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Climate Change Impact on Freshwater Ecosystems in Latvia

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CLIMATE CHANGE

PHYSICAL CHANGES OF WATERS

CHEMICAL CHANGES OF WATERS

BIOLOGICAL CHANGES

Climate change impact to freshwaters physical features:

- increase in water temperature;
- decrease in number of ice days;
- changes in river water discharge;
- increase of extreme phenomena

etc.

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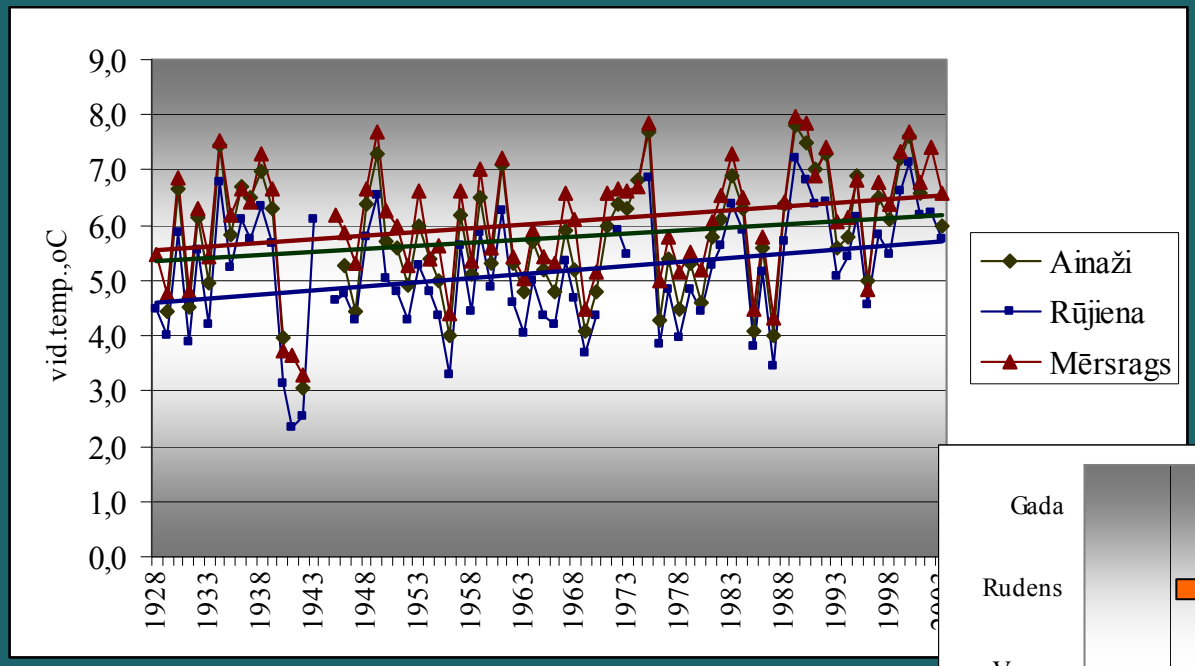
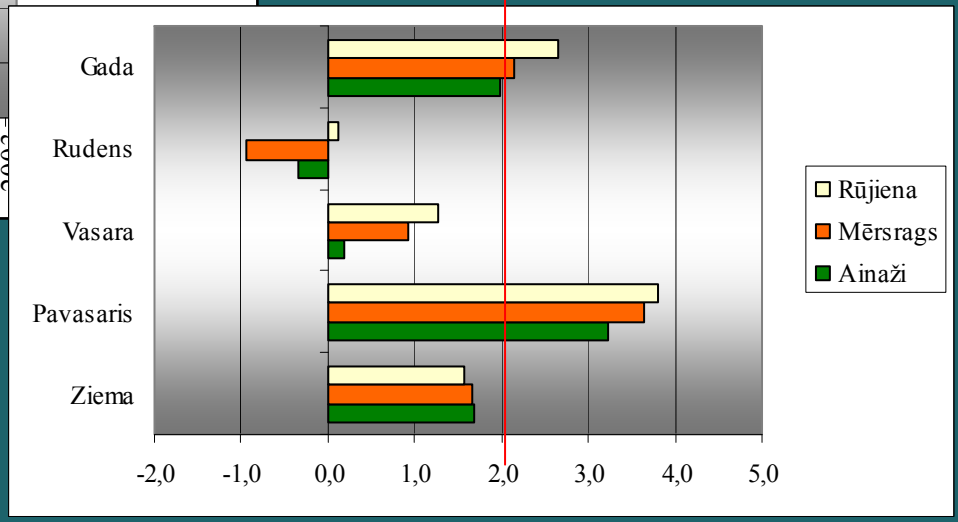
Character of annual mean air temperature (1928 – 2003) at meteorological stations near to long-term ecological research sites (River Salaca, Lake Engure)





Mann-Kendall test statistics for seasonal temperatures for time period 1928 - 2003

