Silver distribution along the salinity gradient and accumulation in European Eel (*Anguilla anguilla*) of the Gironde Estuary, France.

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Geochemistry and Eco-toxicology of Metals in Aquatic systems - GEMA

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Marennes-Oléron

EC (2002):

Cd < 5 mg.kg^{-1}

« Mussel Watch »

Cd: 40-60 mg.kg^{-1}

(d.w.); **RNO** 2005

Silver in mussels from the French coast (RNO – National Mussel Watch Program)

Marennes-Oléron Bay / Gironde estuary

Seine estuary (Paris)

= “hot spot”

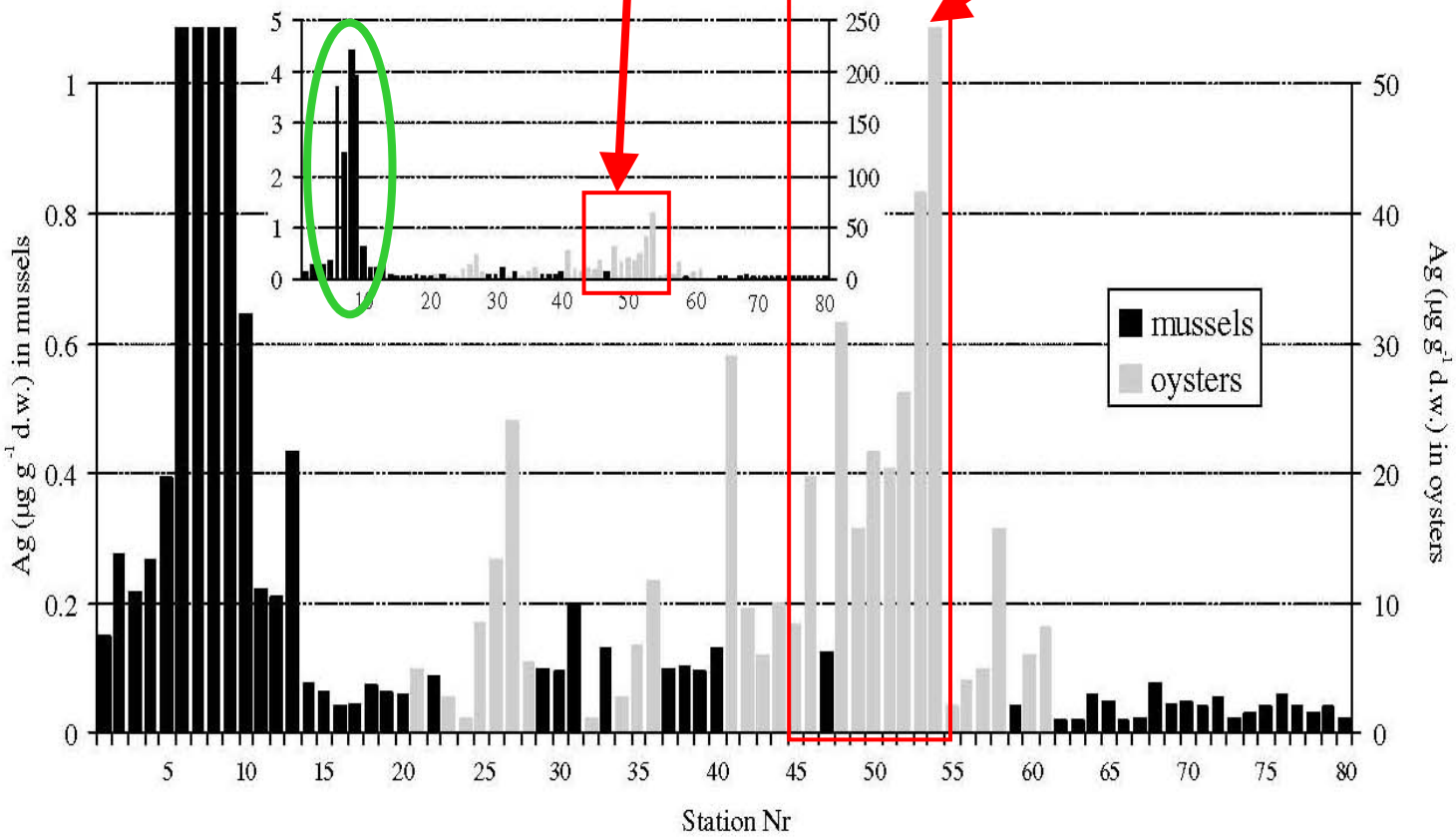
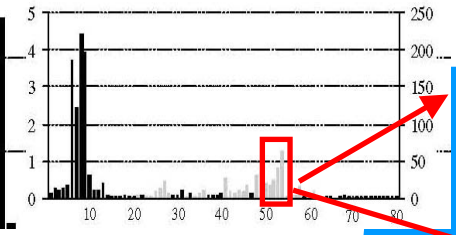


Fig. 2. Distribution of silver (µg g^{-1} dry weight) in mussels and oysters along the French coasts in 2003 2004. The insert refers to a full scale for silver concentrations.

