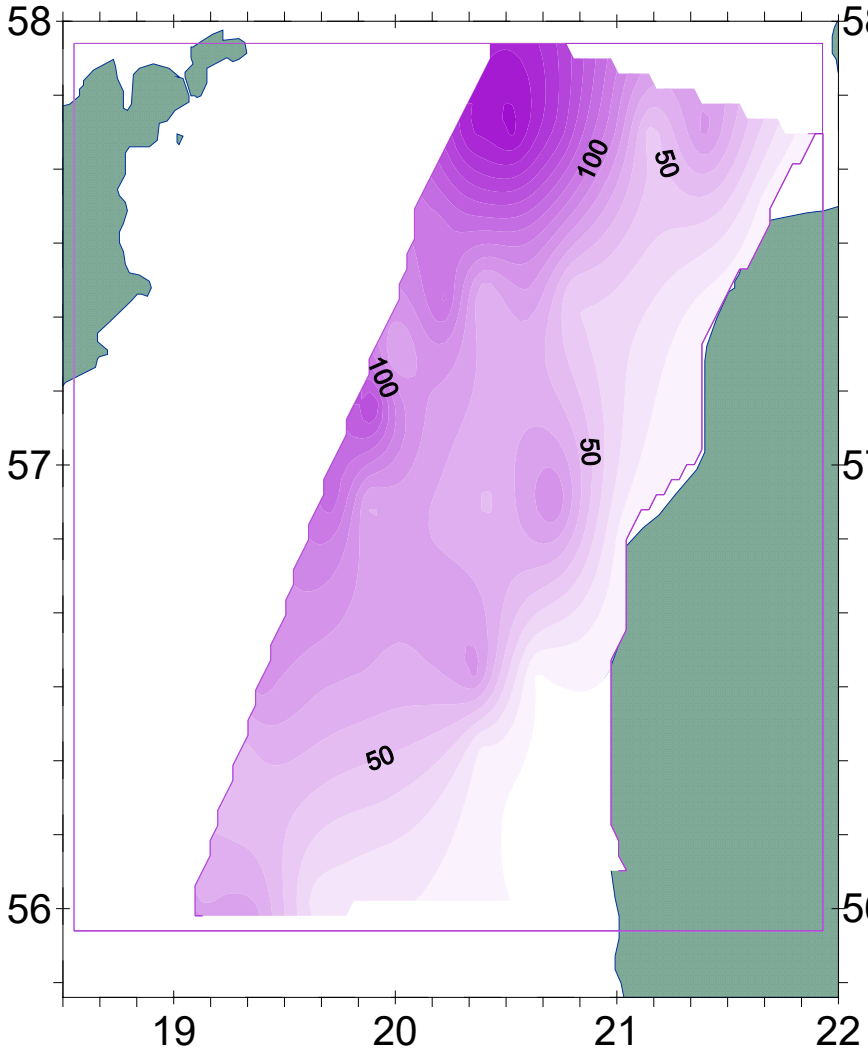
Ca. 10 % (North) – 13 % (South) of sprat eggs in the layer with bad oxygen conditions