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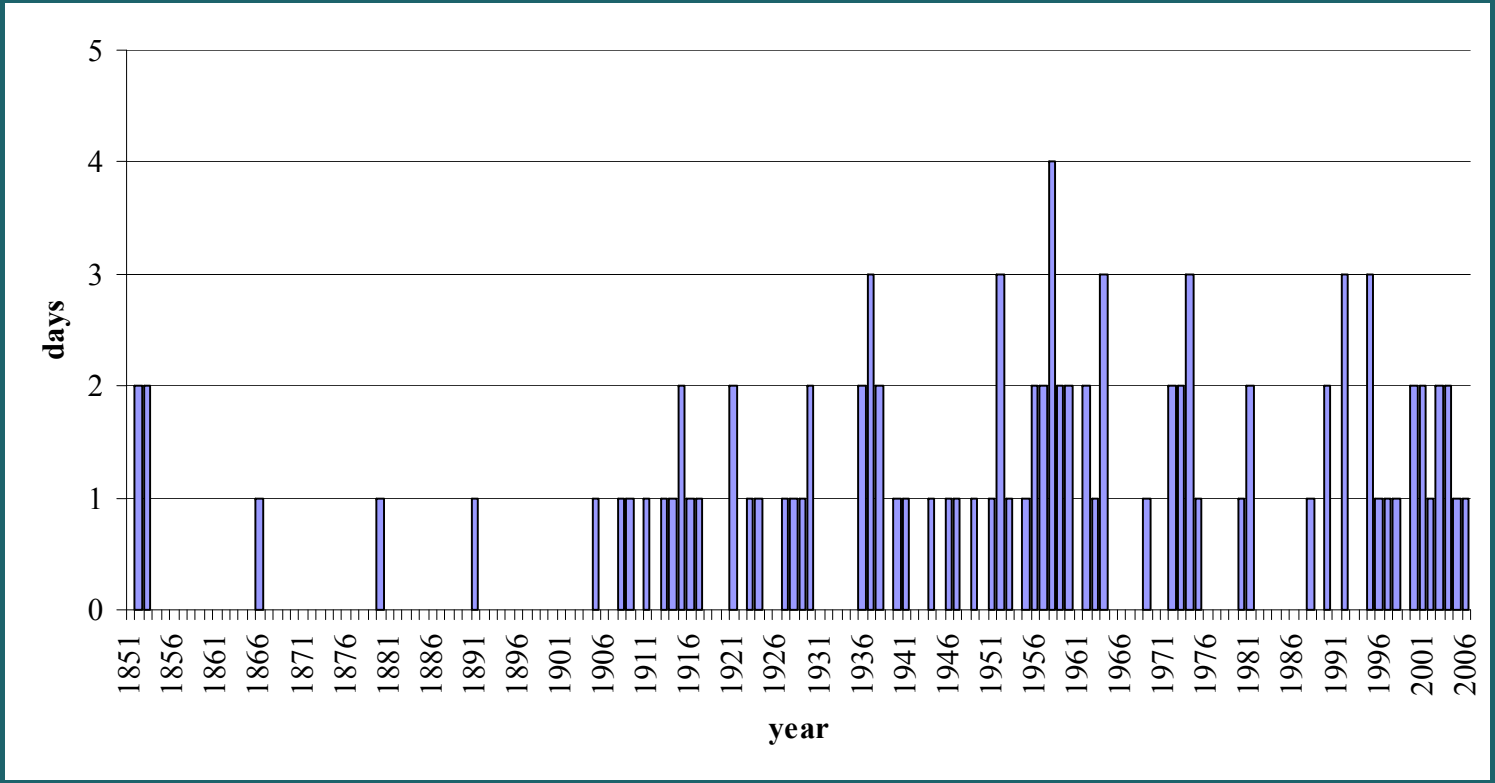
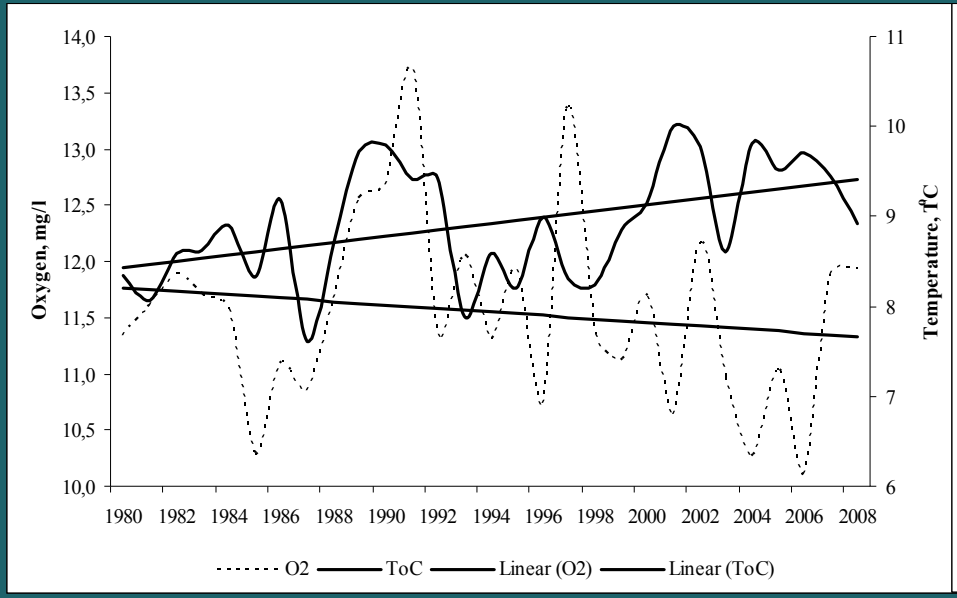
Number ox extremely wet days (Riga-University meteorological station)

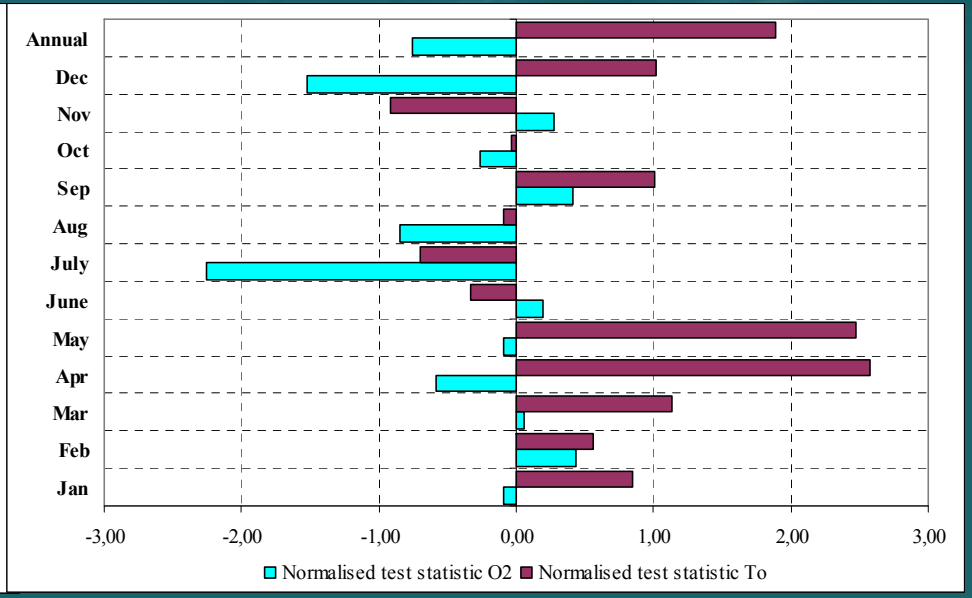


- **Chemical changes:**

  - decreased oxygen content (epecially – in summer low water period);
  - incresed conductivity;
  - increased water colour

etc.





Changes of dissolved oxygen and water temperature (annual mean 1980 – 2008) of the River Salaca

Long term trends of dissolved oxygen and temperature to Mann-Kendall normalized test statistic (1980-2008)

Long-term (1996-2005) changes of water chemical composition after Mann-Kendall test (N- number of observations; coloured p<0.05; italic – p<0.1)

Monitoring station	Color	COD* (TOC)	pH	$N\text{-}NO_3^-$	$P\text{-}PO_4^{3-}$	HCO_3^-	SO_4^{2-}	Mg^{2+}	Na^+
Salaca	2.90 N = 109	2.56 N = 81	*-1.94* N = 109	-0.83 N = 109	-0.51 N = 107	-0.54 N = 83	-2.61 N = 83	-1.36 N = 83	-0.38 N = 85
Gauja	1.97 N = 111	-0.06 N = 82	-1.09 N = 111	-1.20 N = 111	-0.30 N = 111	-0.39 N = 92	-3.02 N = 92	-2.19 N = 92	0.67 N = 92
Daugava	2.41 N = 74	0.87 N = 50	-0.58 N = 74	0.11 N = 74	0.26 N = 74	2.06 N = 63	-1.99 N = 63	0.54 N = 63	1.50 N = 63
Aiviekste	2.42 N = 71	*1.88* N = 47	-0.80 N = 71	0.55 N = 71	-1.63 N = 71	1.14 N = 45	-1.42 N = 45	-1.09 N = 45	-1.28 N = 45
Dubna	1.53 N = 71	2.28 N = 47	*-1.94* N = 71	-1.29 N = 71	-0.23 N = 71	1.27 N = 45	*-1.72* N = 45	*-1.71* N = 45	-0.90 N = 45
Lielā Jugla	2.69 N = 94	1.28 N = 94	-2.36 N = 94	-1.33 N = 94	-1.34 N = 94	0.07 N = 94	-2.76 N = 94	-2.00 N = 94	-1.50 N = 94
Lielupe	2.65 N = 111	1.51 N = 81	-0.73 N = 111	-0.39 N = 110	-1.48 N = 111	-0.13 N = 87	*-1.83* N = 86	-2.20 N = 87	-1.59 N = 87
Iecava	1.61 N = 77	2.19 N = 49	-1.51 N = 77	-0.04 N = 77	1.17 N = 76	-1.24 N = 26	-1.61 N = 18	*-1.64* N = 26	-0.47 N = 26
Venta	2.29 N = 85	1.51 N = 56	-1.42 N = 84	-2.01 N = 85	-1.26 N = 85	1.41 N = 78	-2.98 N = 78	-0.37 N = 78	1.14 N = 78
Irbe	2.56 N = 93	*1.93* N = 64	*-1.74* N = 92	-2.07 N = 93	-0.46 N = 93	1.26 N = 84	-3.12 N = 84	0.03 N = 84	0.40 N = 84
Tebra	-0.12 N = 72	1.34 N = 45	-2.44 N = 67	-0.93 N = 70	-1.64 N = 72	*-1.73* N = 18	0.26 N = 18	*-1.85* N = 18	-0.52 N = 18