Chiffoleau et al., 2005; Mar Poll Bull 50

Silver is a tracer of urban contamination ***(Sanudo-Wilhelmy and Flegal 1992; ES&T)***

Potential Ag sources in the watershed drained by the Gironde Estuary



Taillebourg

Charente

Gironde

?

Au, Ag

Pb, Zn

Isle River

St Denis de Pile

Bordeaux

Pessac

Dordogne River

Pb, Zn

Pb, Zn

Massif Central

La Réole

Temple

Decazeville

Riou Mort

Lot River

Pb, Zn

Pb, Zn

2 urban agglomerations
0.7-1 million inhabitants each

Garonne River

Pb, Zn

Adour River

Toulouse

Gaves River

Pb, Zn

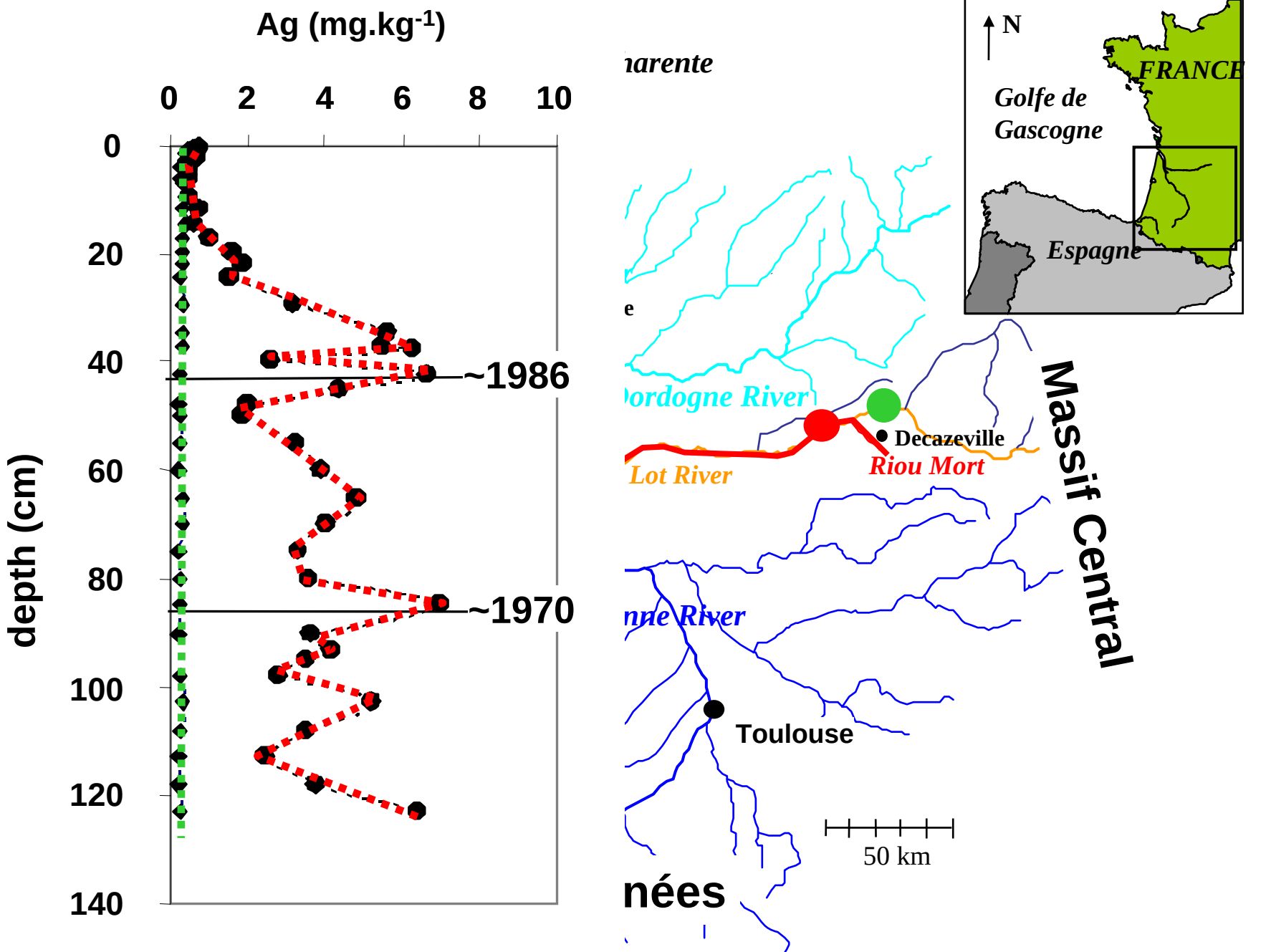
Pb, Zn

Pb, Zn

Pyrénées

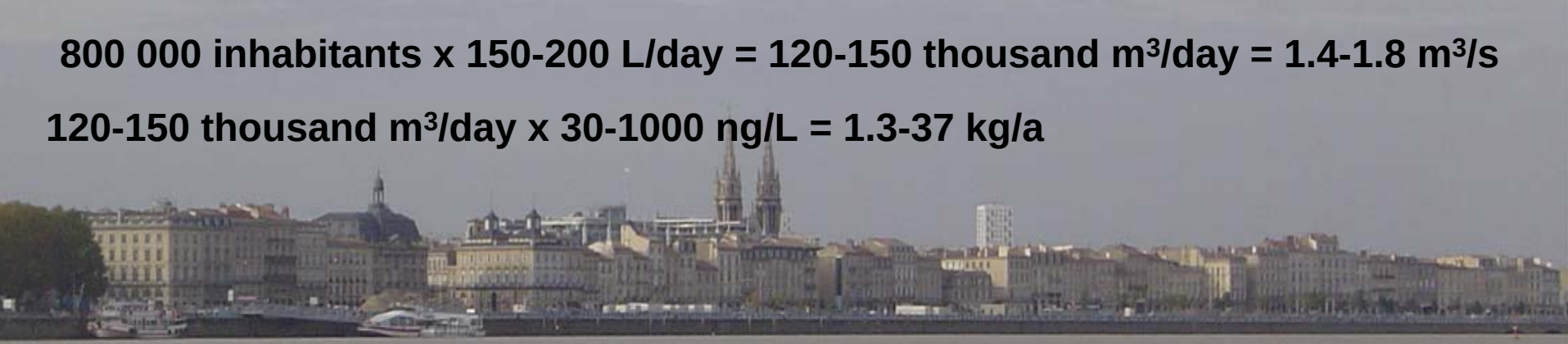
Ag mining/extraction:
Roman Empire, ….
19th and 20th century