16 – 18 June 2021

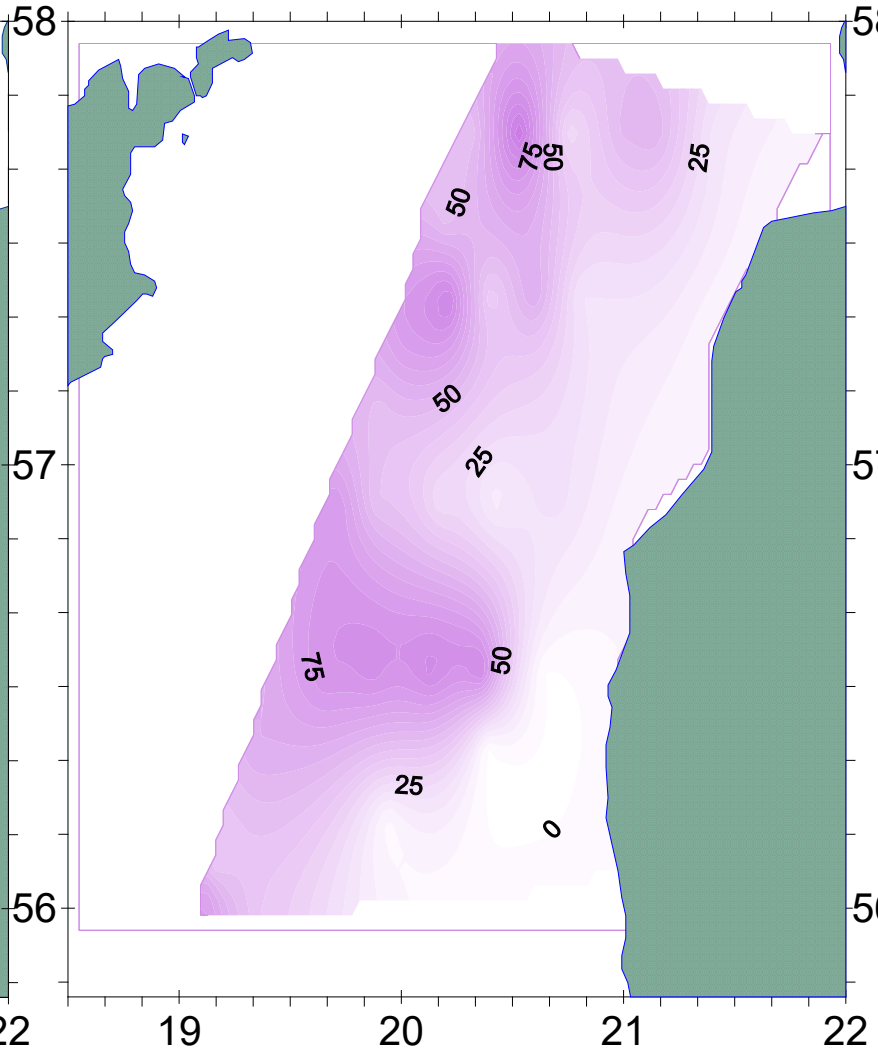


Ca. 15 % (South) – 18 % (North) of sprat eggs in the layer with bad oxygen conditions