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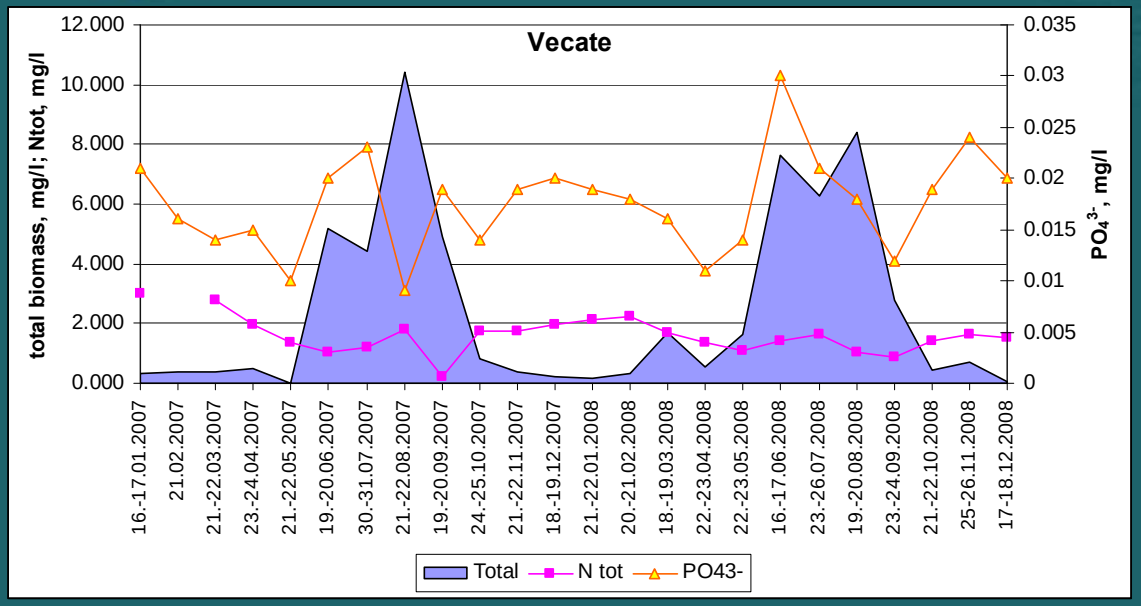
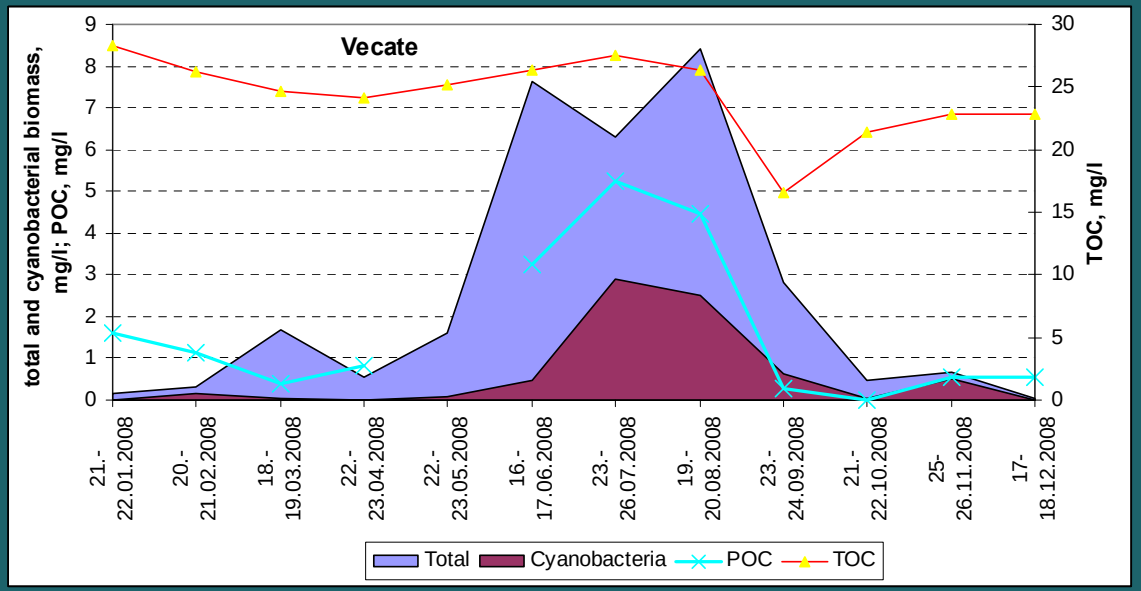


Changes of total algal biomass and nutrient N_{tot} and P-PO_4^{3-} concentrations at sampling site Vecate (River Salaca outflow) in 2007-2008



Changes of total and cyanobacterial biomasses, particulate organic carbon (POC) and total organic carbon (TOC) at the sampling site Vecate (River Salaca outflow) in 2008