Historical records in Lot River reservoir sediments

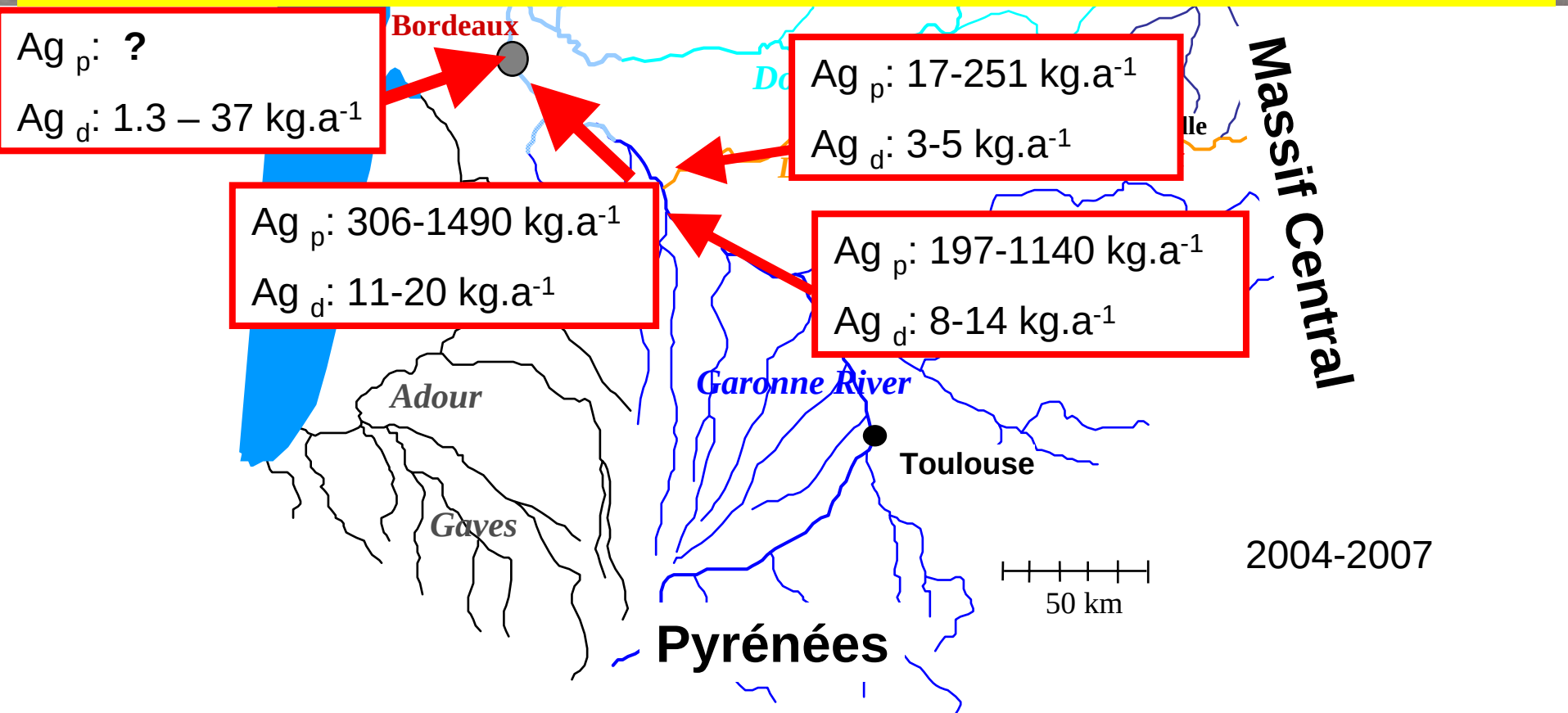


800 000 inhabitants x 150-200 L/day = 