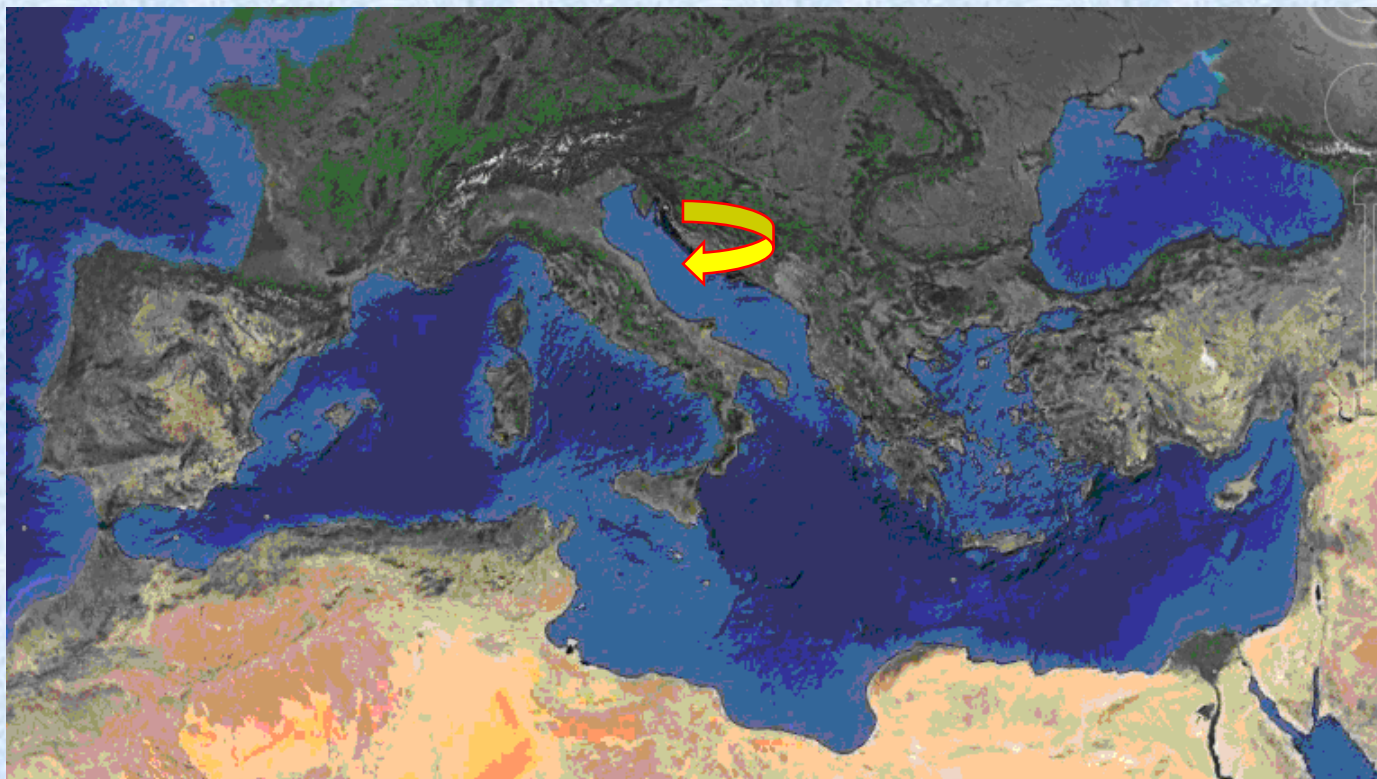




ENVIRONMENTAL STATUS OF THE CROATIAN PART OF THE COASTAL ADRIATIC SEA

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INTRODUCTION

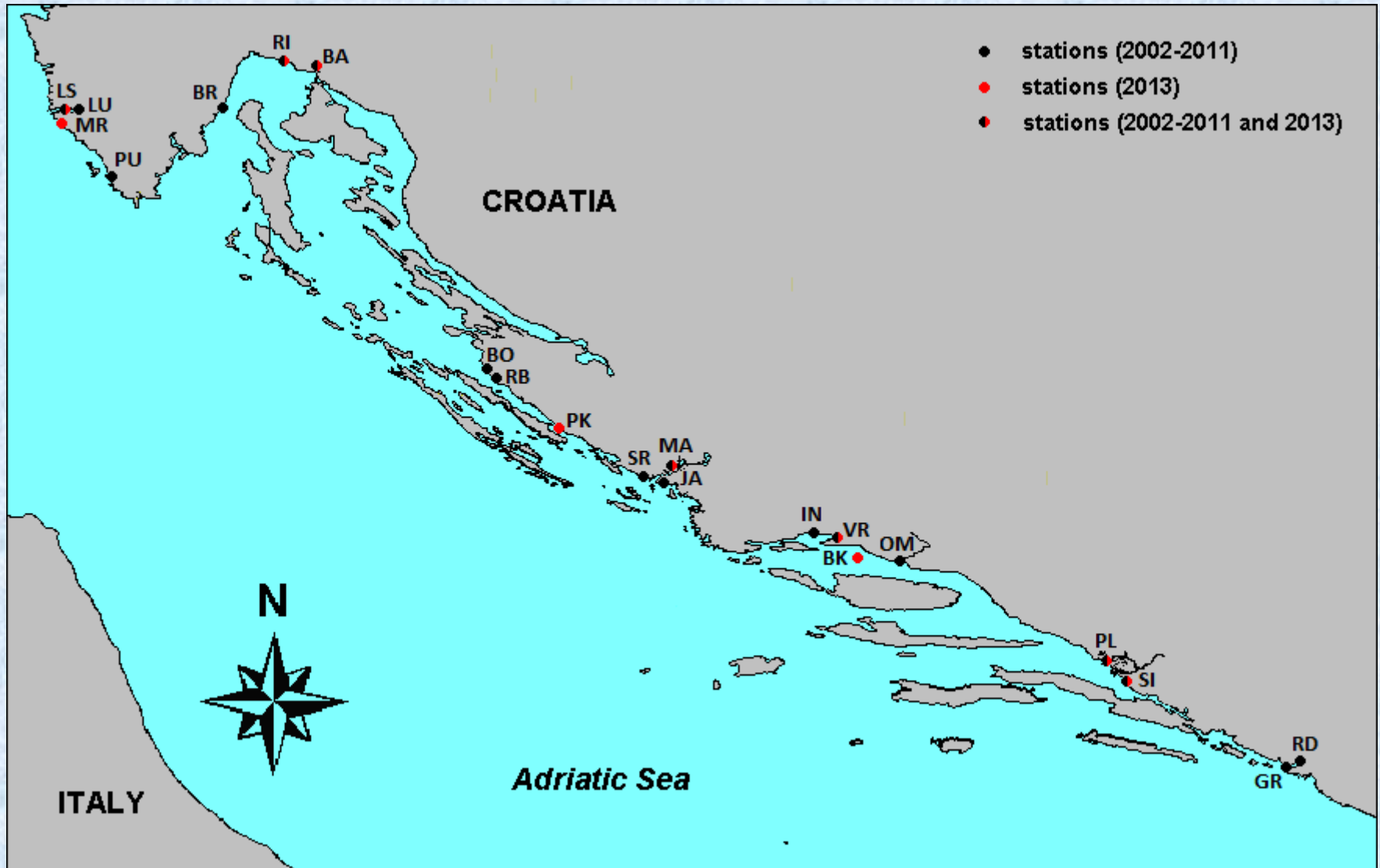


- quality of European aquatic ecosystems is impacted by enormous number of synthetic and non-synthetic compounds
- harm to living resources and marine ecosystems, including loss of biodiversity and hazards to human health
- Marine Strategy Framework Directive (2008/56/EC) demands each Member State to develop marine strategies for its marine waters
- Croatia has transposed MSFD into Croatian legislation (OG 136/11) establishing a framework for action in the field of environmental protection
- initial assessment of the situation and the load on the marine environment of the Croatian part of Adriatic Sea was the first step in the preparation of program of measures for achieving and maintaining good status of the marine environment
- it was based on monitoring activities in the Adriatic coastal waters carried throughout national projects and in the frame of the MED POL monitoring program in the last decades
- outcomes of this activities represent a good background to define qualitative descriptors according to MSFD and establish monitoring and observation system for ongoing assessment of Croatian waters