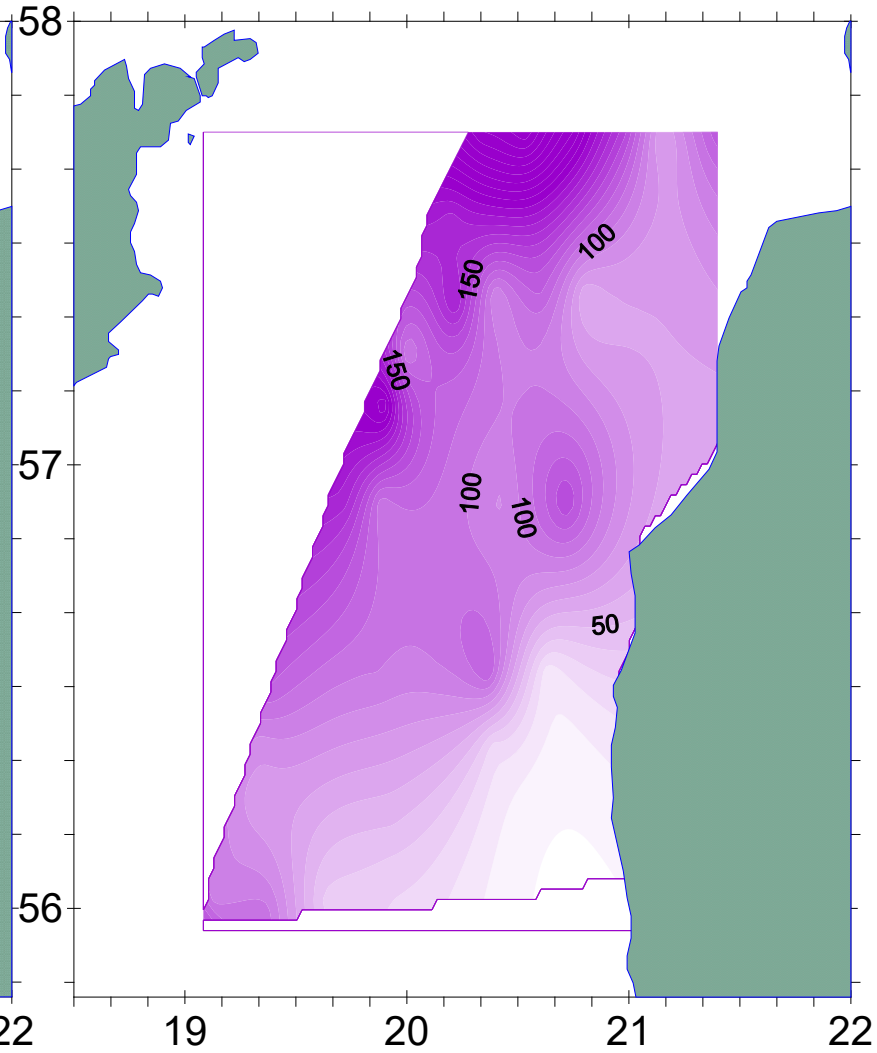
June 2019



Daily abundance of sprat eggs on the stage I. FV '"Vergi", 17 - 19 June 2019

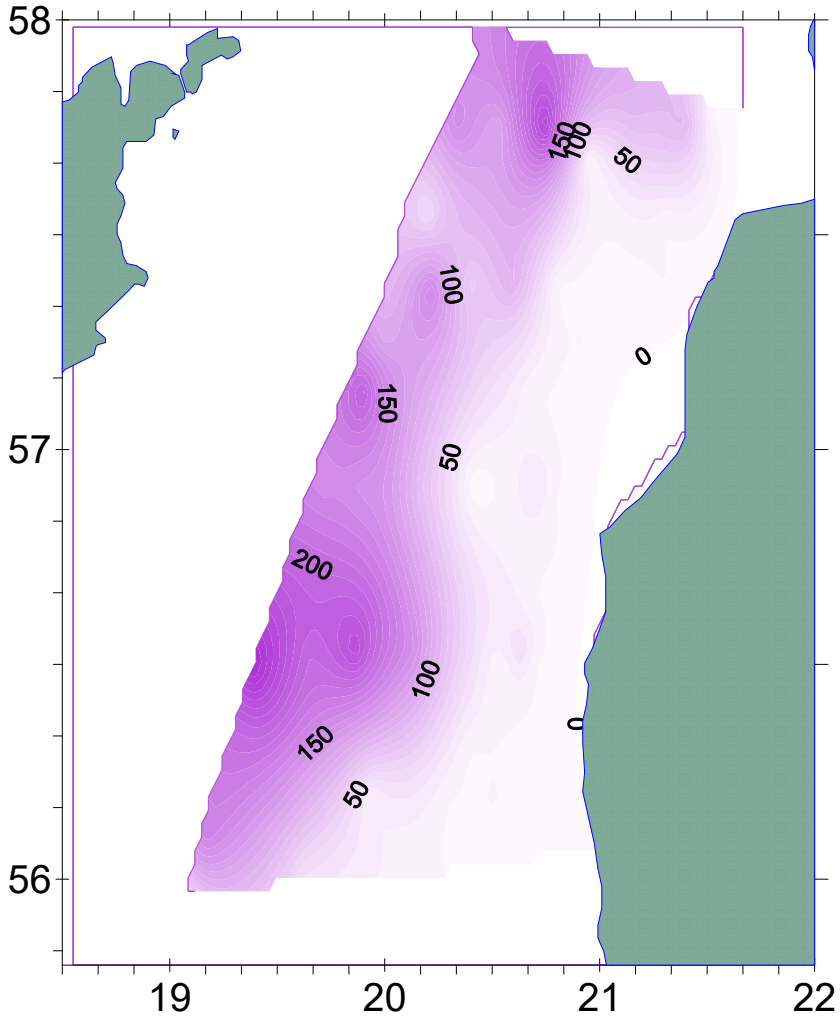


Daily abundance of sprat eggs on the stage