120-150 thousand m³/day = 1.4-1.8 m³/s

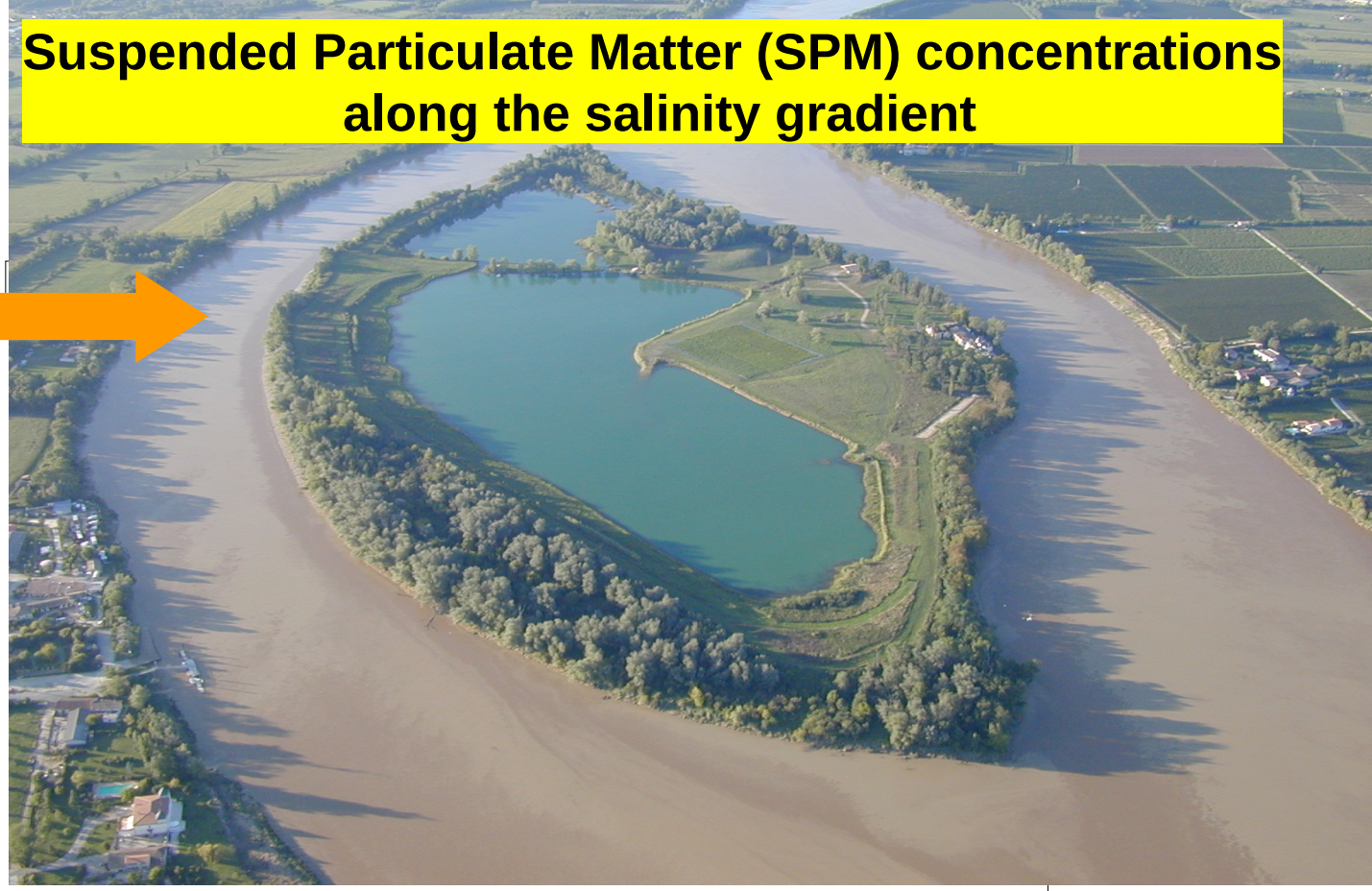
120-150 thousand m³/day x 30-1000 ng/L = 1.3-37 kg/a