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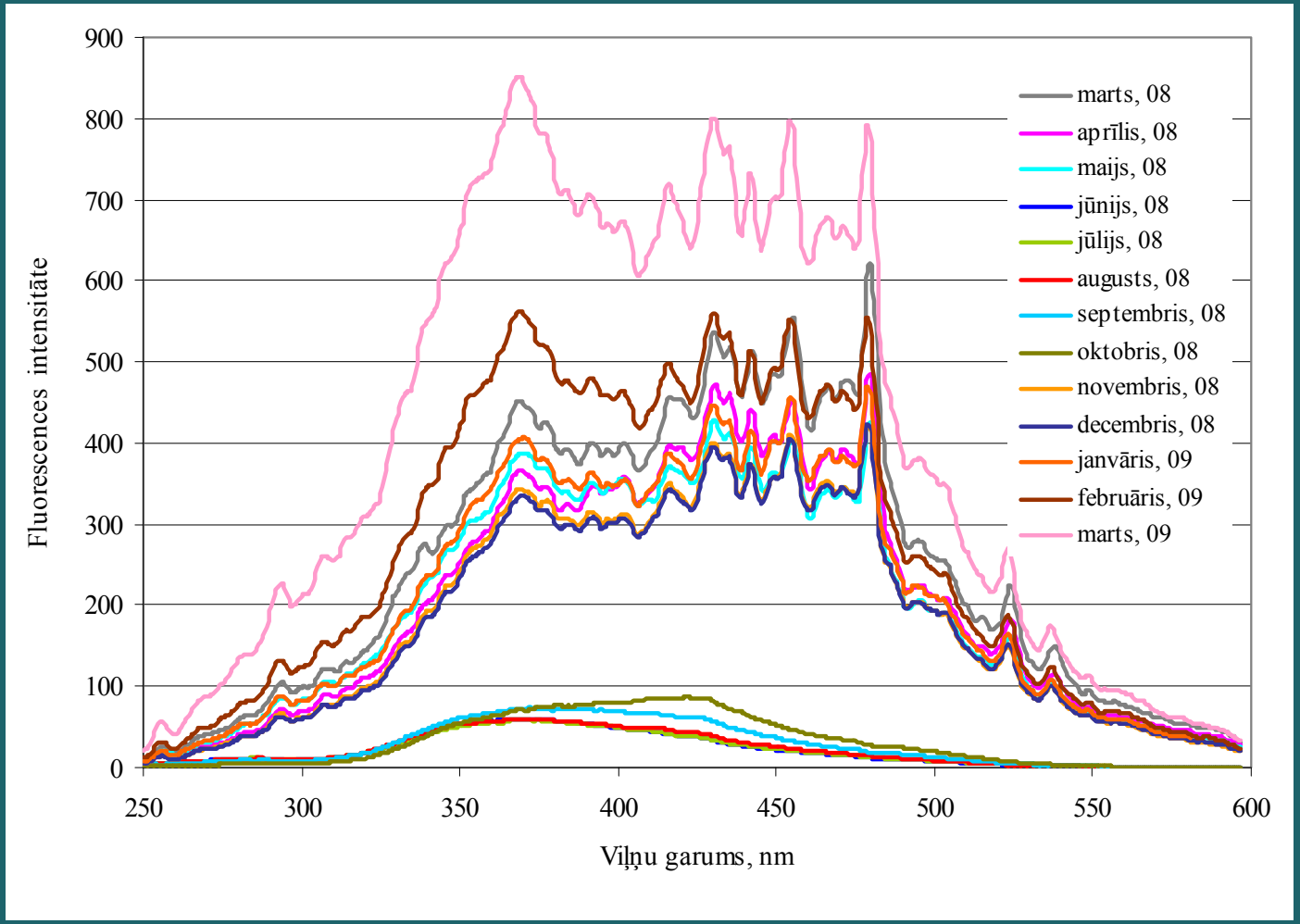
Synchronous fluorescence spectra of water sample from River Salaca at sampling station Vecsalaca



Structural and functional changes of water biota

- Changes of algae species composition;
- Changes of development aquatic vegetation;
- Changes of fish species structure

etc.

Att. no: www.mfe.govt.nz

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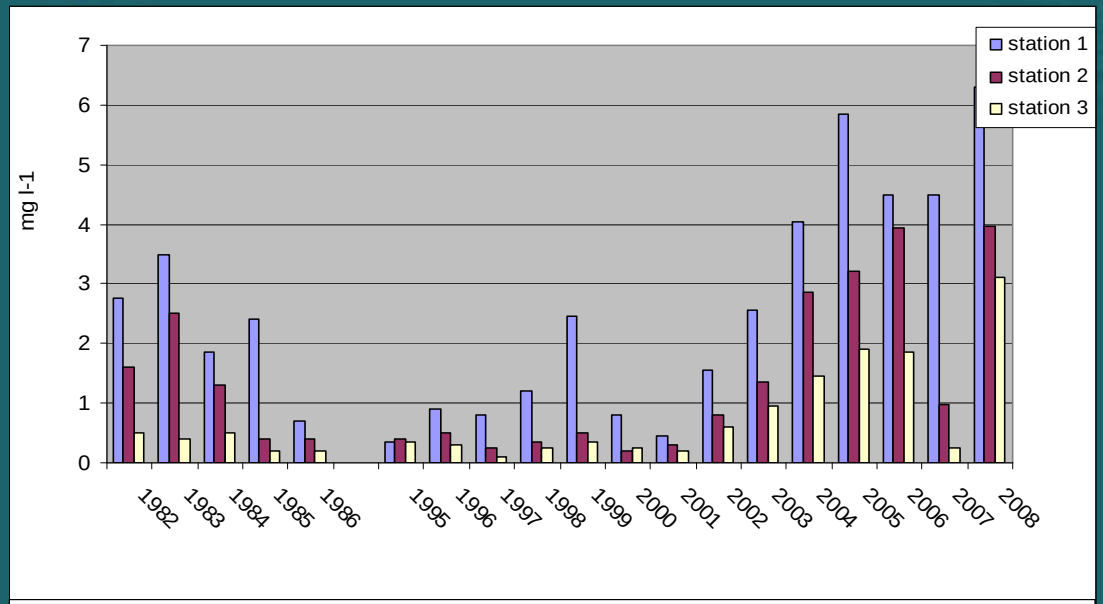
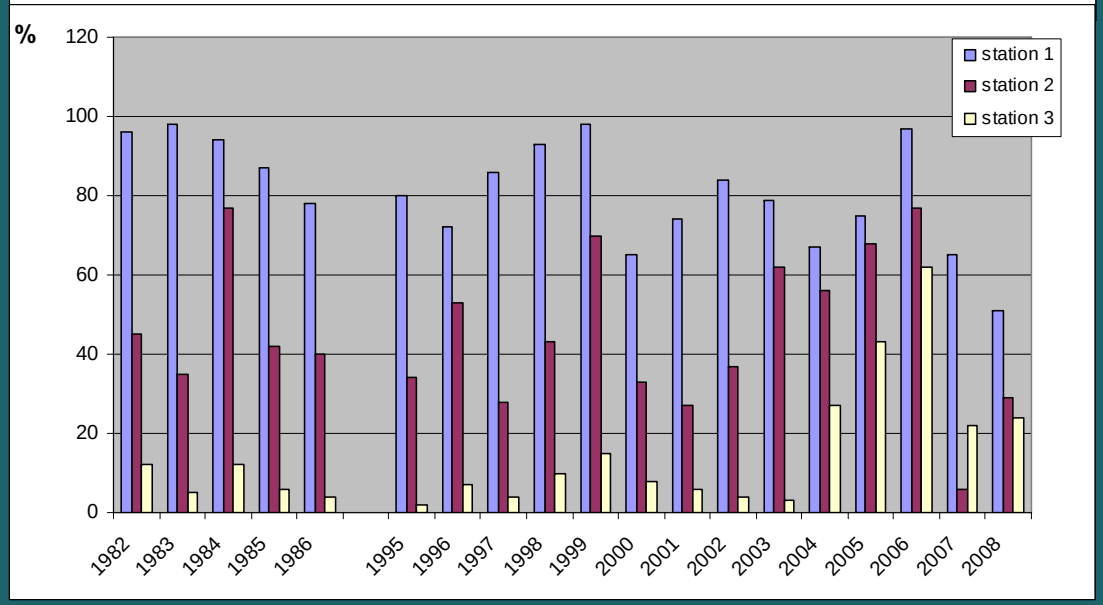


Changes of phytoplankton total biomass (mg/l) in River Salaca (1982 – 2008)



Changes of ratio of blue-greens in total phytoplankton biomass in River Salaca (1982 – 2008)