- with regard to Descriptor 8, concentrations of contaminants (PCBs, chlorinated pesticides) were investigated in the Croatia in surface sediment and biota (bivalve *Mytilus galloprovincialis*)
- sampling sites were selected at locations identified as hot spot area and as well at locations suspected to be free of contamination, covering the entire eastern Adriatic coastal area (Croatia)
- the majority of stations were located in areas that are exposed to anthropogenic impact
- bivalves were collected at 18 stations in prespawning period (March/April) within the regular national and MED POL/MAP/UNEP monitoring program conducted in the 2002-2011 period
- sediments were collected at 6 stations in the 2006-2011 period
- in 2013, as a part of the Adriatic Monitoring Project – Phase II, determination of target contaminants was conducted at 8 stations (bivalves) and 10 stations (sediment)

Sampling stations





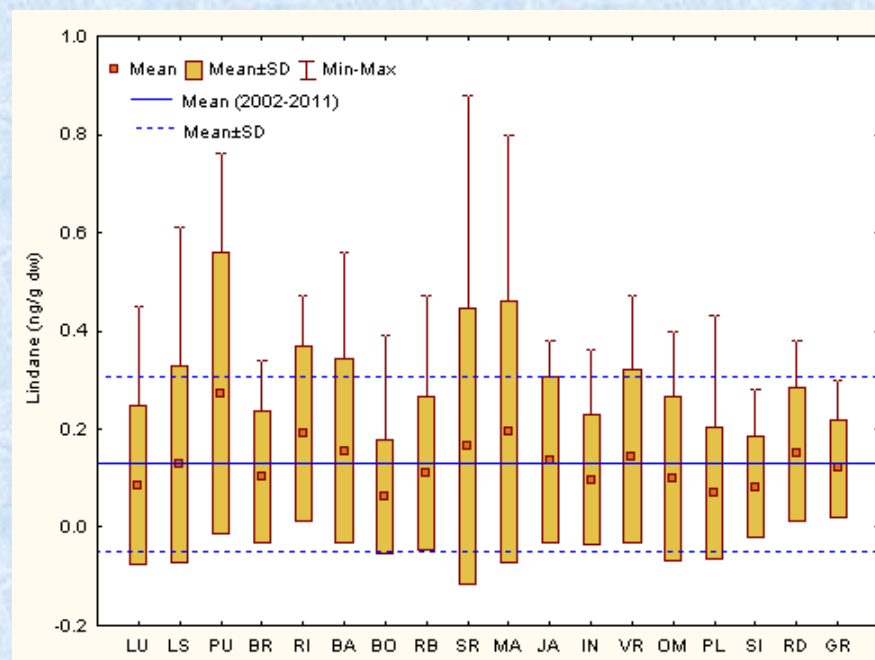
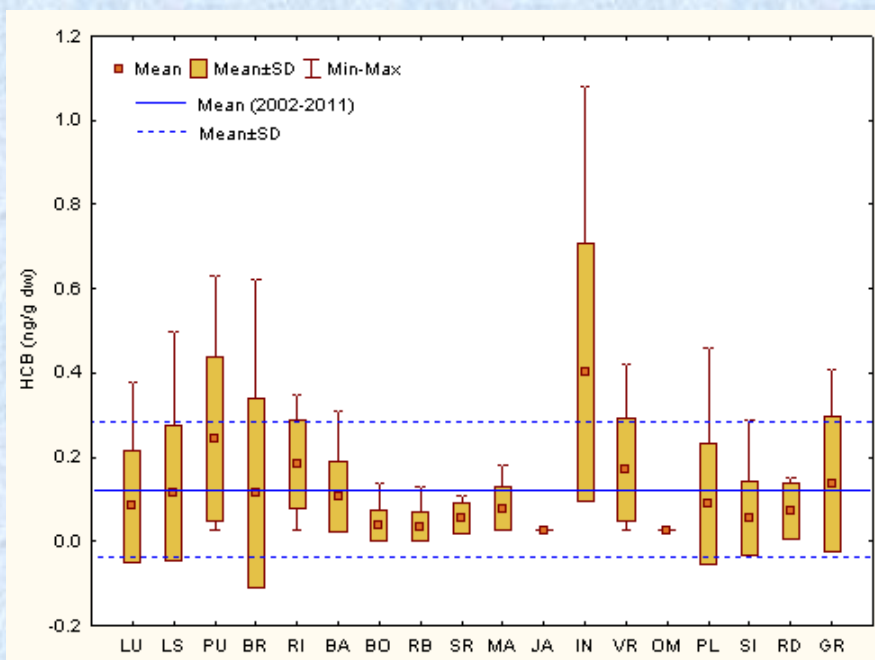
- bivalves (25-30 specimens) scrubbed, rinsed, soft tissue dissected, pooled, frozen (-20°C), freeze-dried, homogenized
- sediments (1-3 cm), frozen (-20°C), freeze-dried, homogenized, sieved (250 µm)
- Soxhlet extraction of samples and blanks, extract clean-up procedure, separation of OCs in 3 fractions on florisil column
- qualitative and quantitative OCs determination by GC-Ni63 ECD (Agilent 6890N), HP-5 capillary column (30 m, 0.25 mm, 0.25 µm)
- target contaminants (HCB, lindane, heptachlor, aldrin, dieldrin, endrin, p,p'-DDE, p,p'-DDD, p,p'-DDT, PCB congeners 28, 52, 101, 118, 138, 153, 180)
- internal standards recovery (PCB-29, PCB 198, ε-HCH, endosulfan Id4)
- RM IAEA-406 and IAEA-432 (biota), RM IAEA-408 (sediment) for assurance of data quality
- IAEA/MEL interlaboratory comparison exercises, MED POL/IAEA proficiency tests
- concentrations expressed in ng/g on dry weight basis

RESULTS AND DISCUSSION

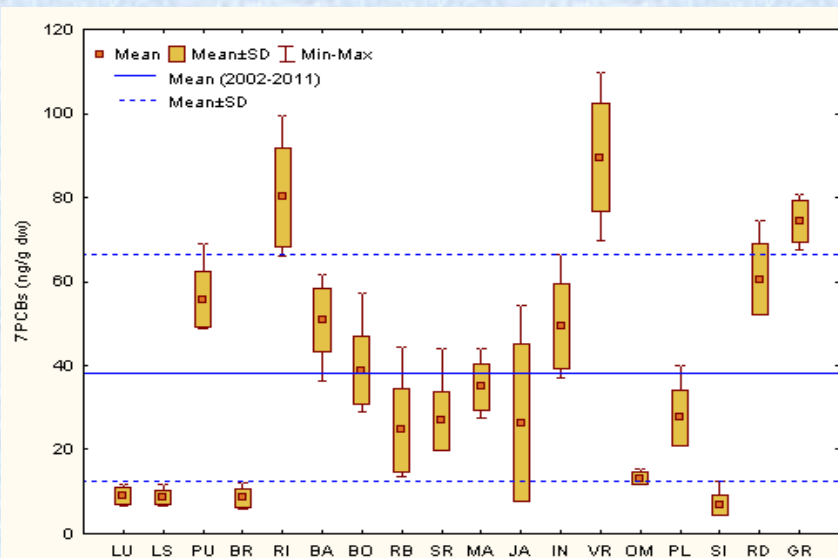
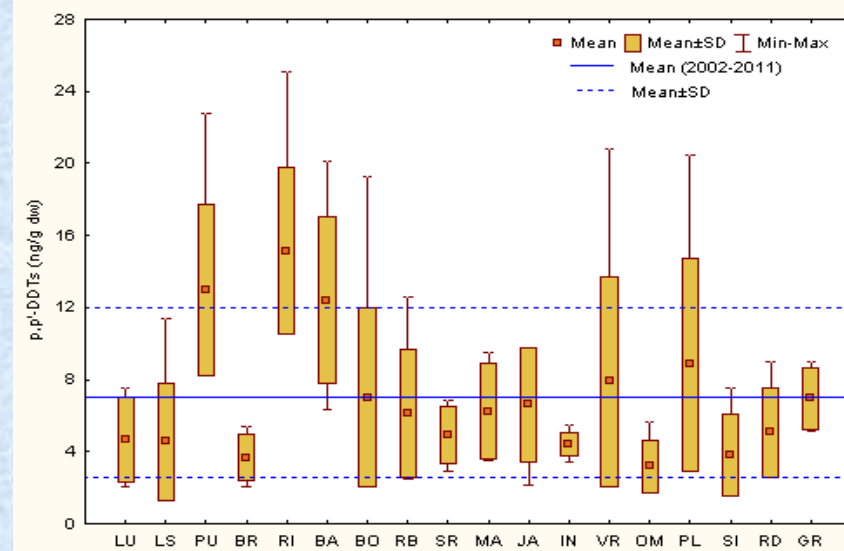
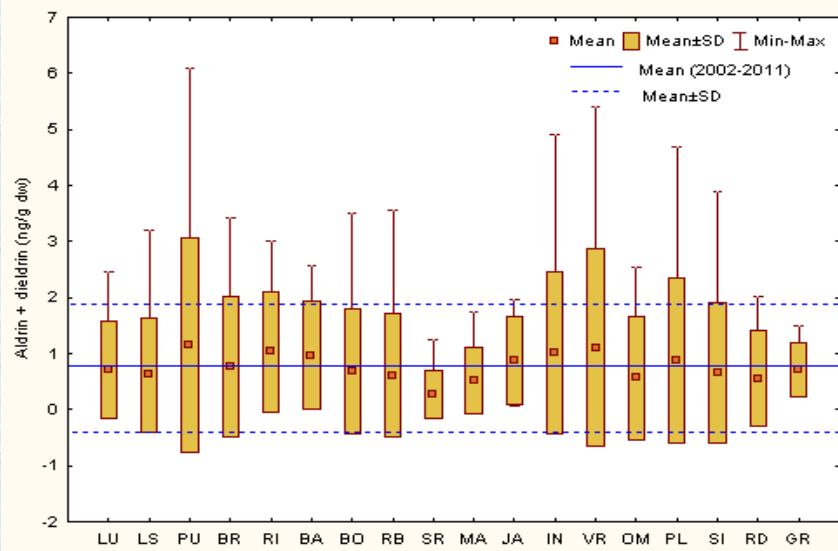