II. FV '"Vergi", 17 - 19 June 2019

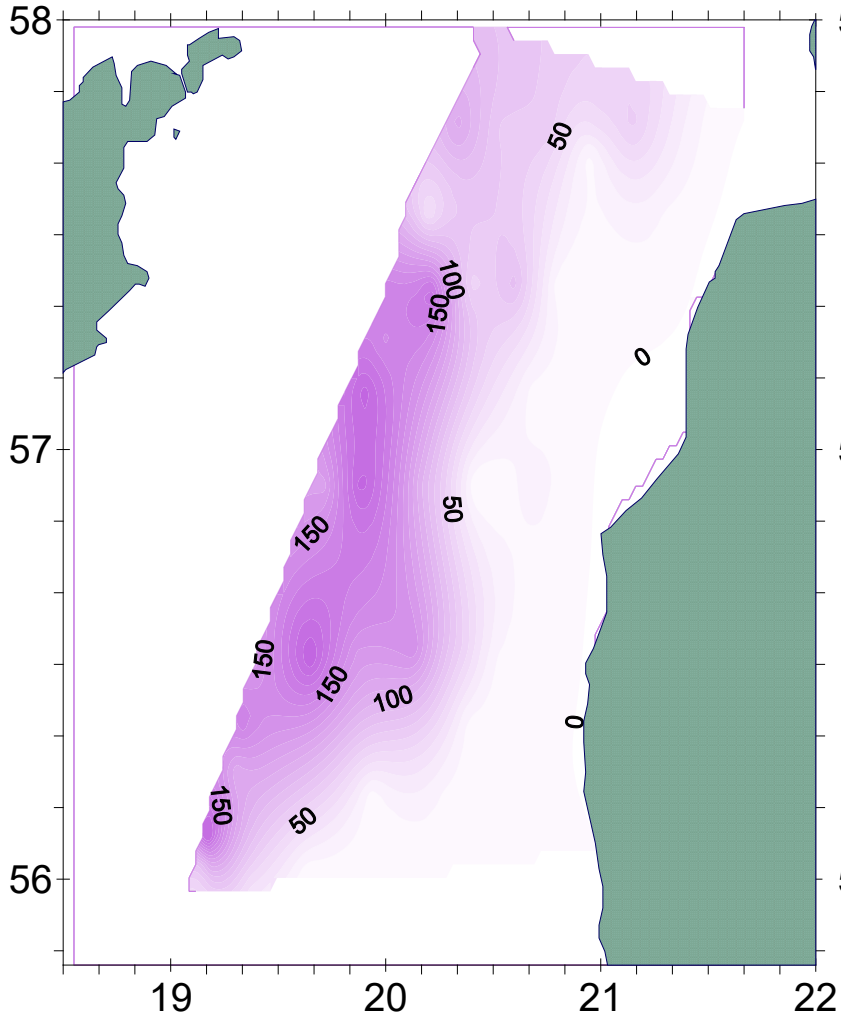


Daily production of sprat eggs stage I. FV '"Vergi", 17 - 19 June 2019. n/m2

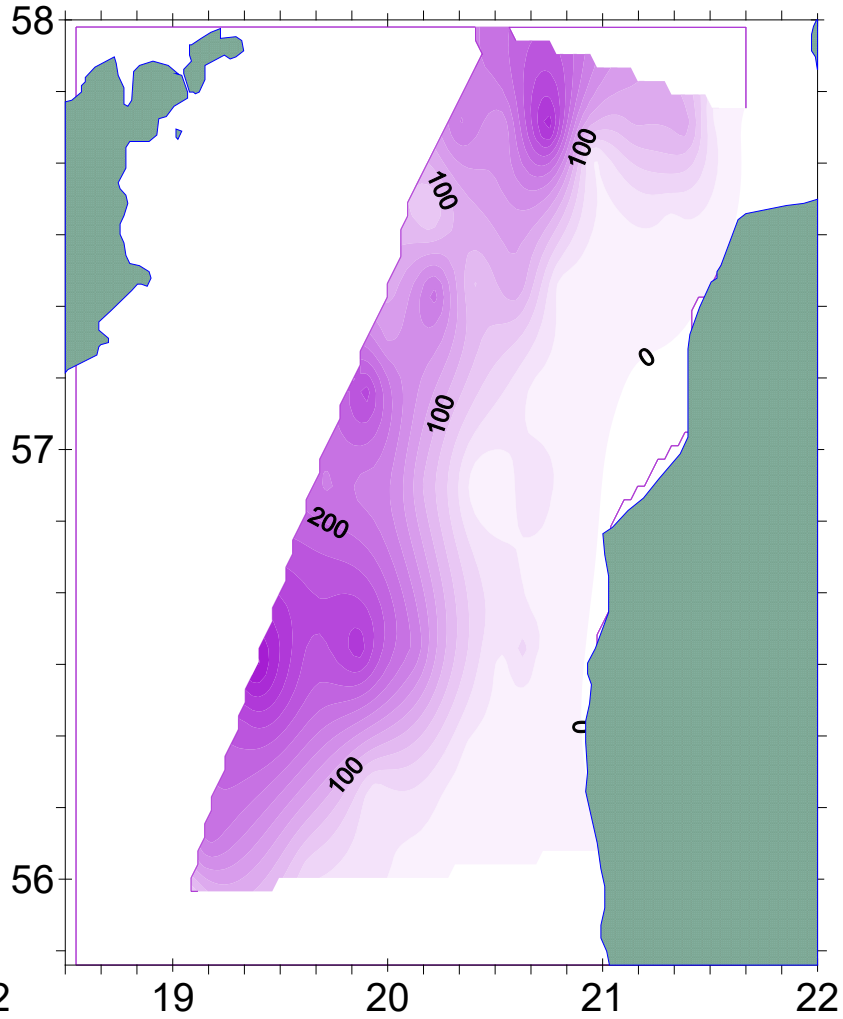
June 2020



