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THE EUTROPHICATION IN THE RIVER VOUGA BASIN - IMPACTS ON THE QUALITY OF WATER FOR PUBLIC SUPPLY

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Summary:

- **The river Vouga basin**
- **Water quality problems**
- **Options for water management**
  - **Control of urban pollution**
  - **Control of non point pollution**
  - **Garanty of minimum flow**

Hydrology of River Vouga Basin

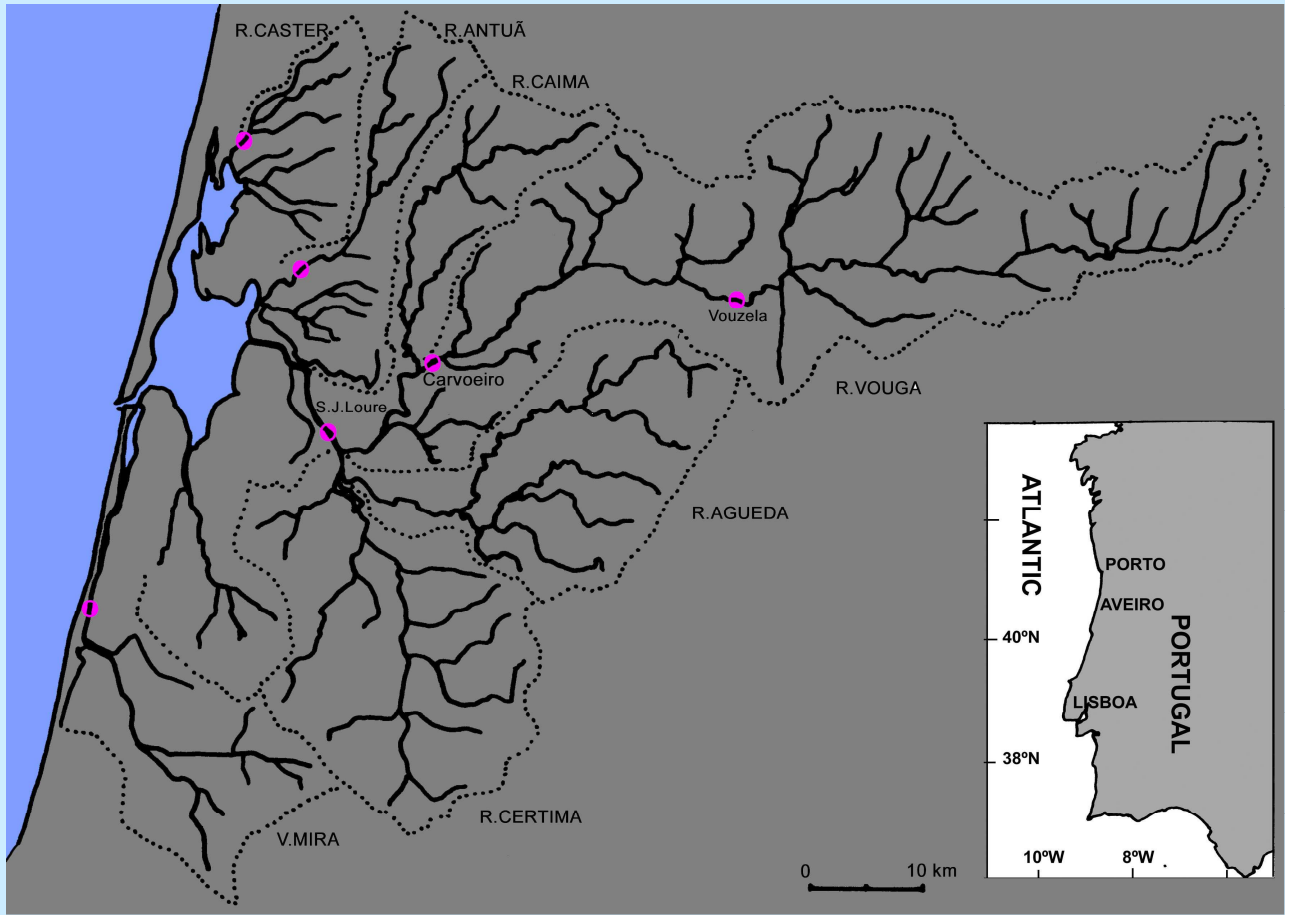
Several rivers flow into the estuarine system of Ria de Aveiro

- Total catchment area c. 3600 km^2
- Samples were collected in the main rivers:

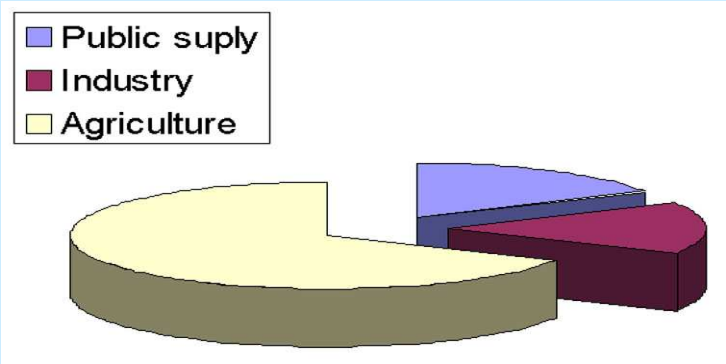
Vouga (2500 km^2)
V.Mira (300 km^2)
Antuã (150 km^2)
Caster (80 km^2)

The hydrologic regime involves a summer low flow condition.

The dynamic of the coastal lagoon of Ria de Aveiro, is dominated by tidal oscillation.



Water Use and Surface Water Intake



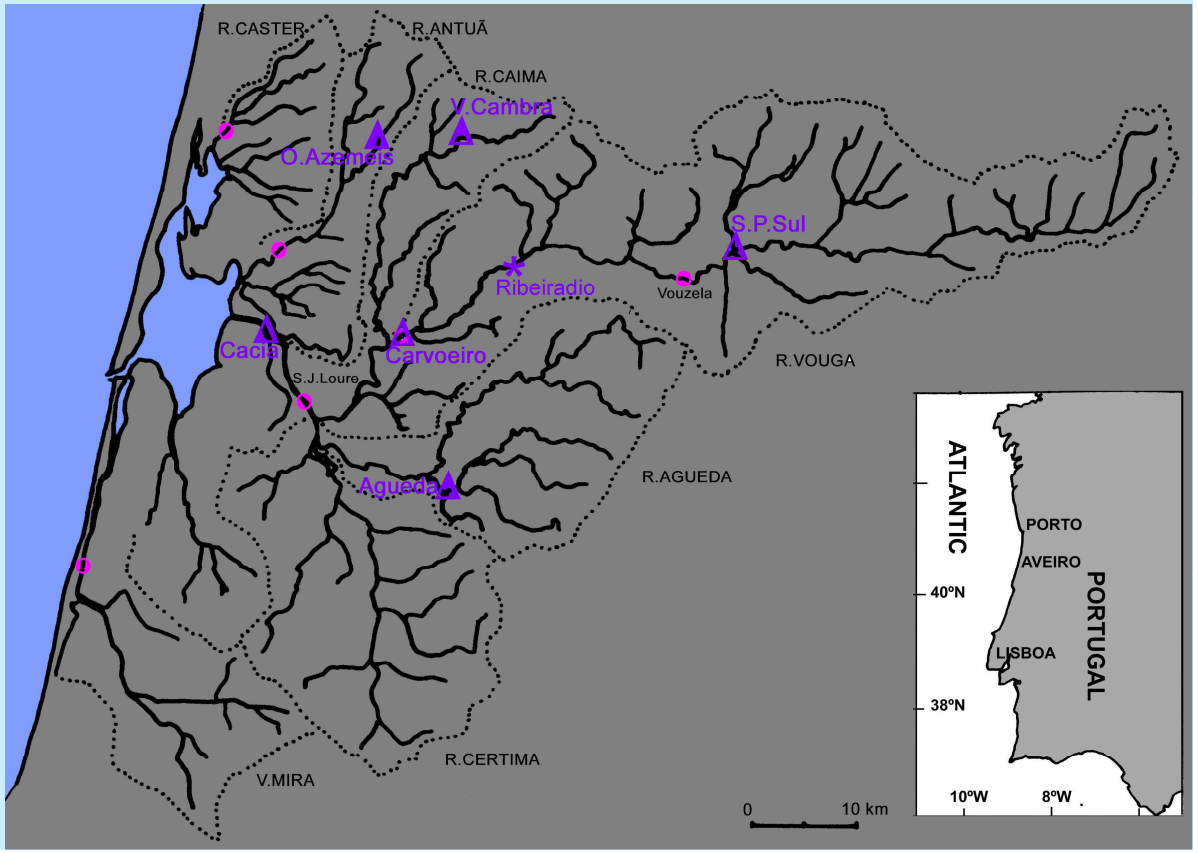
Global water use is estimated to be 243 hm^3/year (1999)

A large number of water sources are used: ~400

Surface water intakes for municipal and industrial use are few, but important:

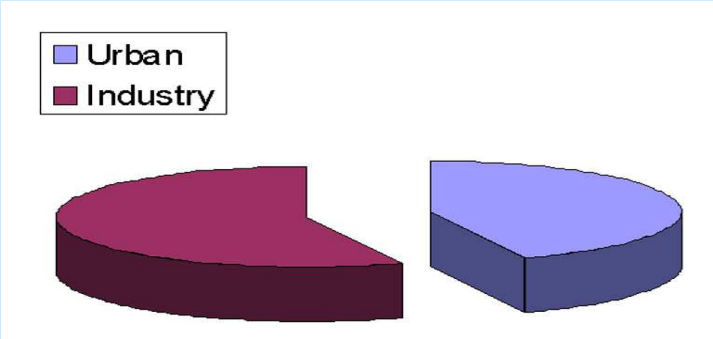
~30% of the total

- Carvoeiro supplies ~9 hm^3/year



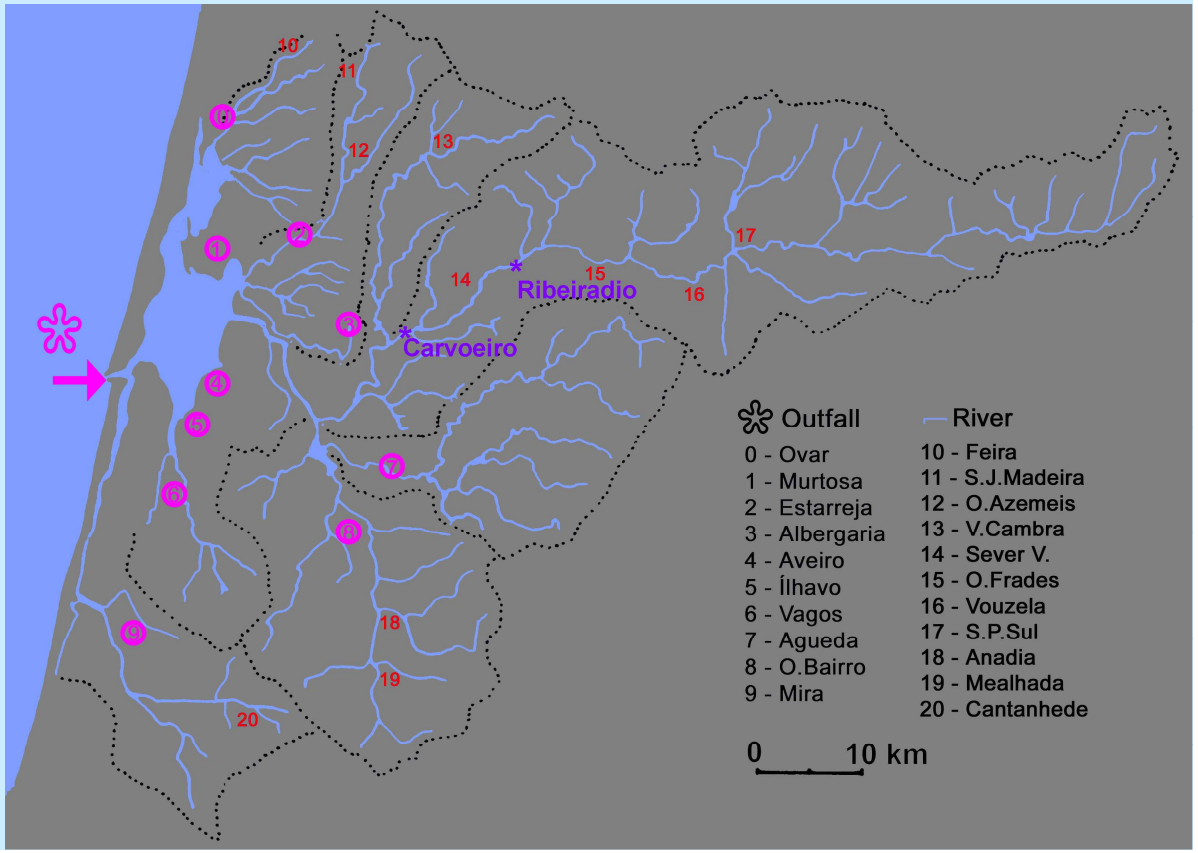
Water Pollution from Point Sources

Total wastewater generated is 73 hm^3/year, from urban and industrial sources.



The wastewater from the lower area of the basin is transported for discharge in a submarine outfall.

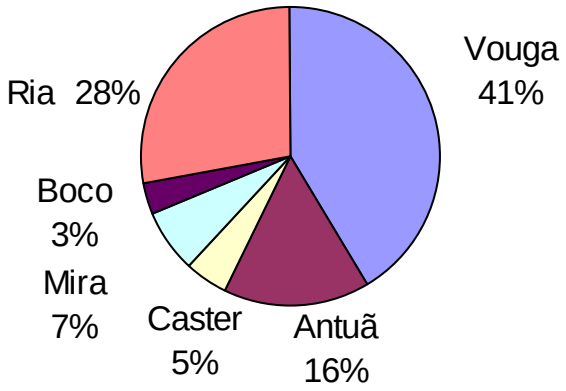
In the upper reaches wastewater is discharged into the rivers.