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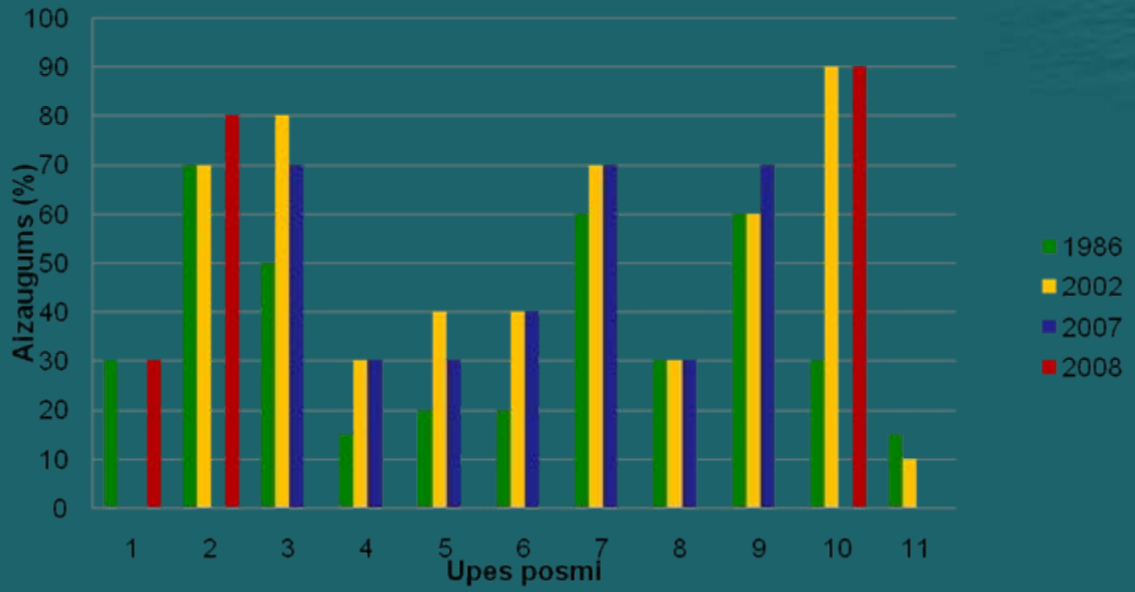
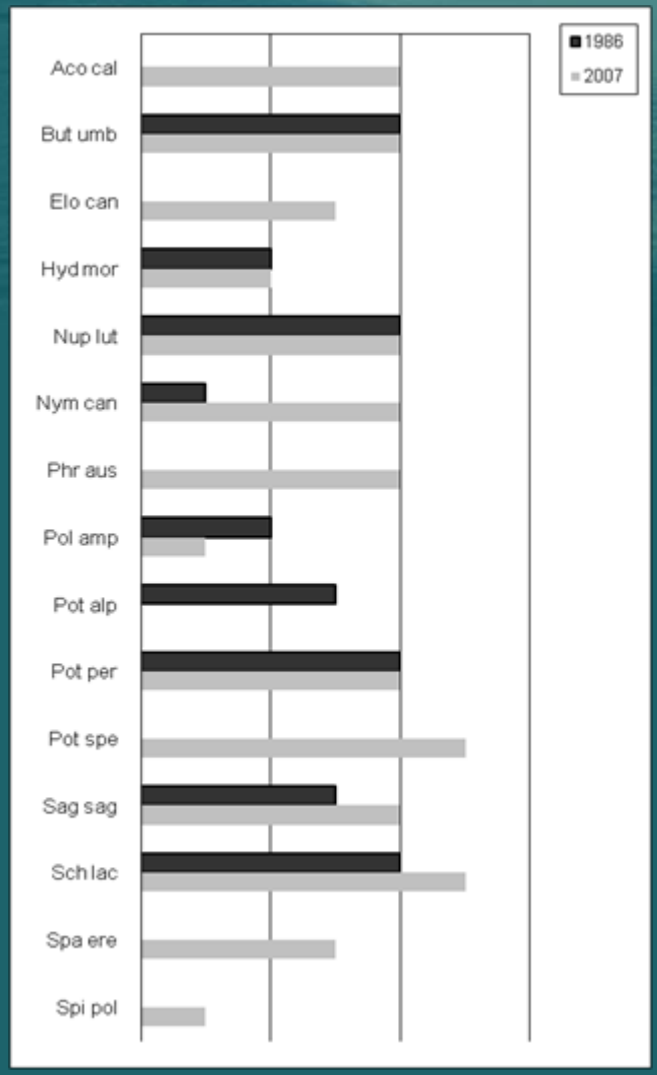


Overgrowth (%) changes of aquatic vegetation in River Salaca



Changes of species composition in River Salaca stretch "Inflow of Pužupes – Red cliffs"

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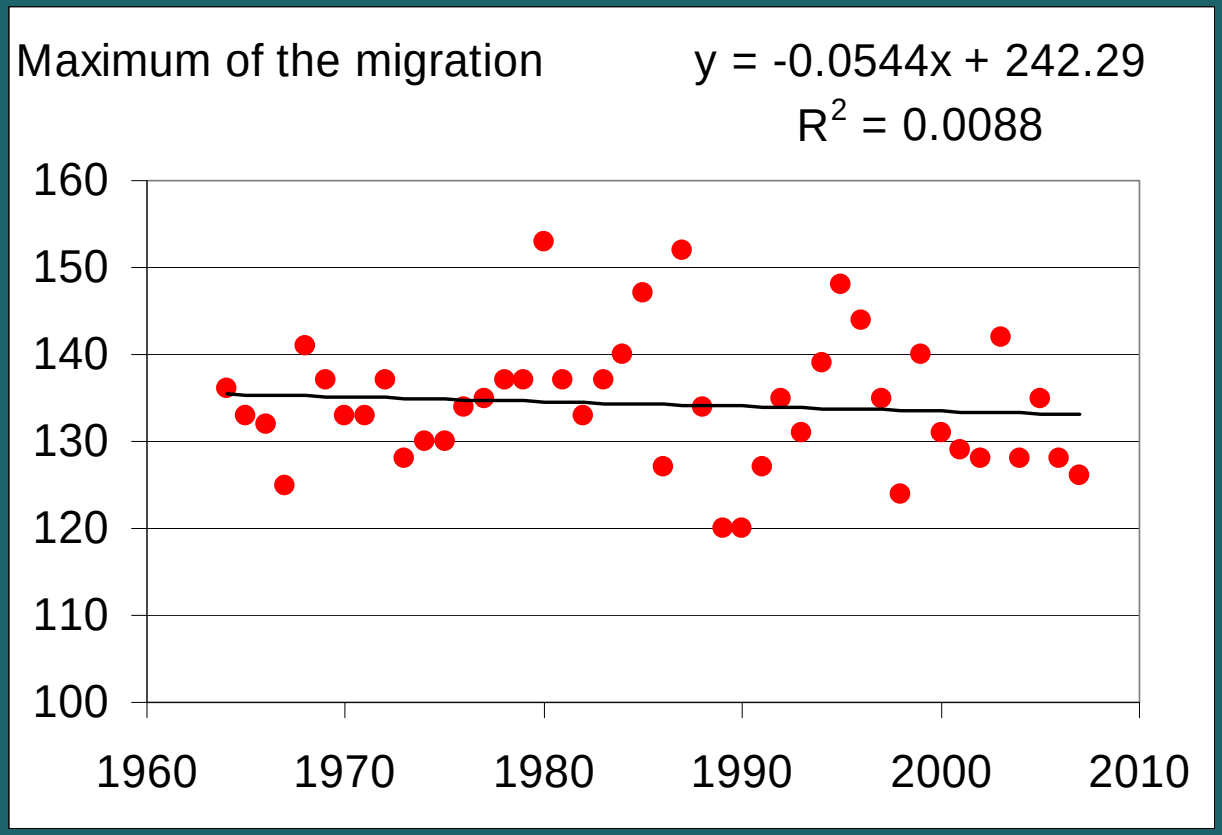
- Changes of salmon smolts migration period: migration ends ~ 1 weak earlier than 20 years