Organochlorines in mussels (2002-2011)

- main pressures and impacts in Croatia are generated by introduction of non-synthetic and , to a smaller amount synthetic compounds from point and diffuse sources (wastewater outlets, runoff, riverine inputs and pollution by ships)
- elevated concentrations of organochlorines near industrial, urban areas, harbours
- HCB, lindane, aldrin and dieldrin were observed in low concentrations

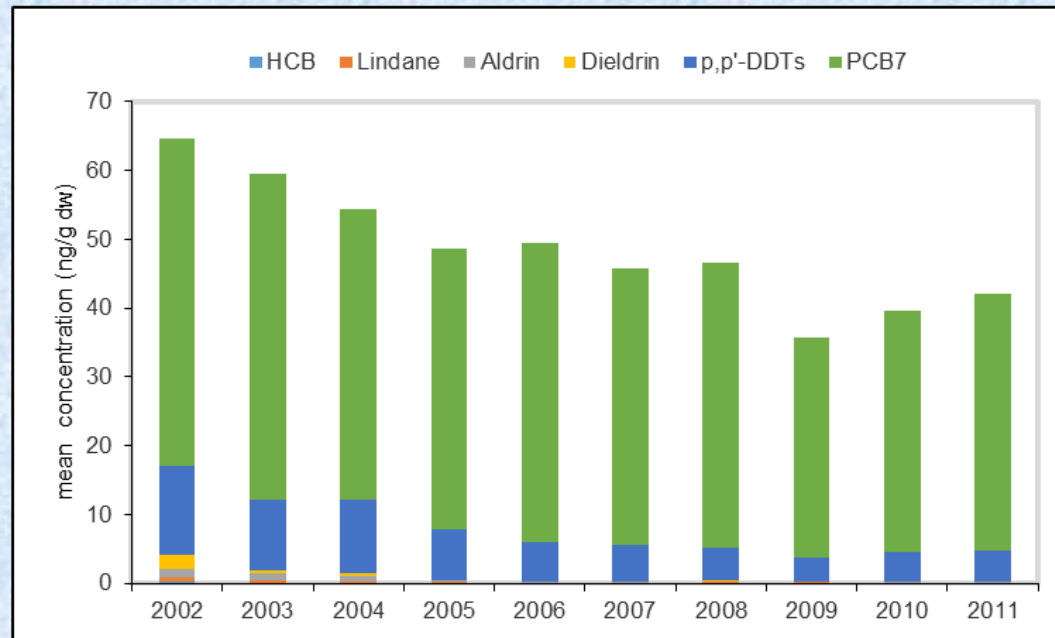


Organochlorines in mussels (2002-2011)



- p,p'-DDTs prevailed in relation to other pesticides
- much higher PCBs levels than pesticides
- geographical variation of PCBs depending on local position of sampling sites and distance from a particular pollution source
- the lowest PCBs levels related to areas far from anthropogenic sources of contamination

Organochlorines in mussels (2002-2011)

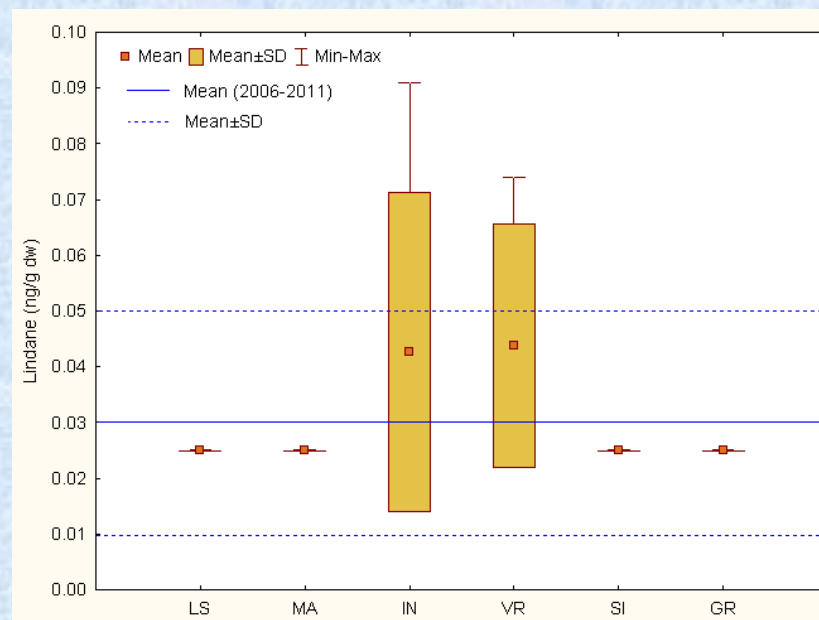
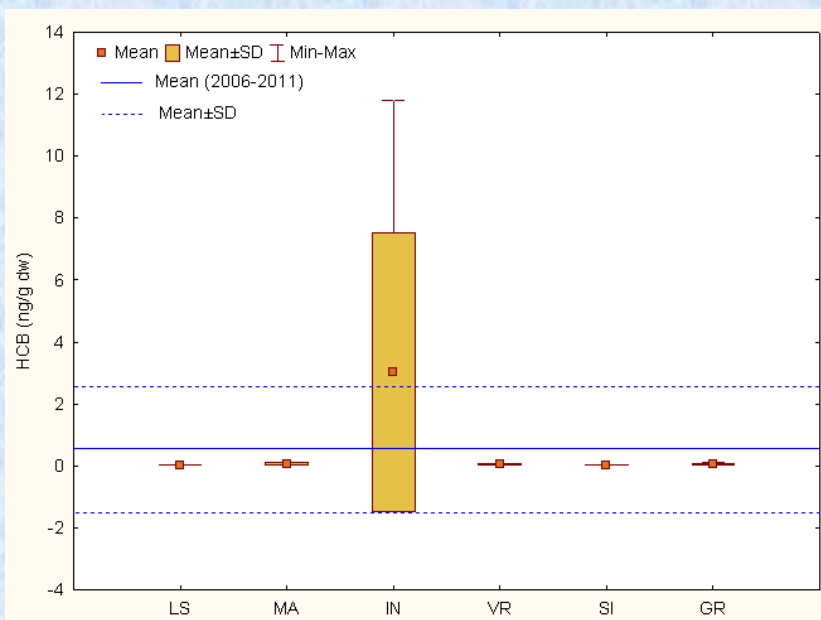