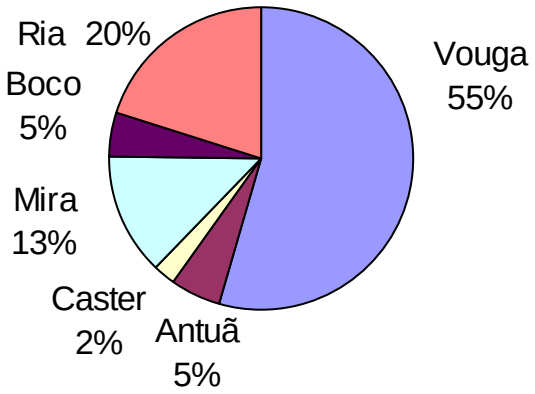
Pollution by Nitrogen
Role of Animal Husbandry

River	Inhabitants km^{-2}	Equivalent km^{-2}	Urban area %	Agricultural %	Other area %
Vouga	103	581	15	22	61
Antuã	551	795	30	14	56
Caster	516	1122	42	17	67
Mira	111	915	7	42	51
Boco	144	897	18	35	52
Ria	262	799	22	30	49

Load in sewage



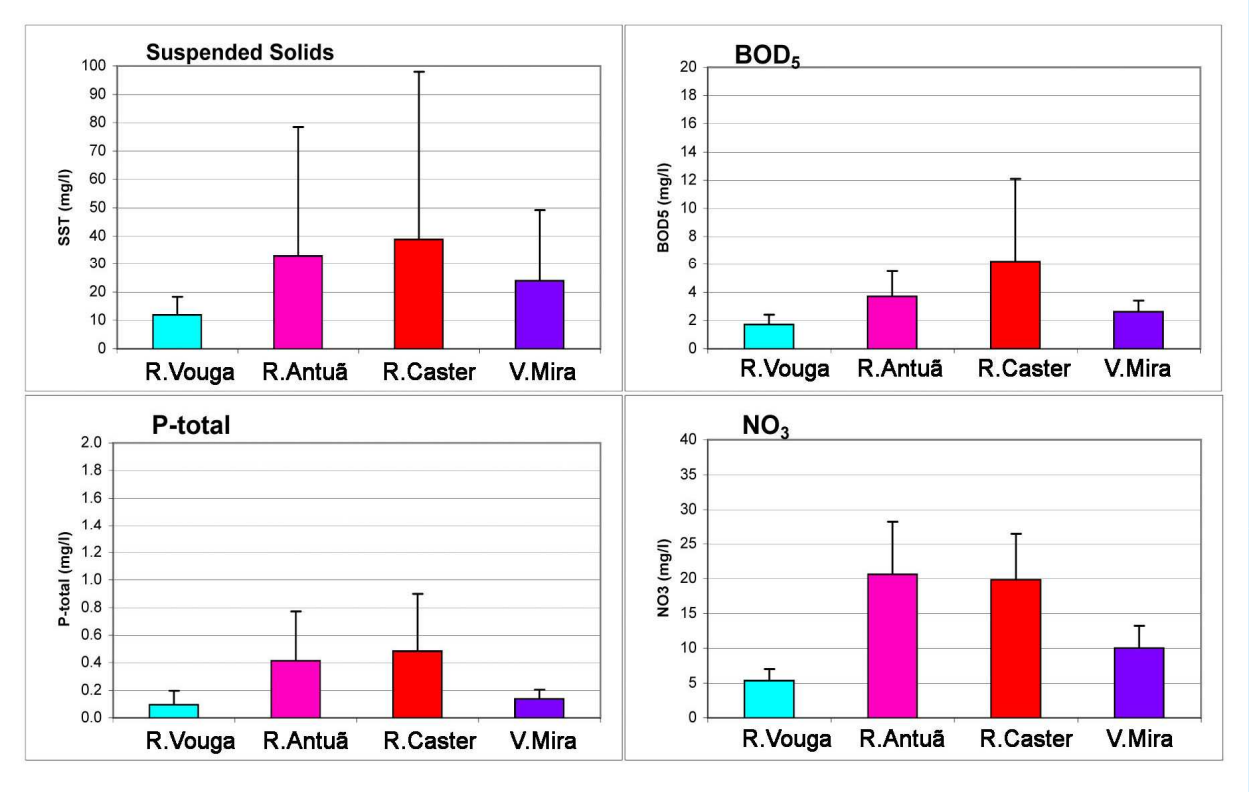
Equivalent Load from Animal Husbandry



Quality of Water in the River Inflow to the Ria de Aveiro

- River Vouga has the lower concentration of pollutants which agrees with the lower density of water use in this basin