- Changes of maximum migration of salmon smolts



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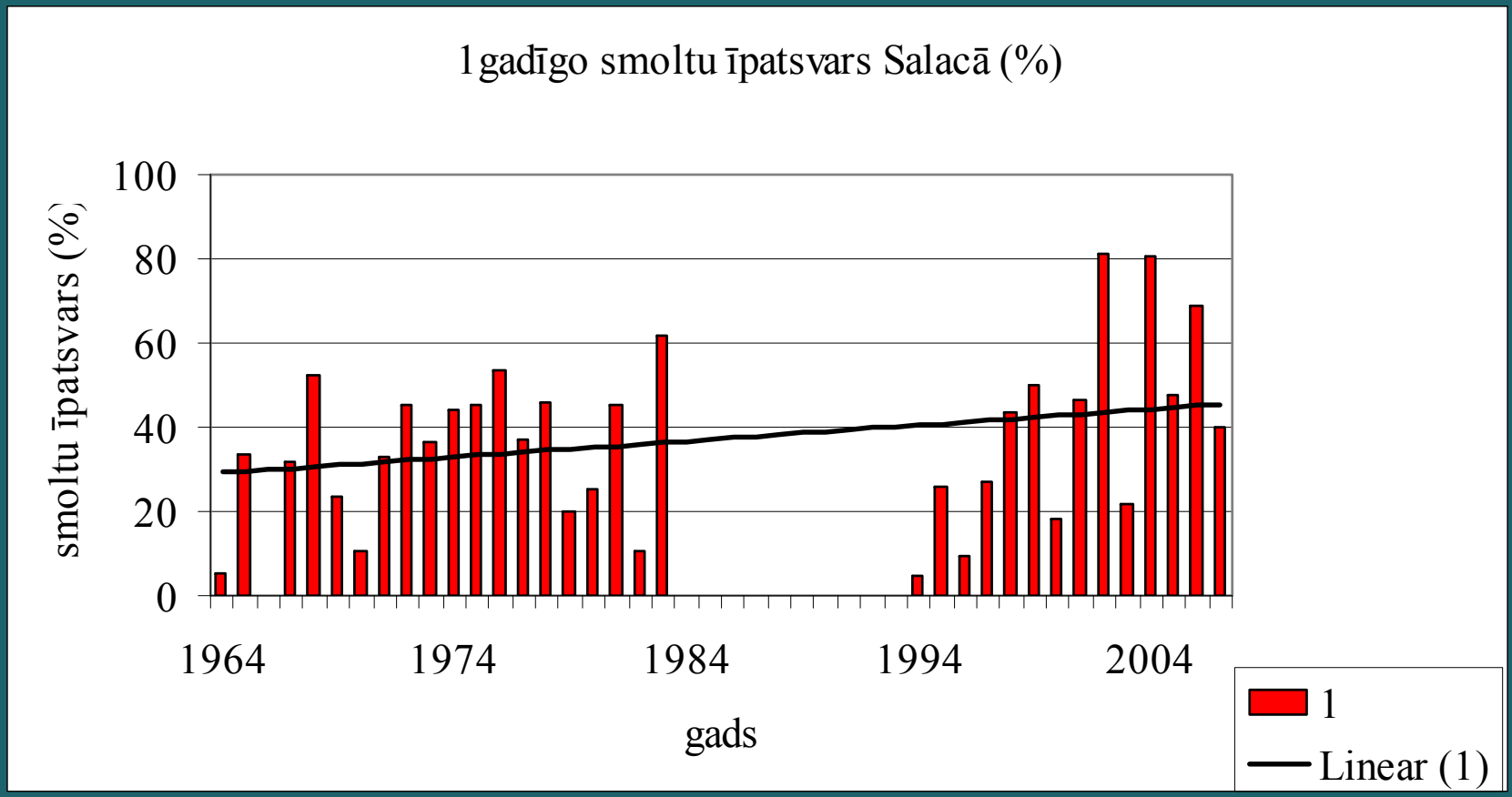
Increase of ratio of 1-year salmon smolts in migration process



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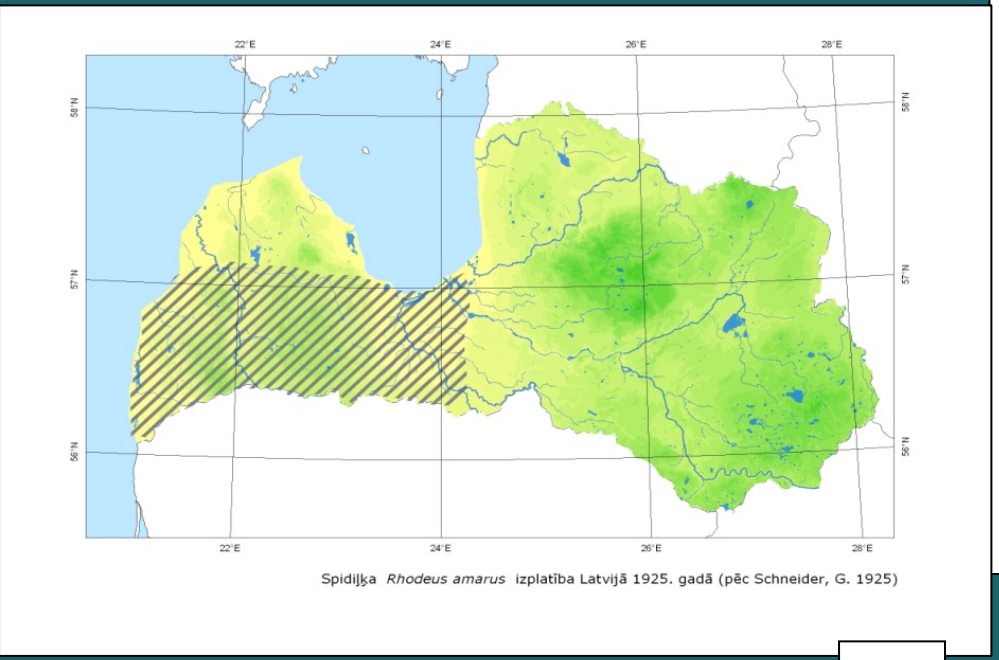
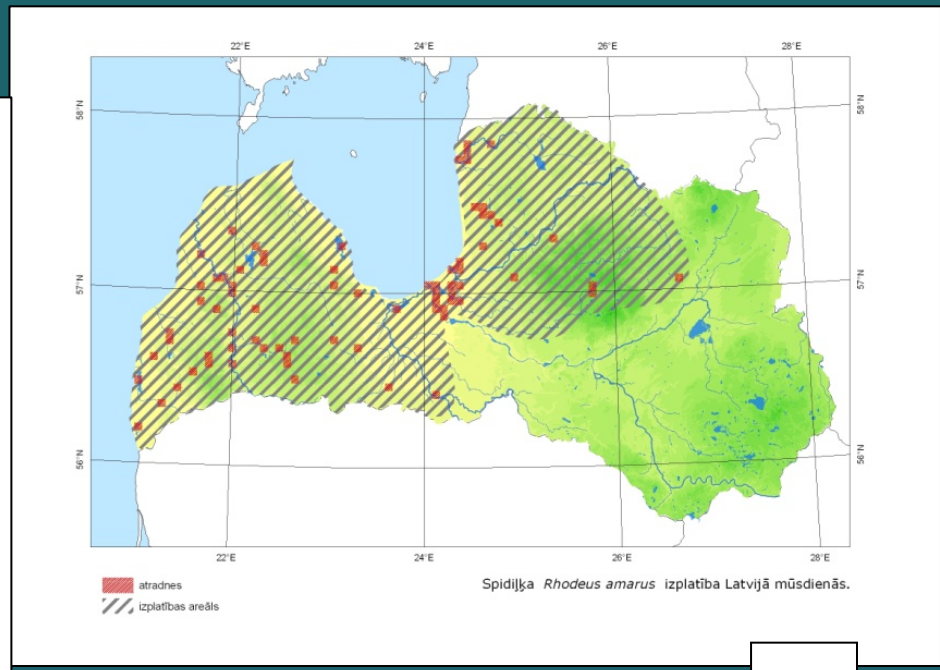
Biogeographical changes