- based on all 2002-2011 data, mean concentrations per year indicate decrease in contamination by HCB, lindane, aldrin and dieldrin
- slight decrease of p,p'-DDTs was observed as well
- PCBs are slowly decreasing providing proof of their persistence in the environment

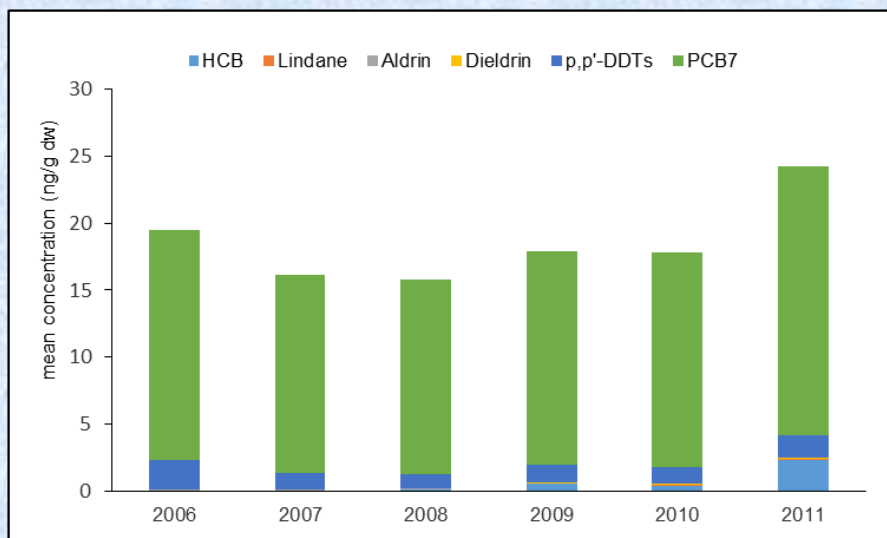
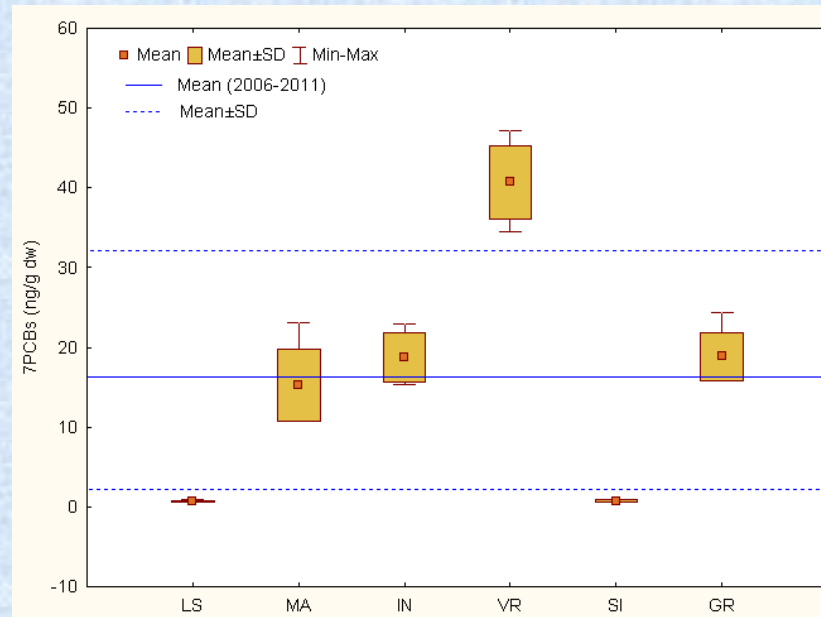
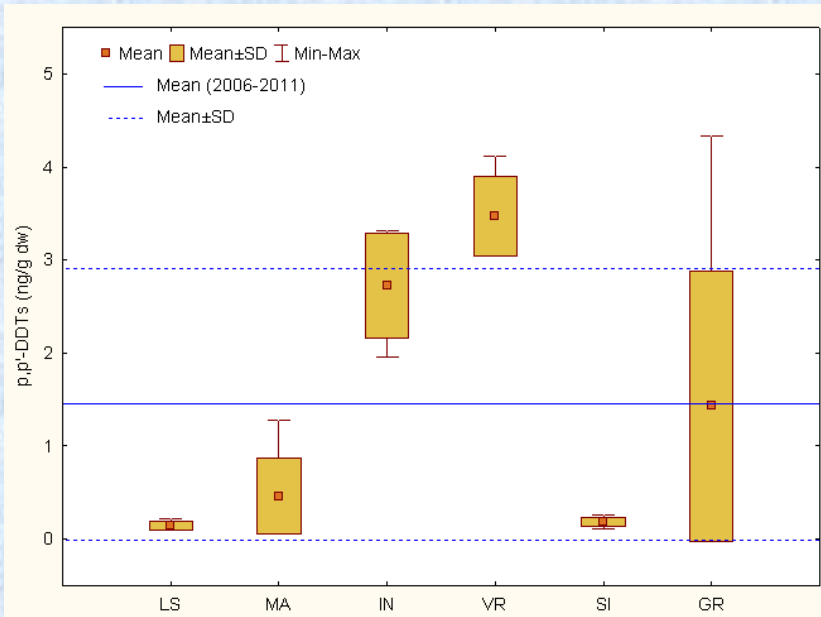
Organochlorines in sediment (2006-2011)



- similar distribution of organochlorines found in sediments
- organochlorine concentrations lower in sediments than in mussels
- the highest organochlorines concentrations related to Kaštela Bay one of the most polluted areas at the Croatian Adriatic coast
- the lowest concentrations related to areas far away from known anthropogenic sources of contamination



Organochlorines in sediment (2006-2011)

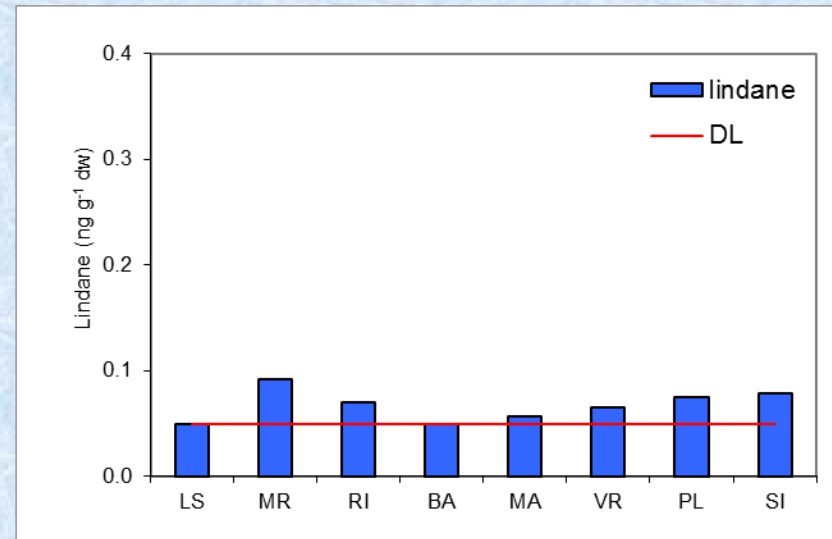
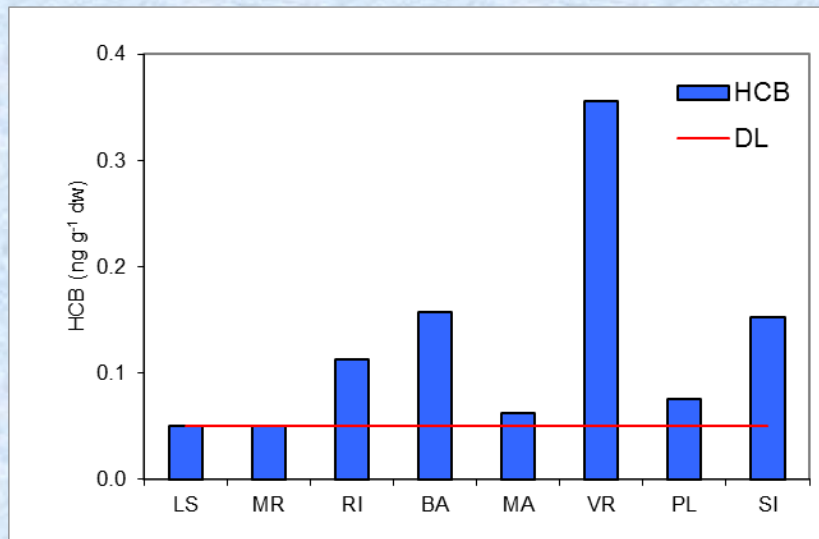