Daily abundance of sprat eggs on the stage I. FV '"Priedaine", 15 - 17 June 2020. n/m2

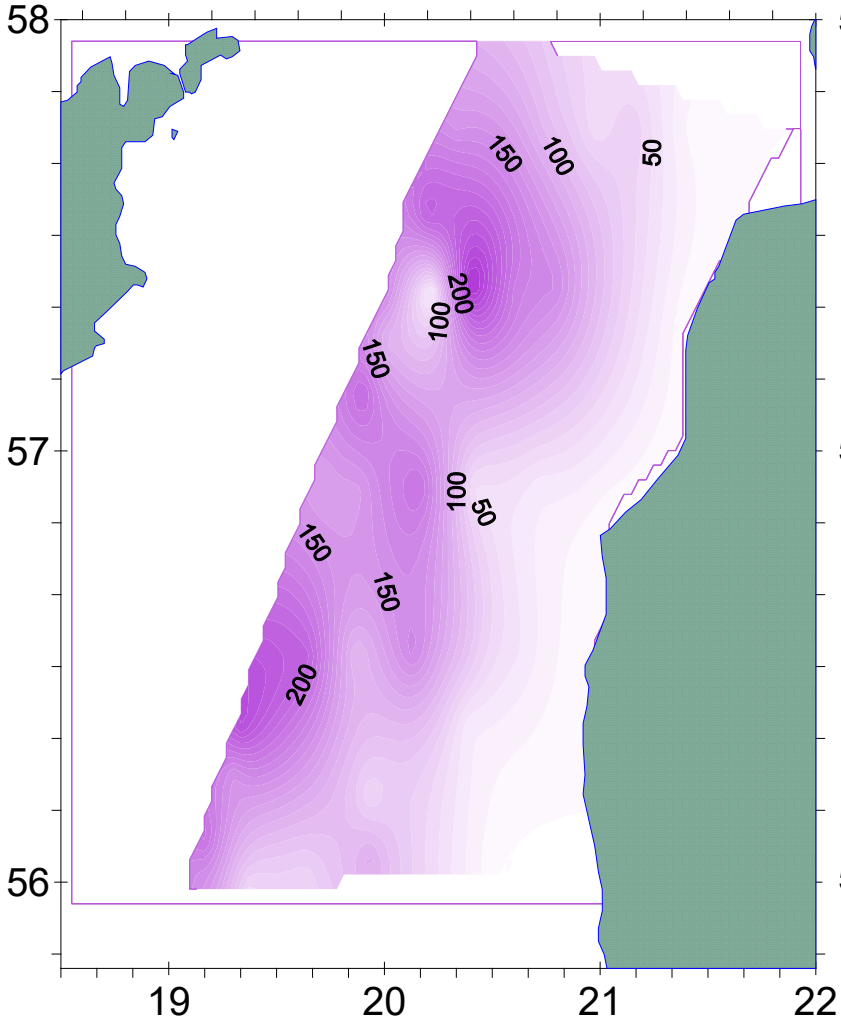


Daily abundance of sprat eggs on the stage II. FV '"Priedaine", 15 - 17 June 2020. n/m2