Distribution of bitterling *Rhodeus sericeus* in Latvia in 1925 (A) and now (B)



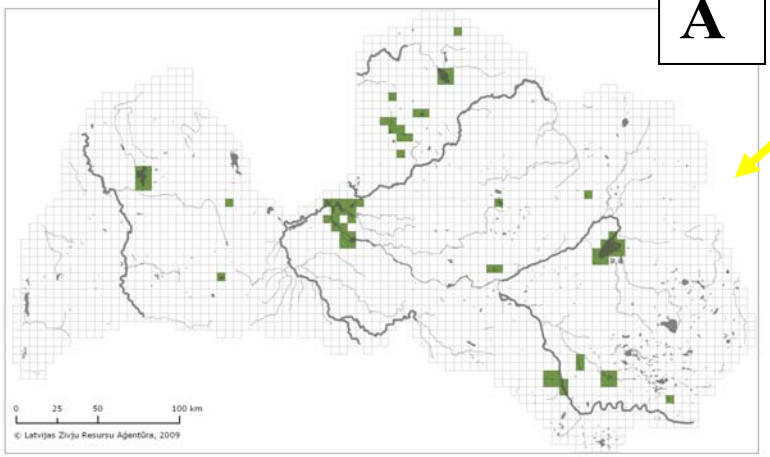
Spidiļķa *Rhodeus amarus* izplatība Latvijā 1925. gadā (pēc Schneider, G. 1925)

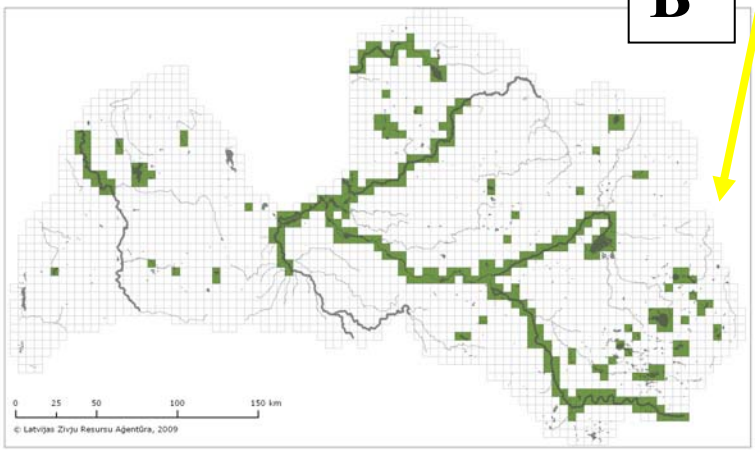
A



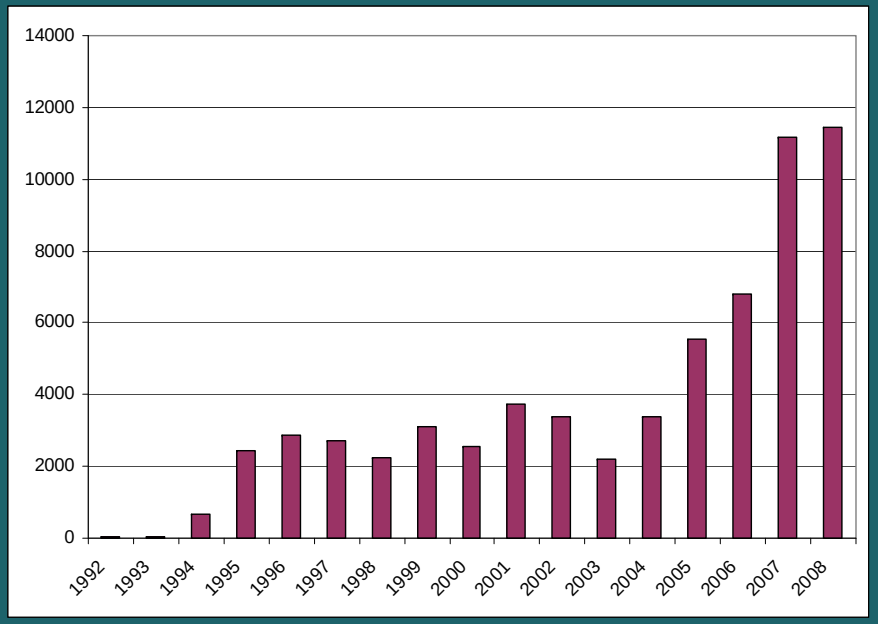
Spidiļķa *Rhodeus amarus* izplatība Latvijā mūsdienās.

B





Distribution of pike-pearch *Stizostedion lucioperca* in Latvia in 50-ies of 20th (A) and now (B)



Catch of pike-pearch *Stizostedion lucioperca* (kg) in Lake Burtnieku since 1992 till 2008