- obtained data indicate an increase of HCB levels from 2009 to 2011 related to sediments from Kaštela Bay (IN)
- no significant increase of p,p'-DDTs
- PCBs slightly increasing

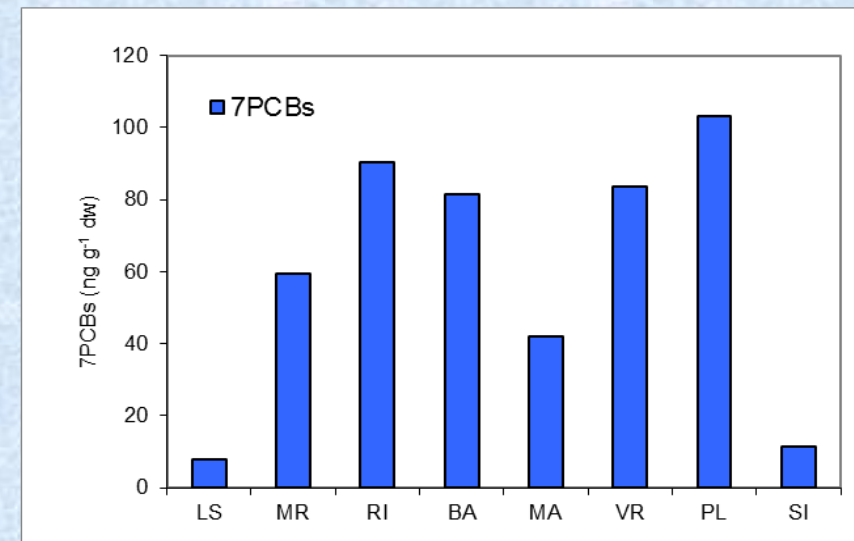
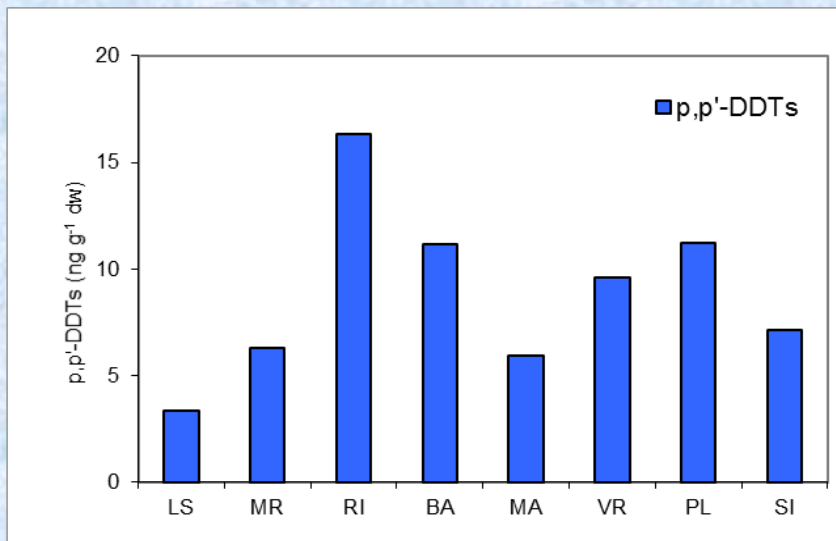
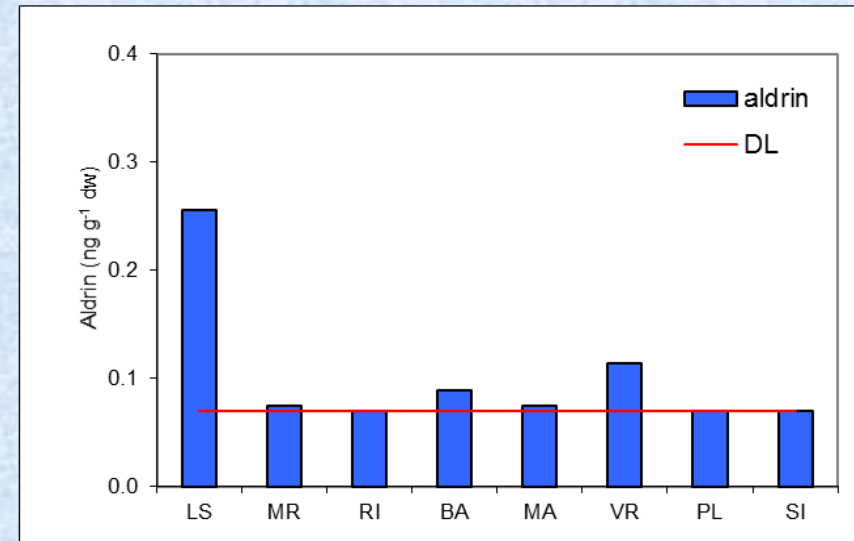
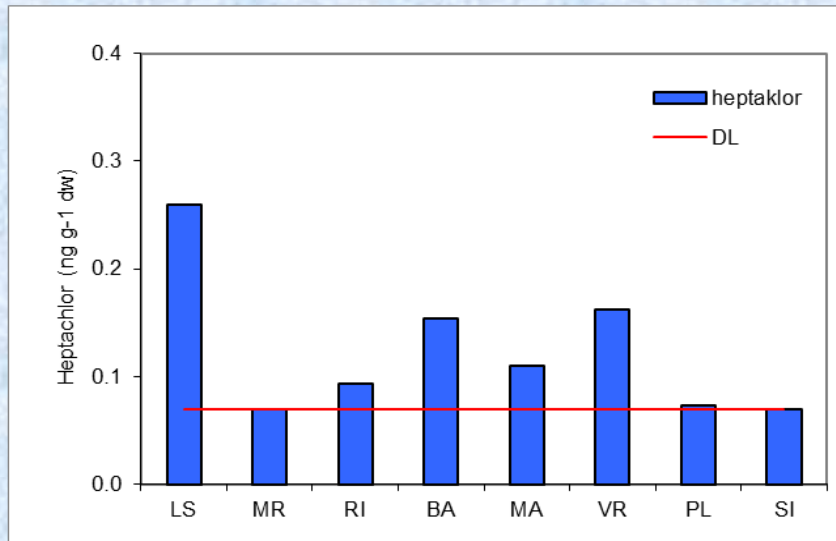
Organochlorines in mussels (2013)



- similar distribution of organochlorines in 2013
- spatial OCs distribution related to major cities (hot spots)
- HCB, lindane, aldrin and DDTs concentrations lower in relation to 2002-2011 period
- PCBs concentrations within range of values observed for 2002-2011 period showing higher mean value in 2013 than in 2011
- pesticides concentrations decreased contrary to widespread PCBs still present in environment