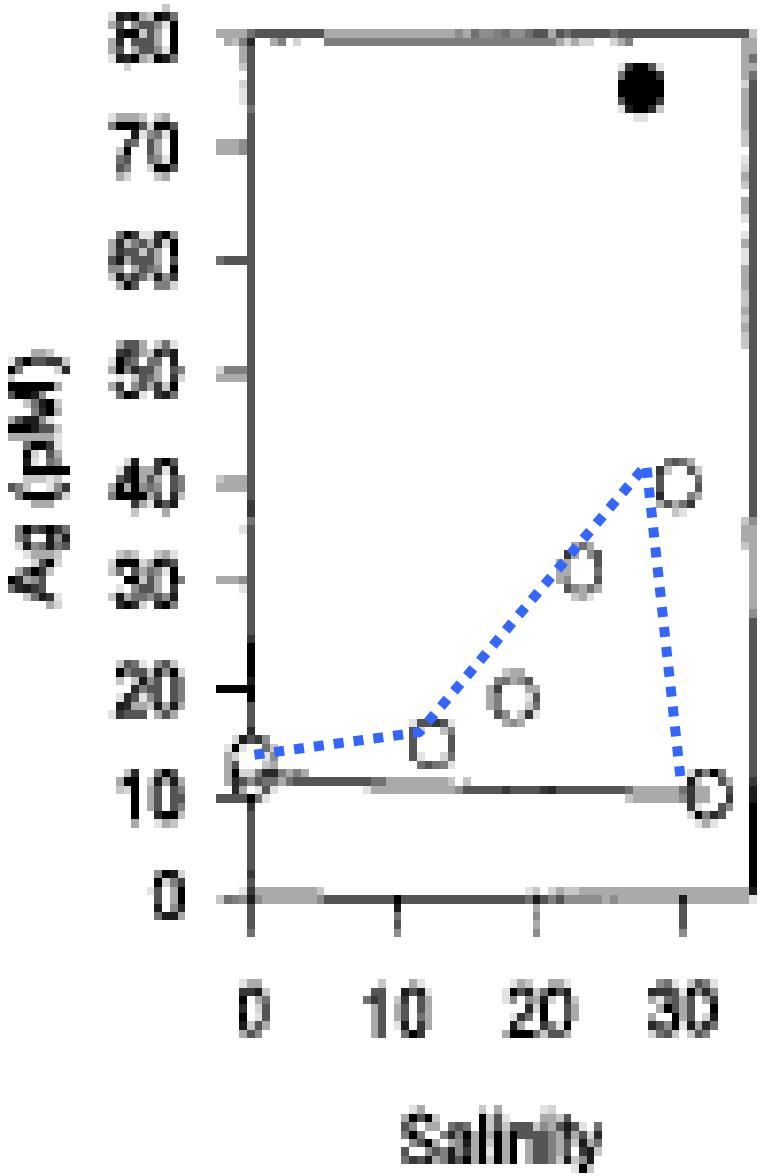
- Low discharge (~100 **m³/s**): urban inputs may locally increase [Ag_d] by 40-1,800 %
- measured values in Bordeaux are 3-15 fold higher than river water values



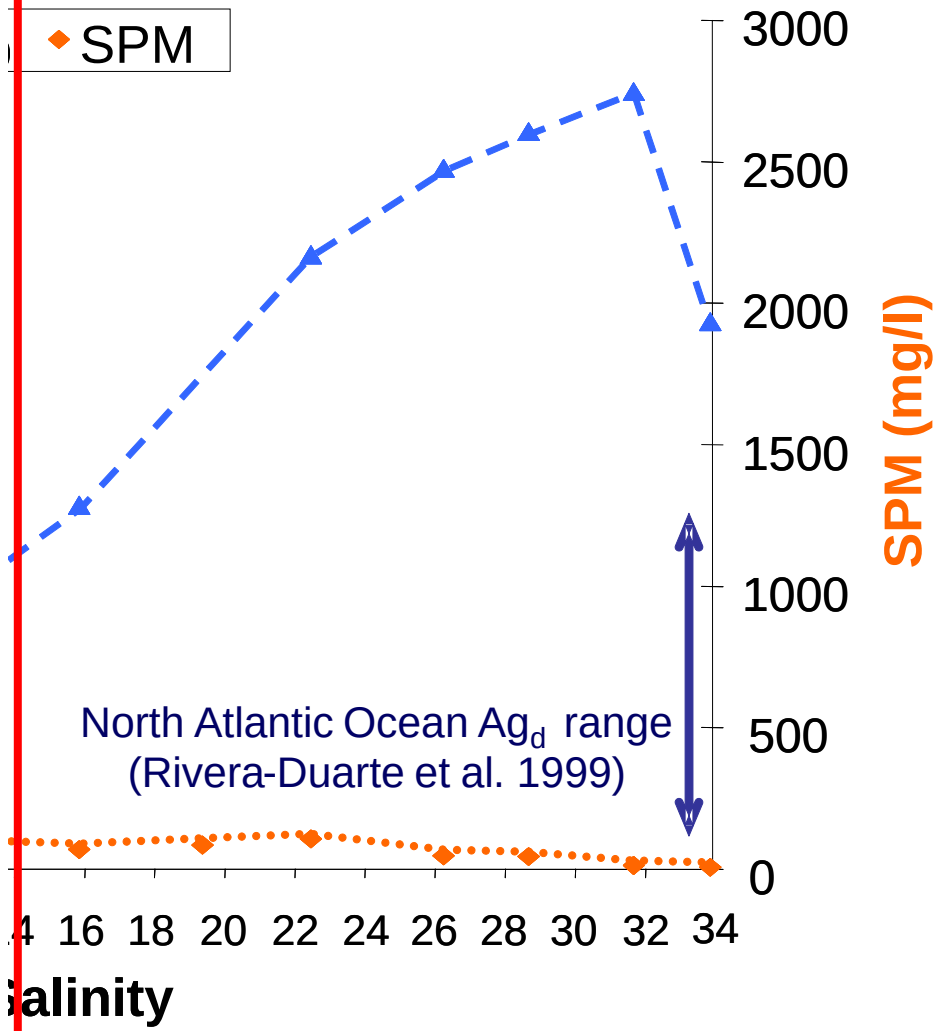
Suspended Particulate Matter (SPM) concentrations along the salinity gradient