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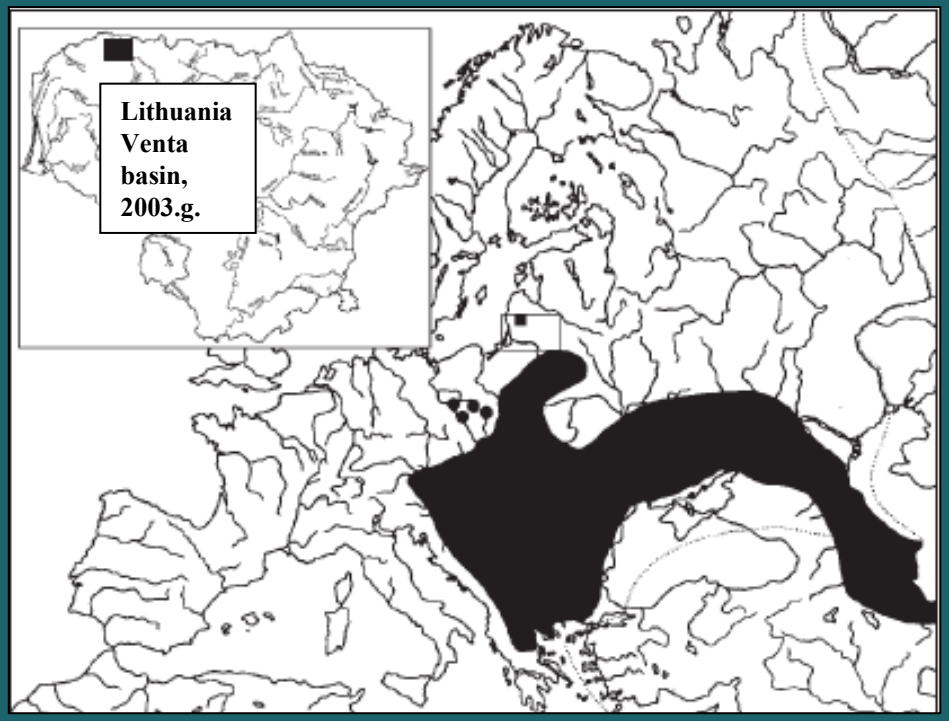
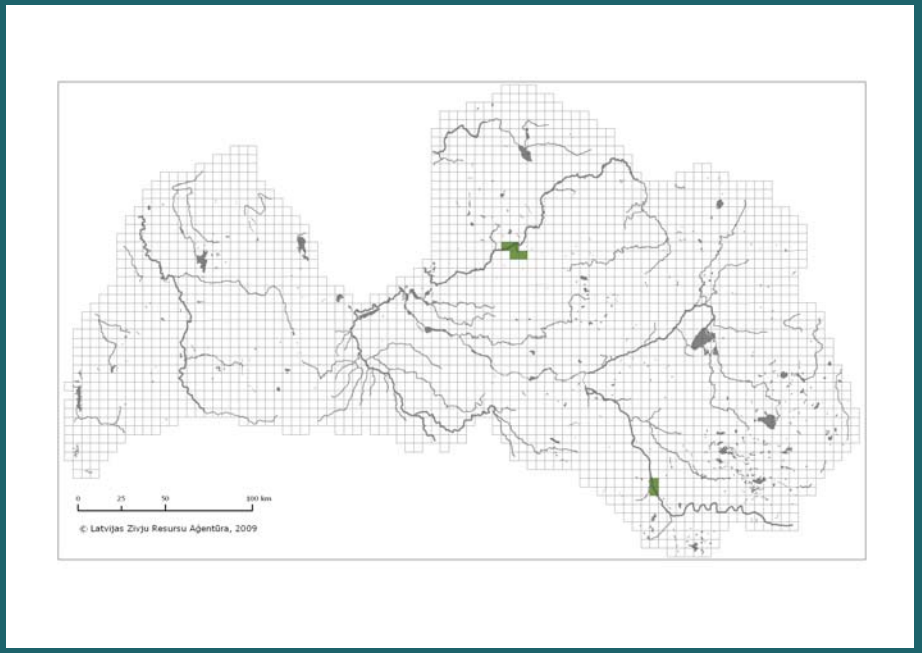
The range of the golden loach *Sabanejewia aurata* geographical distribution in Europe according to Bânârescu (1991), Lelek (1987), Witkowski (1994) and Steponenas (2003) and findspots in Latvia, 2008 - 2009





Arrival of new species in Latvia

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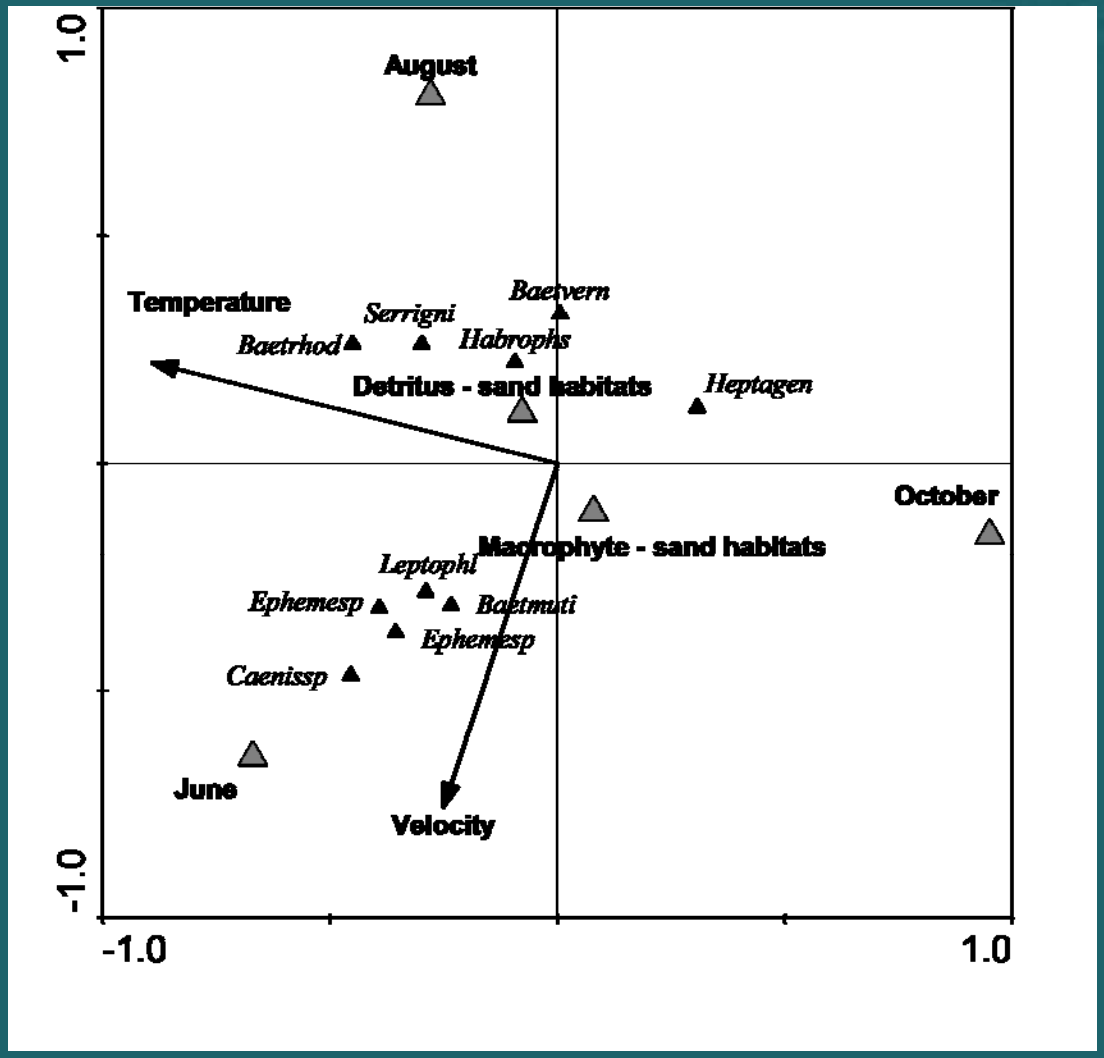
Investigations of benthic drift



Ordination analysis of Ephemeroptera species composition in drift samples in Strīķupe below "sand-macrophyte" and "sand-detritus" microbiotops in June, August and October of 2007.

Axis 1 explains 11,5%, Axis 2 9,4% of total data dispersion.

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Long term data sets coupled with mechanistic experiments provide good way of predicting future climate change effects on aquatic ecosystems (D. Conley)

Thanks:

1. **all team of WP 3!**
2. **all for attention!**