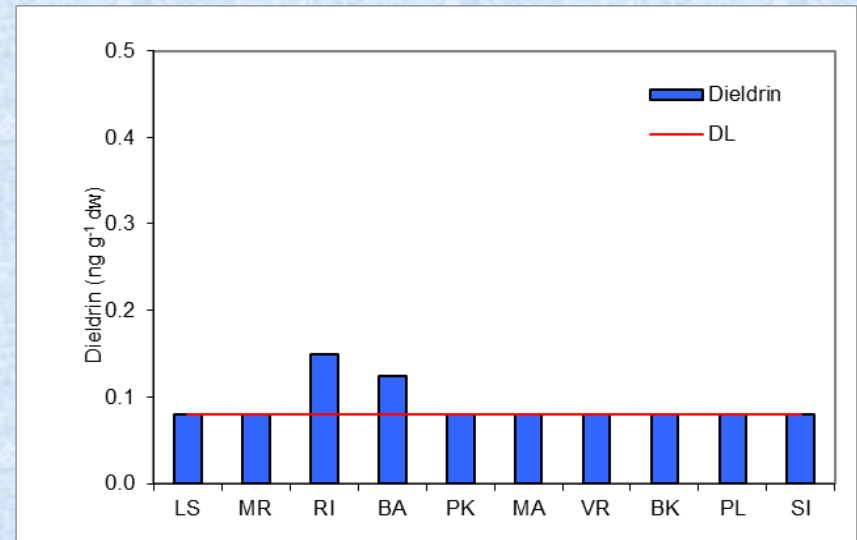
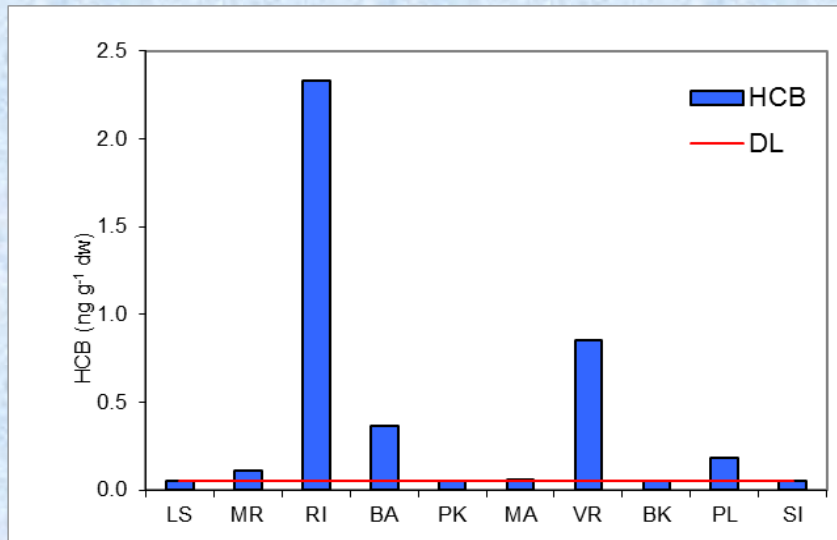
Organochlorines in mussels (2013)



Organochlorines in sediment (2013)



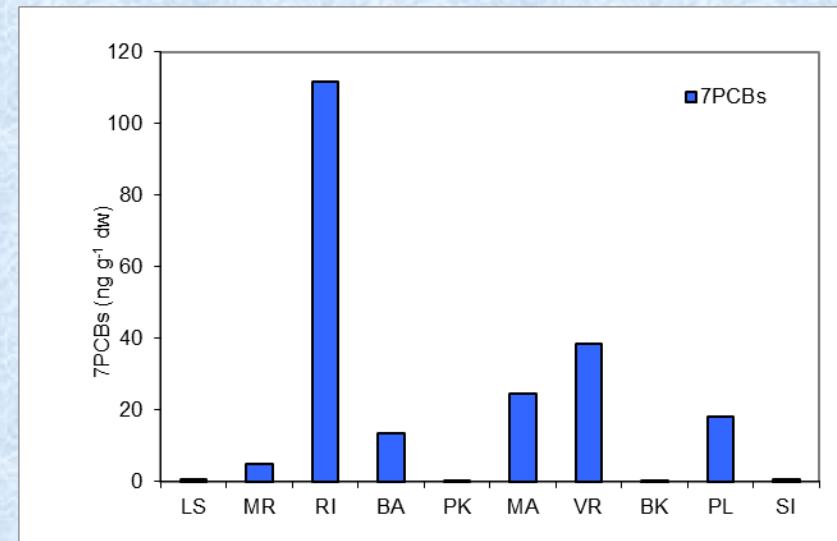
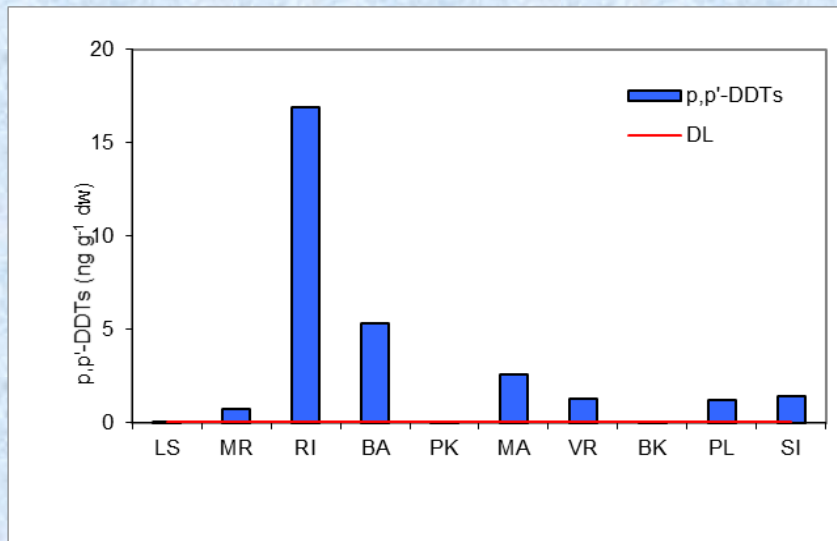
- similar distribution of organochlorines in sediments in 2013
- spatial OCs distribution related to major cities (hot spots)
- HCB and lindane concentrations lower in relation to 2006-2011 period
- dieldrin concentrations were measured in 2013 but not in 2006-2011 period



Organochlorines in sediment (2013)



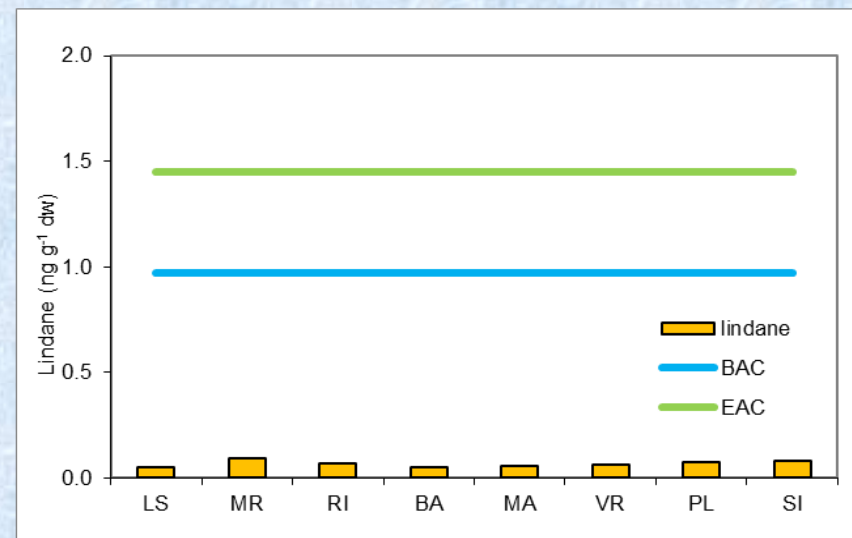
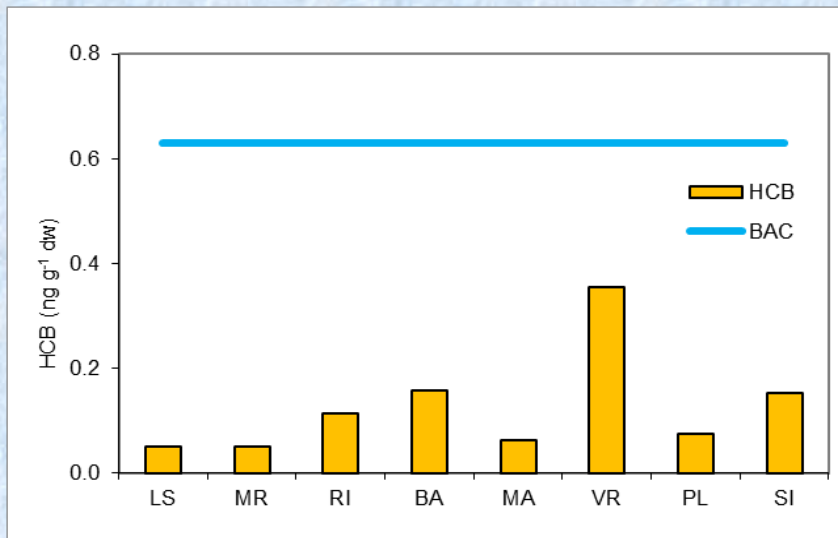
- DDTs and PCBs levels higher in 2013 than in 2006-2011 due to introduction of new stations in monitoring in 2003
- pesticides concentrations decreased contrary to widespread PCBs still reflecting their presence in investigated areas