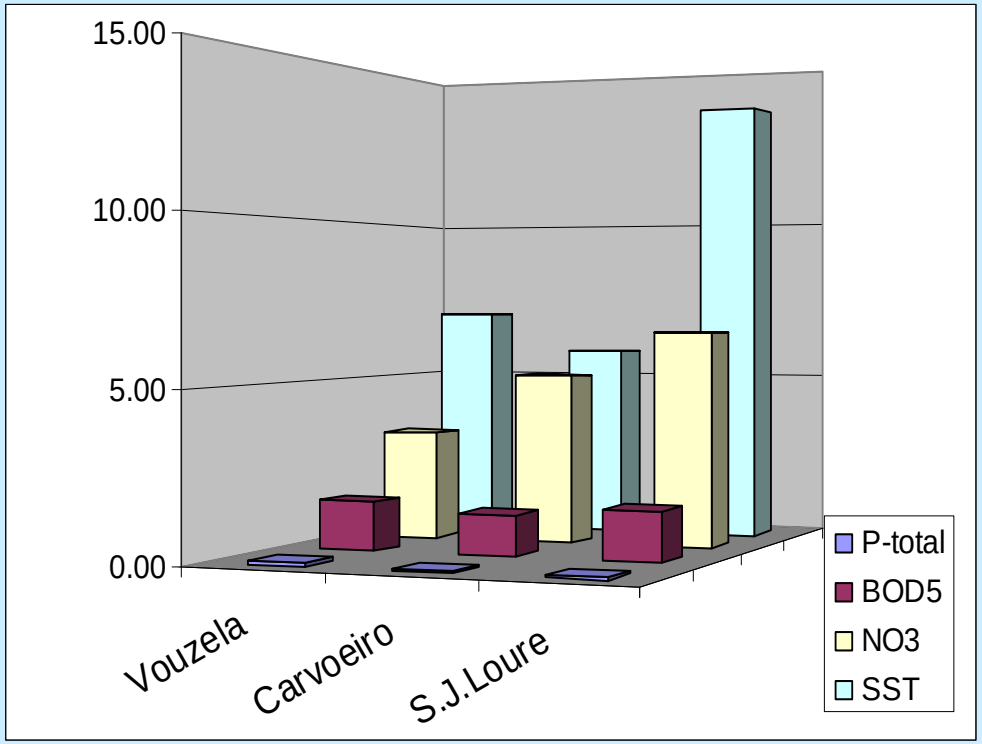
- Rivers Antuã and Caster have higher concentrations of pollutants, in result of a larger load of urban wastewater.



Mean concentrations in samples collected between April 2000 and May 2004

Quality of Water in the River Vouga

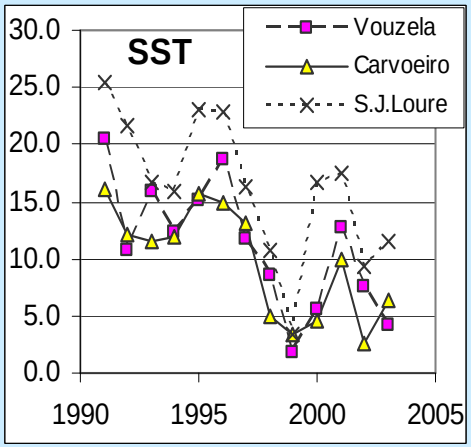
- Suspended solids, BOD and total P decrease along the reach from Vouzela to Carvoeiro.
- The results from the downstream station, in S.J.Loure, point to a reduction in the water quality after the input of the tributaries Caima and Agueda.
- Thus, Carvoeiro corresponds to an optimal location for water intake from the river Vouga, concerning its quality.
- Increase in nitrate concentration leads to a mild eutrophication in the river and potencially in the Ria de Aveiro

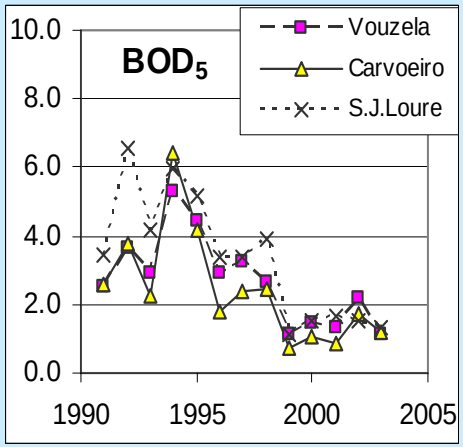


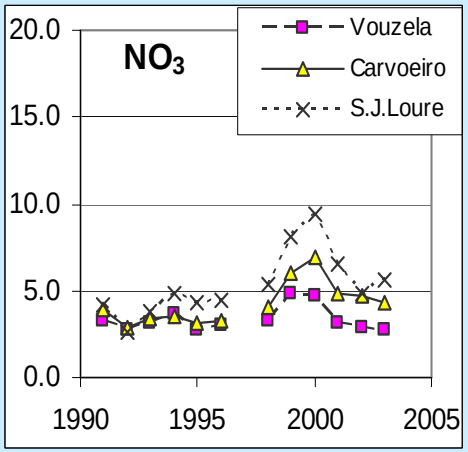
Mean concentrations in sampling stations in river Vouga for the period January 2000 to December 2003