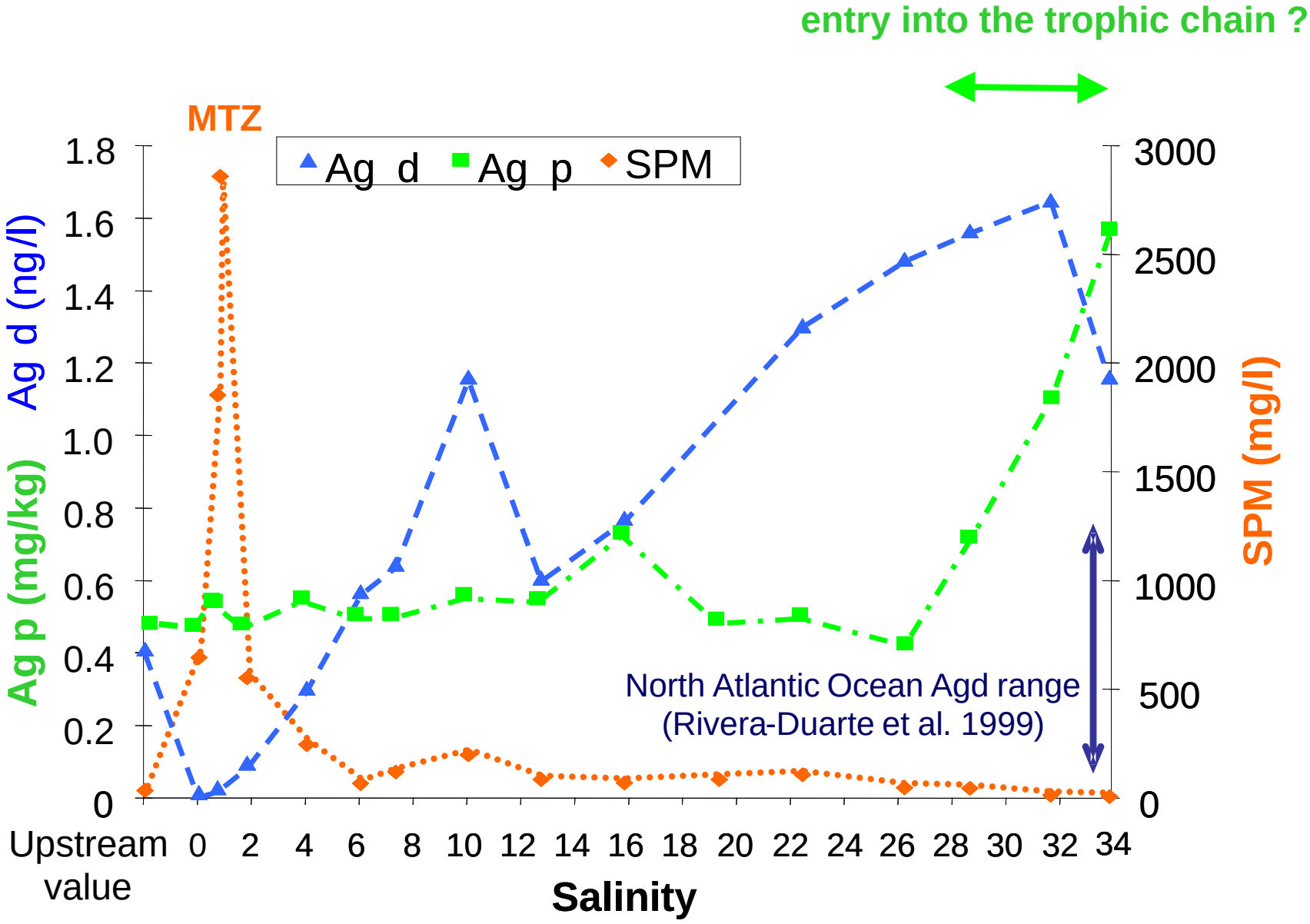


Ag addition (desorption; Cl^- complexation)