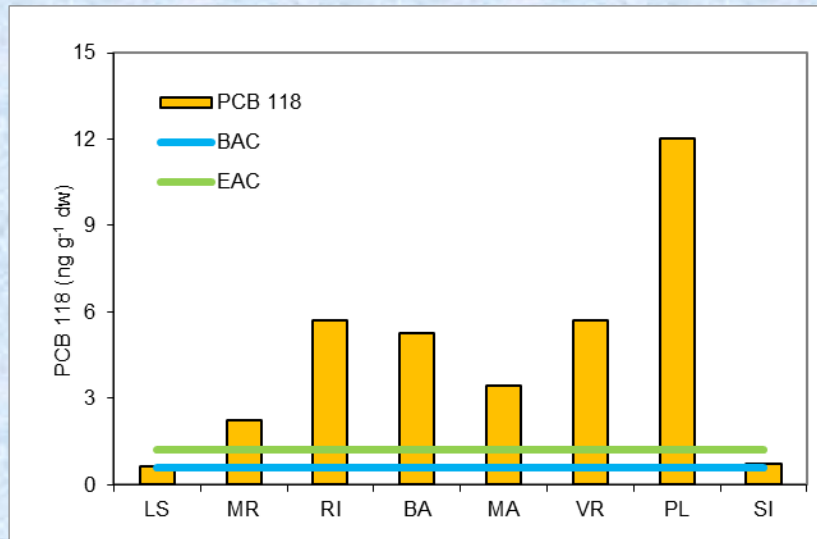
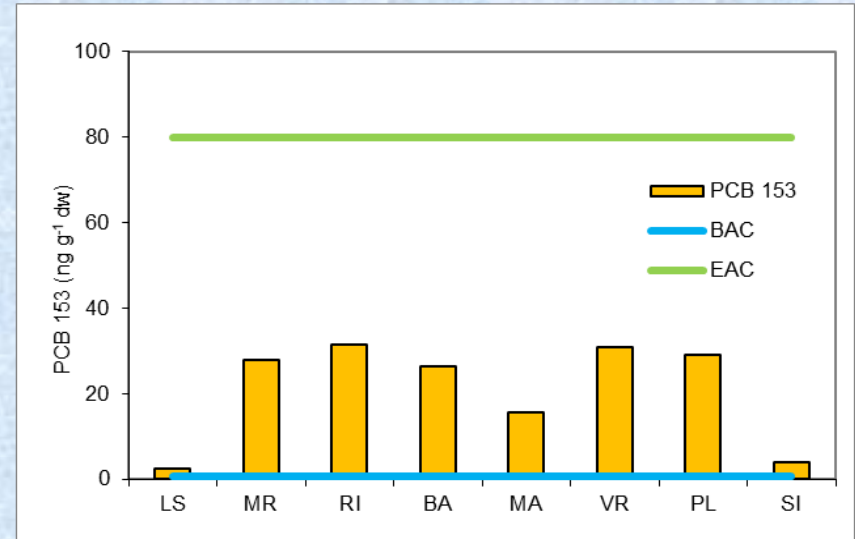
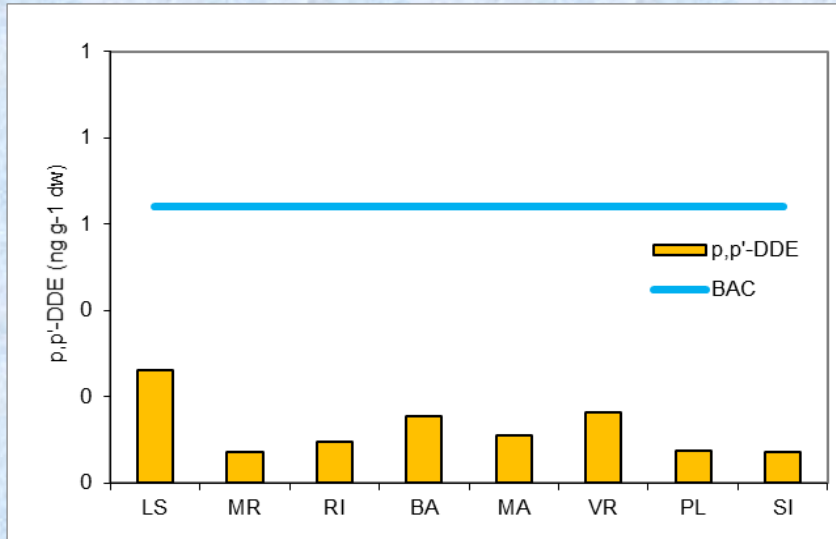
- to assess GES in relation to measured contaminants concentrations in mussels and sediment in 2013, values were compared with OSPAR criteria to determine which portion of samples for each parameter exceeds the limit above which significant adverse effects to the environment or to human health are most likely to occur

Mussels



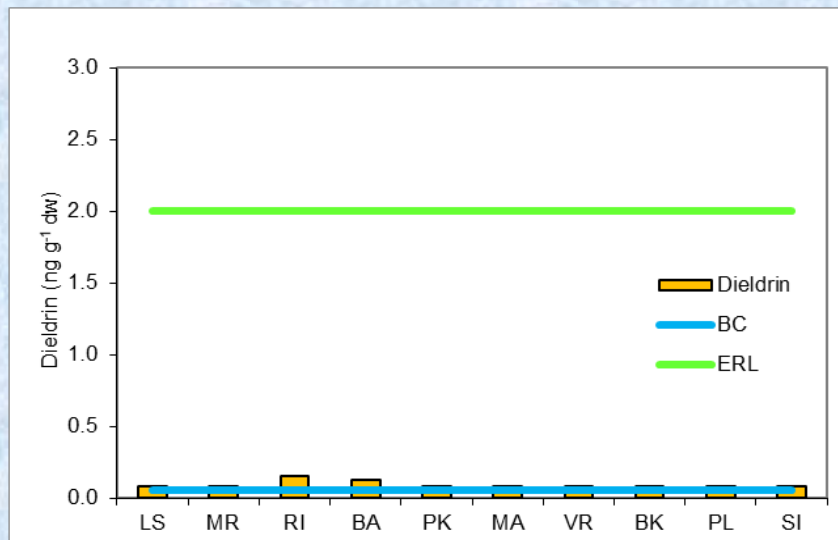
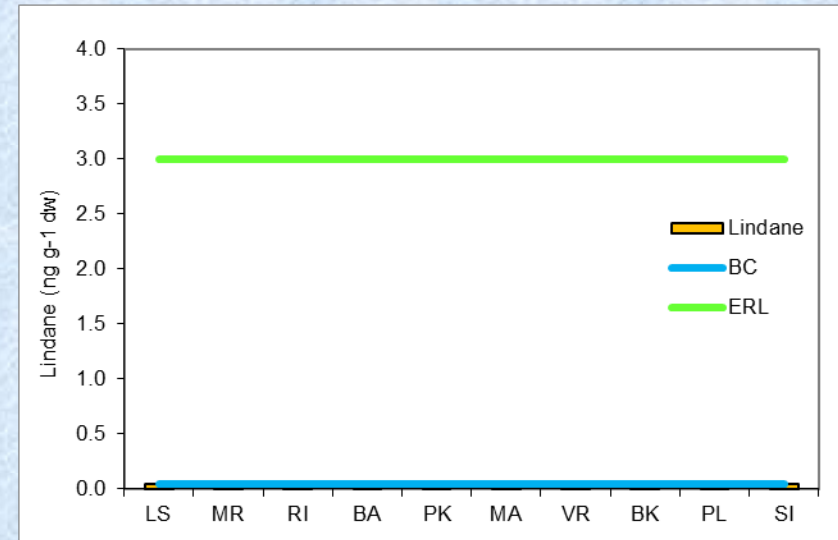
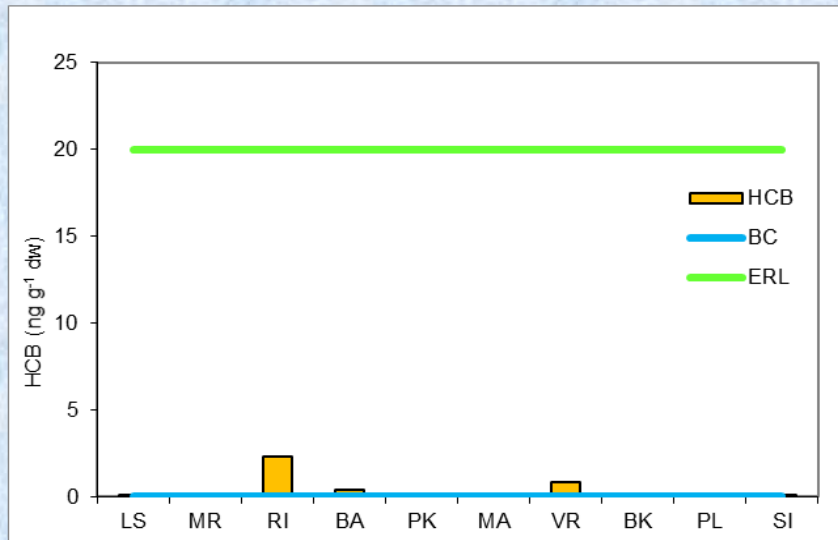
- HCB and lindane concentrations were <BAC values at all stations
- status is acceptable