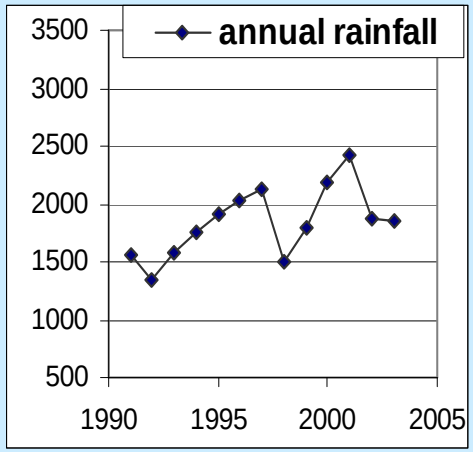
Trends in the Quality of Water in the River Vouga

- Statistical significant trends in the water quality parameters were found for the period 1990-2003:
  - The SST concentration decreases in Vouzela and Carvoeiro
  - The BOD5 concentration decreases only in S.J.Loure
  - The nitrate concentration increases in Carvoeiro and S.J.Loure
- These trends imply an improvement of the water quality, with the exception of the nutrient enrichement in the lower reach



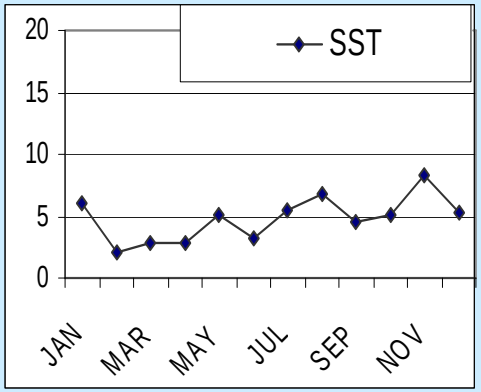


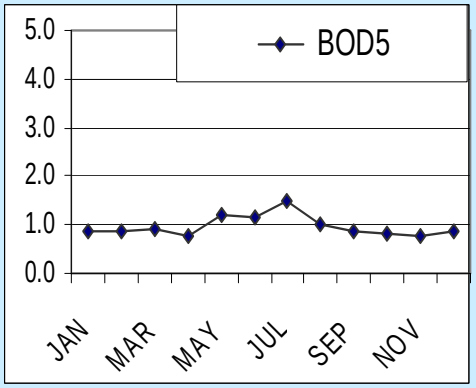


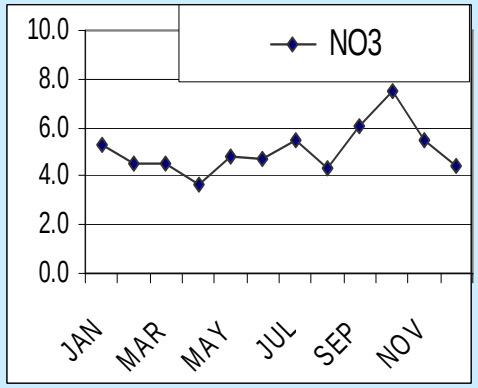


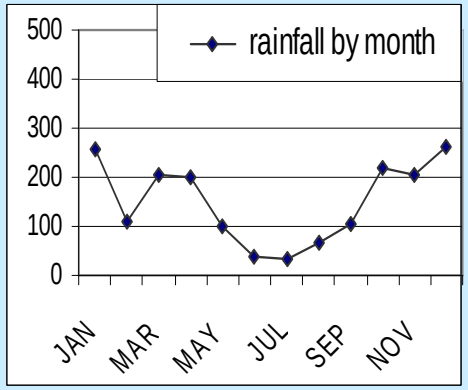
Importance of Non-point Loads

- The monthly mean concentrations obtained in the monitoring in Carvoeiro show that SST increases from February to November.
- BOD5 inreases from April to July .
- Nitrate has a maximum in October, the first wet month.
- These variations can be explained by the relative importance of non-point loads in relation to the urban wastewater load.









Water Quality Problems

The urban wastewater causes pollution with coliform bacteria, organic material and plant nutrients.