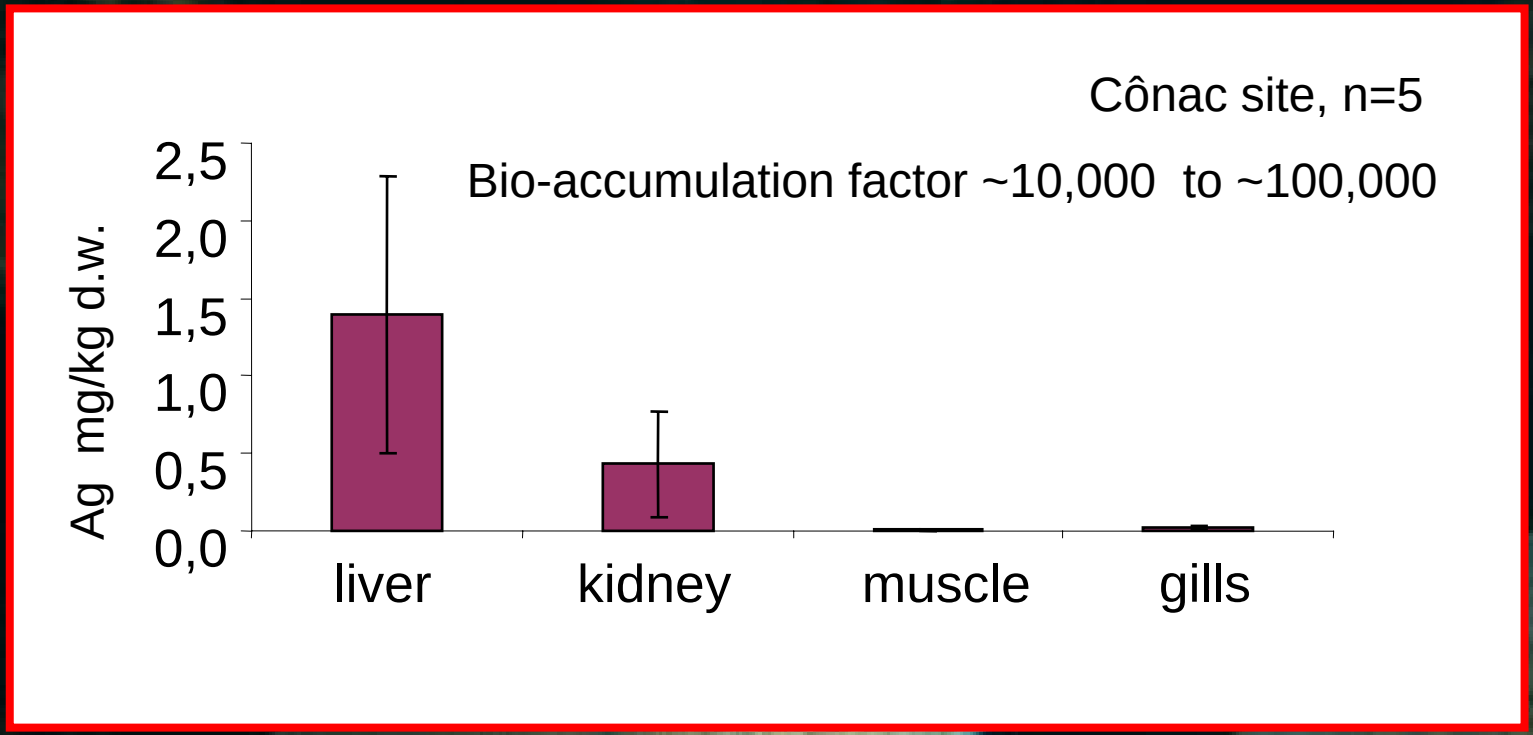


Sanudo-Wilhelmy et al., 1996; GCA




uptake by phytoplancton ?
entry into the trophic chain ?
MTZ
Ag d
Ag p
SPM
Ag d (ng/l)
Ag p (mg/kg)
SPM (mg/l)
North Atlantic Ocean Agd range
(Rivera-Duarte et al. 1999)
Upstream value
Salinity
0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
500
1000
1500
2000
2500
3000
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34