Mussels



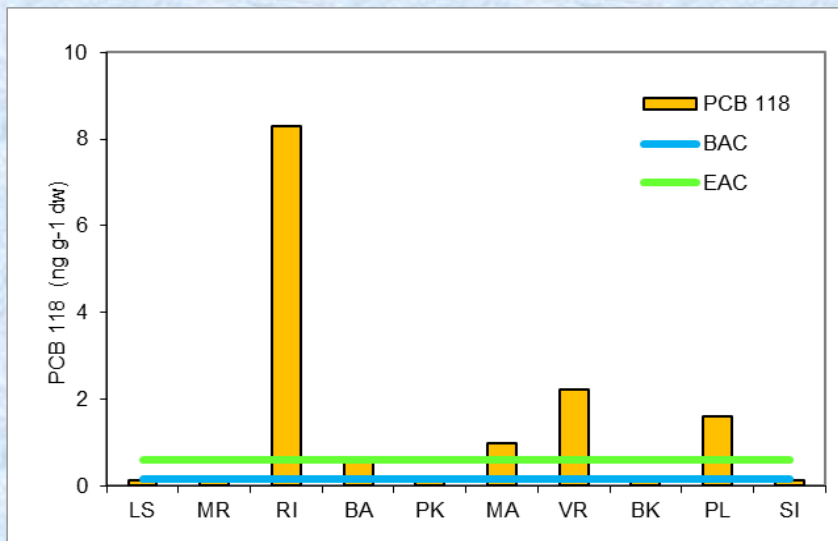
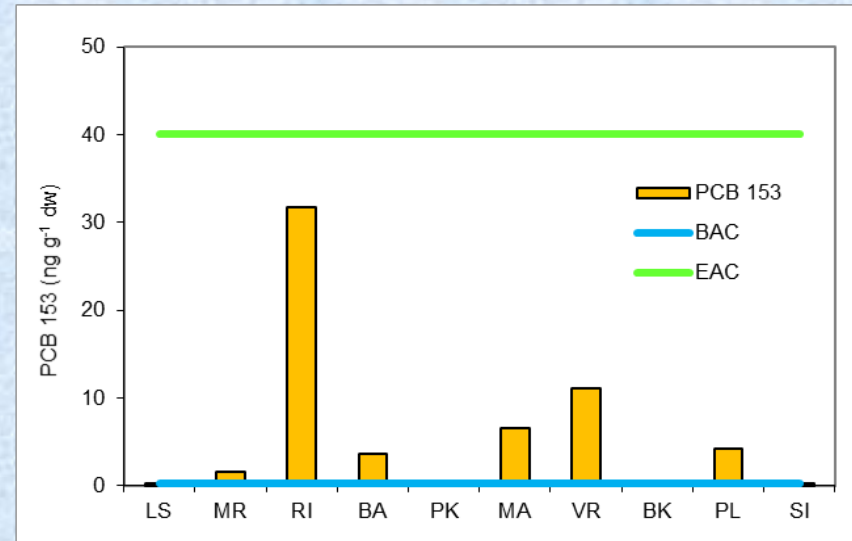
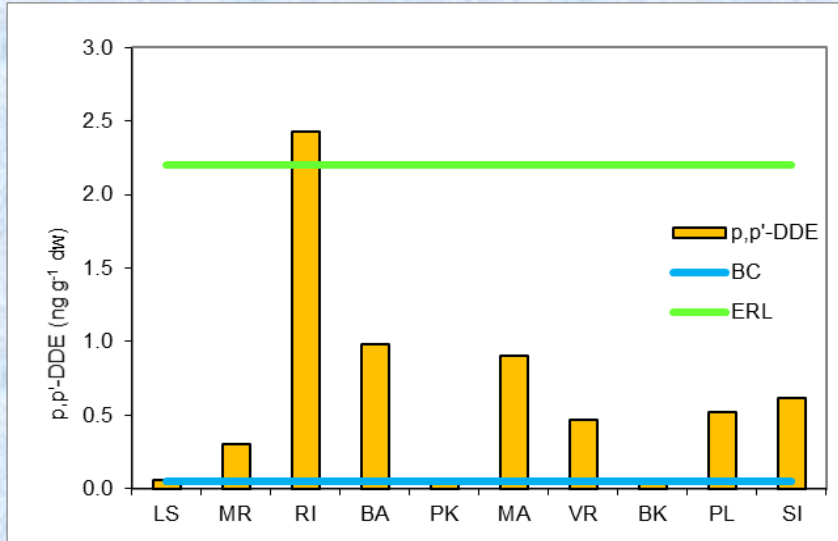
- p,p'-DDE < BAC at all stations
- PCB 153 < BAC and < EAC at all stations
- PCB 118 < BAC (25%) at stations where anthropogenic influence is less pronounced, status is acceptable
- PCB 118 > EAC (75%) at stations under intense anthropogenic influence, status is unacceptable

Sediment



- HCB concentrations <BC (50%) and 50% >BC but much lower than ERL value
- lindane <BC (100%), status acceptable
- dieldrin close to BC (80%), 20% >BAC and <EAC, status acceptable

Sediment



- p,p'-DDE concentrations close to BC (30%), 60% >BC<ERL and only 10% >ERL (RI)
- PCB 153 <BAC (20%) and 20% close to BAC (LS, SI), 60% >BAC<EAC
- PCB 118 <BAC (50%) and 10% >BAC<EAC (BA)
- PCB 118 40% >EAC, status unacceptable

CONCLUSIONS



- concentrations of organochlorine pesticides (HCB, lindane, aldrin, dieldrin and p,p'-DDTs) showed low levels of contamination along the Croatian Adriatic coast likely due to ban of their production and use
- according to long-term monitoring data decrease in pesticides levels were generally observed
- PCBs levels were much higher in relation to target pesticides
- evidently, PCBs are still present in the study area reflecting probably an inefficient management of existing regulations concerning their use and stocking in Croatia
- GES is acceptable with regard to HCB, lindane showing concentrations close to zero at majority of stations
- p,p'-DDE levels suggest generally a good status for majority of stations
- the assessment of ICES 7 PCBs, presented with PCB 153 and PCB 118, indicated a good status for non-dioxin like PCBs at all stations
- PCB 118 levels suggest an unacceptable status for dioxin-like PCBs at 75% of stations
- at coastal stations far from anthropogenic activities, PCB 118 were close to zero

An aerial photograph of a coastal town in Split, Croatia. The town is built on a peninsula with a large white building with a red roof. A harbor with a boat is visible in the foreground. The background shows a large body of water and mountains.

**Thanks for
your
attention!**

Split