The agricultural activities contribute predominantly with nitrogen.

These pollution loads reduce the river water quality, which requires treatment before use for public supply.

Water is abstracted in Carvoeiro, after infiltration in the river bed, and is treated with lime and desinfected with chlorine.

- The infiltration removes 93 % of the fecal coliform
- The dose of chlorine for desinfection is 1.2 mg/L

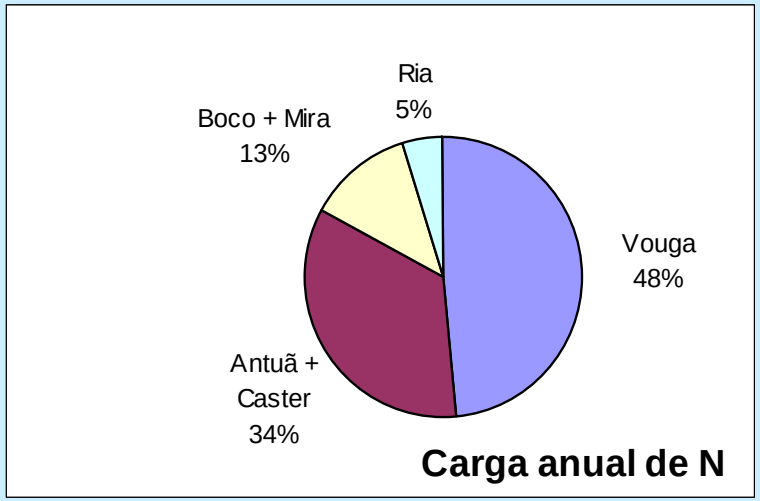
Operational problems include:

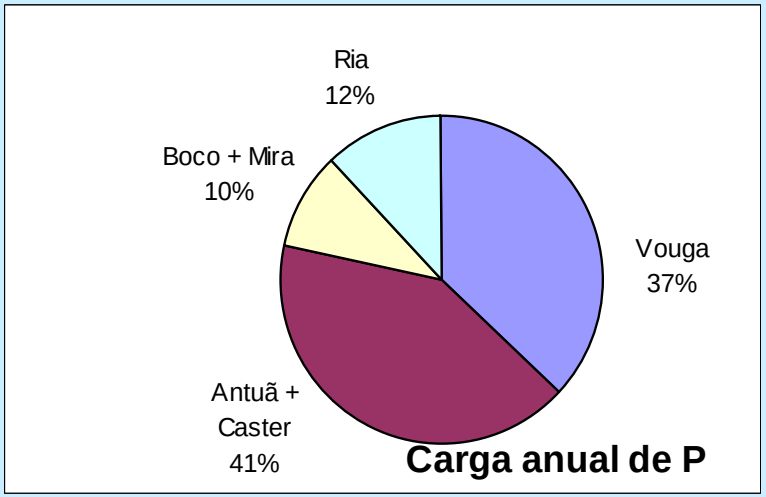
- Clogging of the sand by the solids contained in the river water.
- High chlorine demand for oxidation of organic material in the water.
- Occasional odour problems.

The trend for increased nutrification will aggravate the problems in Carvoeiro and potencially in the Ria de Aveiro.

Nutrient Loading of the Ria de Aveiro

- The river Vouga contributes with almost 50% of the N loading to the Ria de Aveiro.
- The load of P is also important, but less than N load.
- P load is now significantly lower, in result of the Simria system discharging wastewater by a submarine outfall.





Conclusions

River Vouga water is moderately polluted.

Non-point sources are important.

An increase in nitrate concentration has been observed.

To garanty the summer water flow, a reservoir is projected to be built in Ribeiradio.

The increase in the water retention time will aggravate the eutrophication problem.

It will be necessary not only to improve the control of urban wastewater, but also the agricultural activity and the animal husbandery.