Bioaccumulation of Ag in European Eel



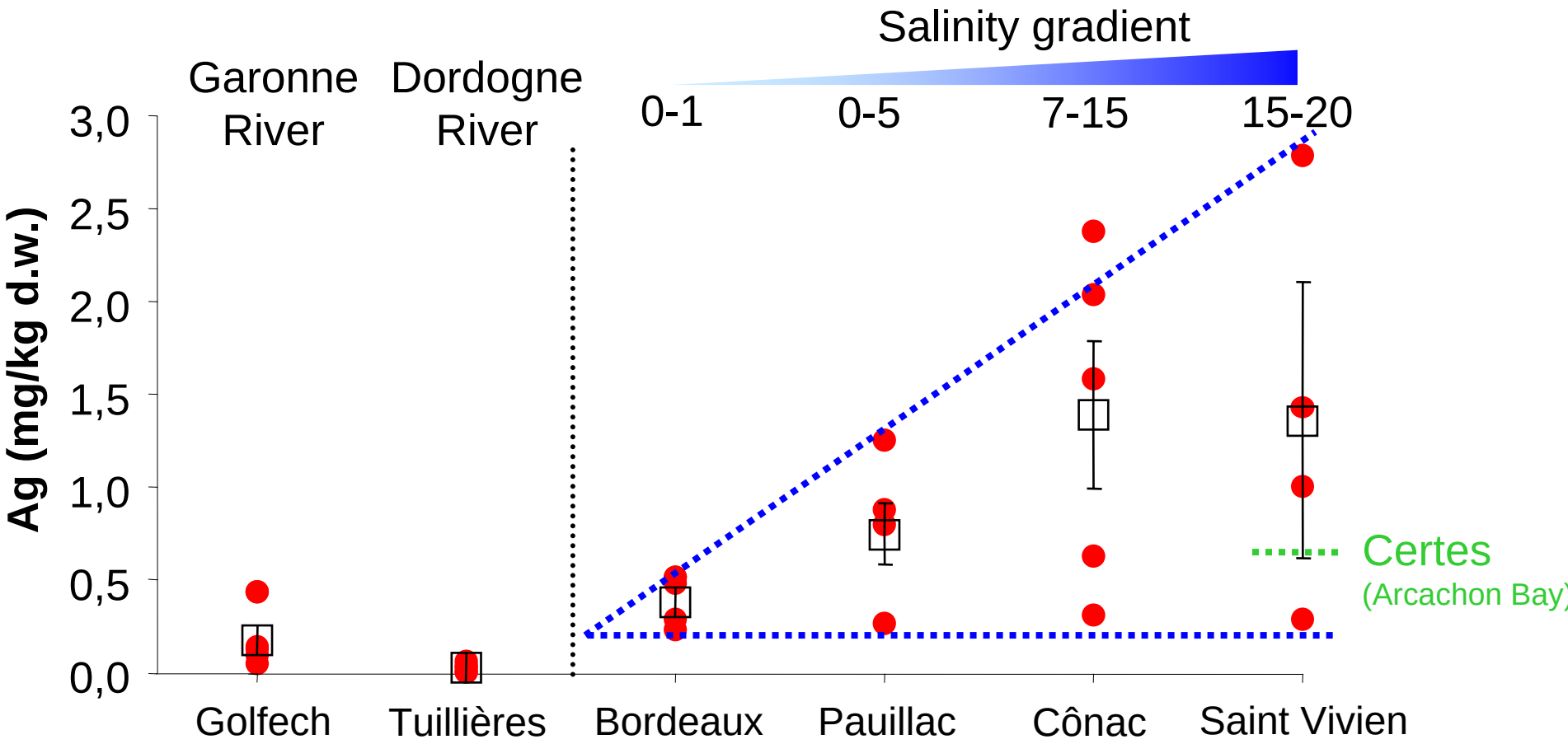
- Ecology : unique lifecycle
  predator at the top of the estuarine food chain
  long residence time in the fluvial-estuarine system (up to 15 years)
  high lipid accumulation

- Economic importance (elver: 700-900 €/kg; professional fishing)
- Patrimonial interest (migrating fish species, sport fishing….)
- Political pressure (European Community : “Eel Management Plan” until end of 2008)

Ag in eel liver (Gironde Estuary and tributary rivers)

(●) 5.7

« Yellow Eel » stage; n=5 at each site



Similar in magnitude to values reported for eel in the Thames estuary

(*Langston et al., 2002;* *Mar Environ Res*) :

Inner: London **Mid:** **Outer:**

10.3 mg/kg d.w. **2.4 mg/kg d.w.** **4.7 mg/kg d.w.**

Conclusions

Ag in the Gironde Estuary derived from both urban sources and ore treatment

Ag addition in the salinity gradient reflected by Ag concentrations in eel liver

Ag levels in eel liver are similar in magnitude to those in the Thames Estuary

Perspectives

Improve source identification and complete mass balance for the Gironde Estuary (e.g. particulate Ag inputs at Bordeaux)

Reactivity of Ag in the estuarine geochemical gradients (salinity, turbidity, redox)

Relationship concentration / speciation and bioaccumulation / toxic effects

EEL-scope (2008-2010)

Acknowledgements: ANR Vulnérabilité, Milieu et Climat, Agence de l'Eau Adour-Garonne, SMIDDEST

Thank you for your attention

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