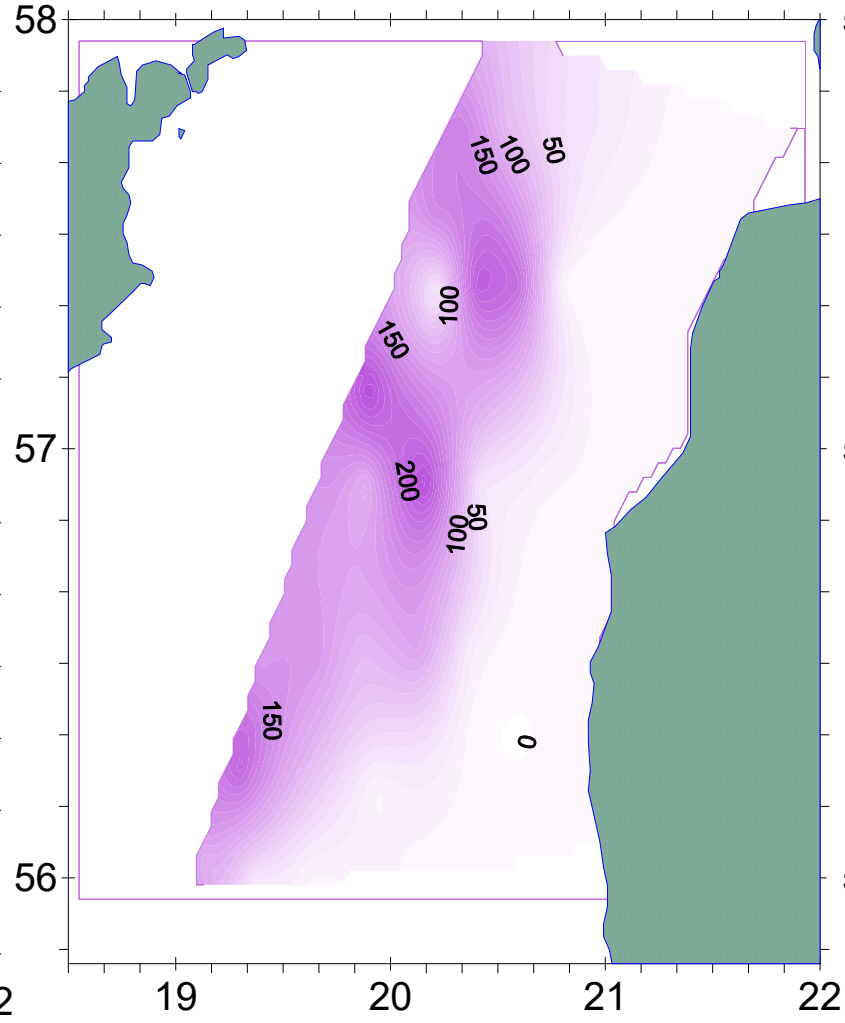


Daily production of sprat eggs stage I. FV '"Priedaine", 15 - 17 June 2020. n/m2

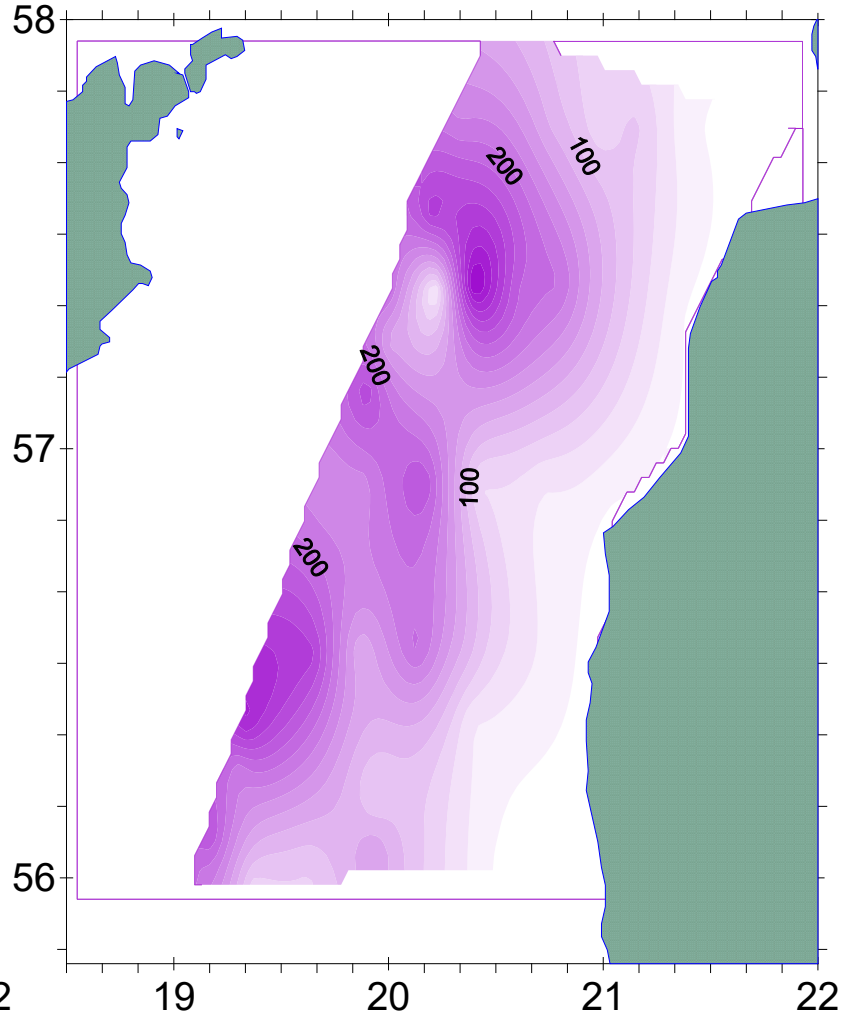
June 2021



Daily abundance of sprat eggs on the stage I.
FV "Albatross 1", 16 - 18 June 2021. n/m2



Daily abundance of sprat eggs on the stage II.
FV "Albatross 1", 16 - 18 June 2021. n/m2



Daily production of sprat eggs stage I.
FV "Albatross 1", 16 - 18 June 2020. n/m2

Instantaneous mortality coefficients Z were very low; it could be an indication that the end of peak spawning was already over.

		Ambient temperature	
Year	Instantaneous mortality coefficient Z	Range	Mean
2019	0.196	3.81 – 18.25	5.36
2020	0.124	5.30 – 13.49	7.95
2021	0.145	3.84 – 15.09	5.30

Year	Daily egg production, stage I, n*10^9	Mean weight of 2+, g	Relative batch fecundity	Interval between batches	Individual fecundity per 1 day	Number of spawning females, n*10^9
2019	1675	10.6	1272	4.5	283	5.919
				4	319	5.251
2020	1836	10.1	1413	4.5	314	5.847
				4	353	5.201
2021	2480	9.9	1139	4.5	253	9.802
				4	285	8.702

Year	Number of spawning females, n*10^9	Number of spawning fishes, n*10^9	SSB from DEPM, thousands tonns	SSB from hydroacoustic survey in May, RV “Baltica”	SSB from h/a survey in October, RV “Baltica”
2019	5.919	11.839	125	70	154
	5.251	10.503	111	70	154
2020	5.847	11.694	118	53	167
	5.201	10.402	105	53	167
2021	9.802	19.605	194	114	123
	8.702	17.404	172	114	123

Conclusions and problems

- **DEPM in the Gotland Basin works well, giving higher values than hydroacoustic surveys in May (but sometimes even less than in similar surveys in October).**
- **Not much accordance with the assessment from hydroacoustic surveys.**
- **Peak of spawning could have moved to the earlier time.**
- **Individual fecundity: potentially great source of mistake.**
- **Fertilization rate ?**
- **Mortality of eggs in the layer with the O_2 < 1 ml/l: must be close to reality.**
- **How to persuade other countries make these surveys everywhere? Bornholm Basin is covered well, but Gdansk Deep is not, and also the western part of the Gotland Basin.**

Thank you!