R.Vouga pollution – Past & Present

Rio Vouga, 1985

S. Jacinto, 2002

Sistema Regional da Simria

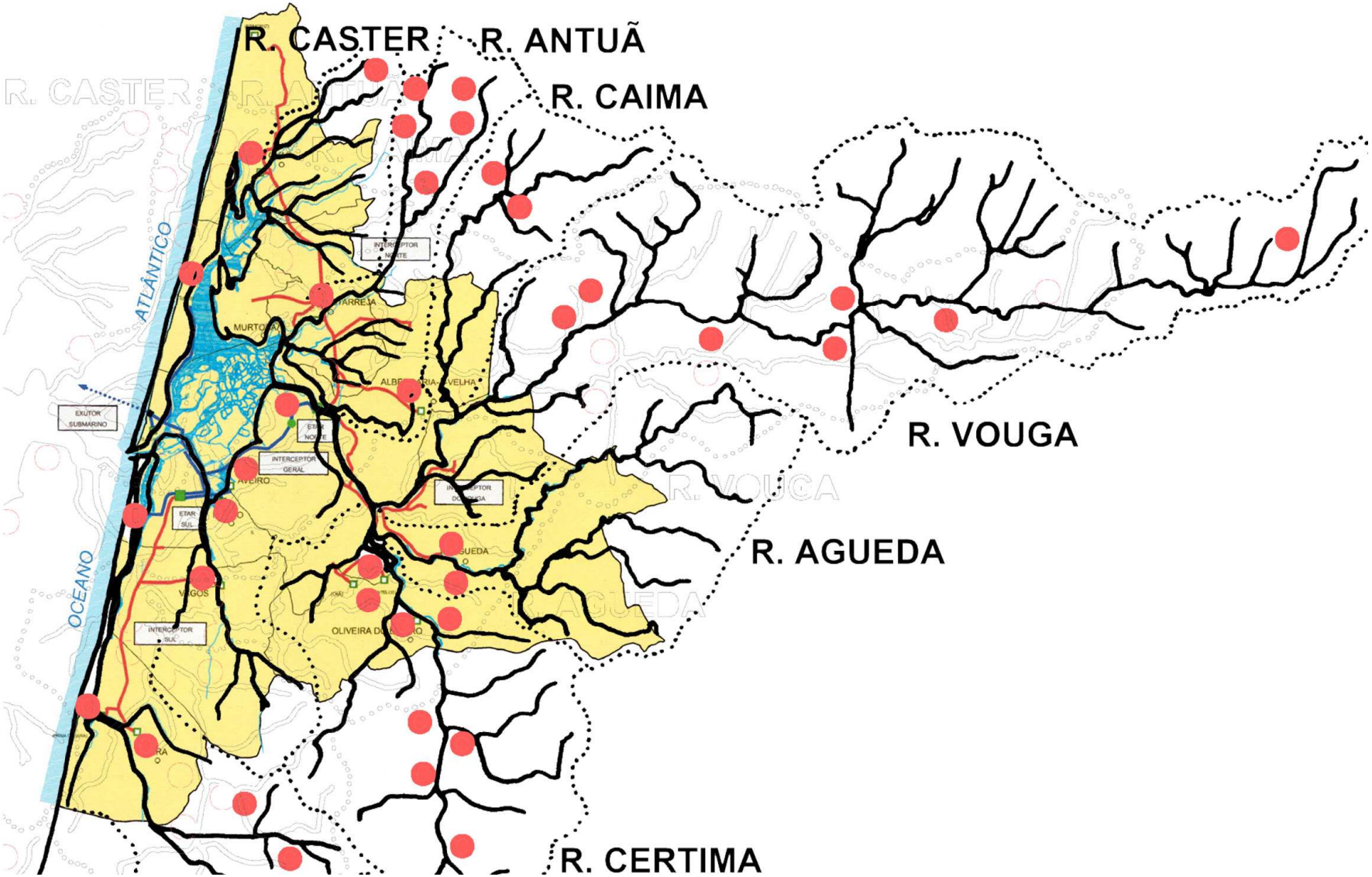
SISTEMA REGIONAL SIMRIA:

- A rede de interceptores com 180 km está ligada a um emissário submarino com 3 km.
- Vai servir >280 000 habitantes.
- Efluentes industriais tratados são também transportados para o mar.
- O fluxo de azoto emitido no mar é c. 30 gs^{-1}:
  - Fracção da carga média anual de c. 15%
- O fluxo de fósforo emitido no mar é c. 7 gs^{-1}:
  - Fracção da carga média anual de c. 40%

IMPACTO DO SISTEMA SIMRIA:

- Pequenas alterações das condições nos rios:
  - Rios Caster, Antuã e Cértima pouco melhoram.
- Maior impacto sobre caudais e cargas de nutrientes para a Ria de Aveiro, durante o verão:
  - Redução de cargas e caudais > 50%

O Sistema de Saneamento Regional e as Principais Áreas Urbanas



Futuro da Qualidade da Água dos Rios

- O sistema regional da simria transfere para o oceano as águas residuais que são geradas na área que rodeia a Ria de Aveiro:
  - Melhora a qualidade da água mas cria stress hídrico

- A recolha e tratamento de águas residuais nas sub-bacias com maior densidade de habitantes (Águeda, Certima, Caster e Antuã) deve ser melhorada.

- Para melhorar a qualidade do meio aquático é necessário:
  - Tratamento eficaz das águas residuais
  - A adopção de boas práticas agrícolas e florestais
  - A preservação das zonas tampão e das características hidráulicas
  - Minimizar o consumo de água (uso eficiente e reutilização)