

# Baseline survey on water and sediments: Agrochemicals, Hydrocarbons and Heavy Metals in an emergent mixed production area

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## INTRODUCTION

Main economic activities of the studied region



World's leading producer of pears. 36,877 ha cultivated.

Enlargement of the agricultural area. Crop diversification.



Hydrocarbon basin- Geologic formation VACA MUERTA

- Second world reserve of tight gas
- Fourth world reserve of shale oil

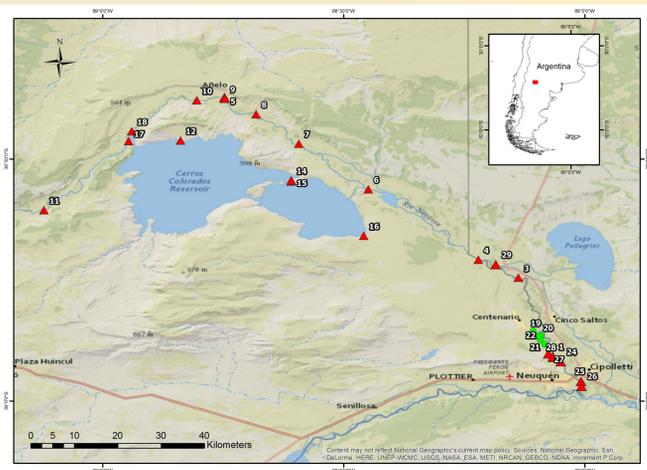
35 years of expected exploitation

The hydrographic basin of the Neuquen river is extremely important as it comprises the major water resource for agriculture, agroindustrial, mining and drinking water (app. 400.000 inhabitants). There is a great public concern about the potential impact of the expected productive development on the water quality. It is necessary to run independent studies providing current baseline information.

### Objective:

The aim of the present study is to assess the ecological condition of the middle and lower basin of the Neuquen river, addressing three main aspects: hydromorphology, biology and chemical status.

## METHODS AND MATERIALS



**Polyaromatic Hydrocarbons (PAHs)**  
 acenaphthene, acenaphthylene, anthracene, benzo[a]anthracene, benzo[b]fluoranthene, benzo[k]fluoranthene, benzo[ghi]perylene, benzo[a]pyrene, chrysene, dibenzo[a,h]anthracene, fluoranthene, fluorene, indeno[1,2,3-cd]pyrene, naphthalene, phenanthrene and pyrene

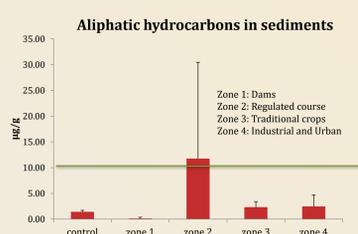
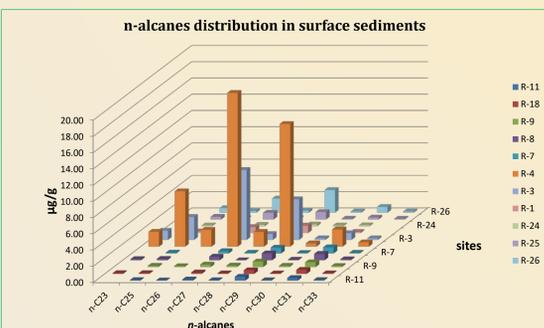
**Organochlorine pesticides and pyrethroids**  
 $\alpha$ -HCH,  $\beta$ -HCH,  $\delta$ -HCH,  $\gamma$ -HCH, Heptachloro, Aldrin, Heptachloro epoxy, Endosulphan I, pp-DDE, Dieldrin, Endrin, pp-DDD, Endosulphan II, pp-DDT, Endrin aldehyde, Endosulphan sulfate, Metoxichloro, A-Cialotrine, Permethrine, Cipermetrine, Fenvalerate and Deltametrine.

**Organophosphate pesticides and carbamates**  
 propoxur, dimethoate, carbofuran, carbaryl, chlorpirifos, methidation, fenamifos, triazophos, phosmet and metylzinphos.

The studied area embraces an extension of 120 km including two dams, a regulated section (12 m<sup>3</sup>/s) and the river after the water restitution (300 m<sup>3</sup>/s). 28 sampling sites were selected in the river, in the dams, and in farm drainages. Water and sediments samples were taken along 4 sampling campaigns. Organochlorine pesticides and pyrethroids (GC- $\mu$ ECD); organophosphate pesticides and carbamates (GC-NPD, GC-MS), heavy metals (ICP-OES, ICP-MS), AHs and PAHs (GC-FID, GC-MS) were analyzed. At the same time, aquatic macroinvertebrates were sampled using the multi habitat method. Basic physicochemical, hydrological and habitat data were measured in situ.

## RESULTS

### Aliphatic Hydrocarbons: n-alkanes C<sub>9</sub>-C<sub>36</sub>



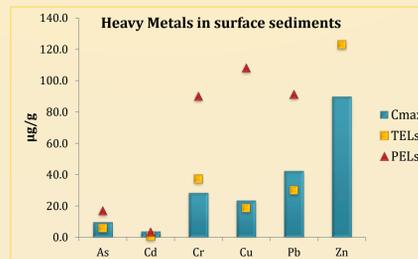
**Evaluation Indexes**  
 CPI: 3.22-42.13. Biogenic source  
 MH: n-C27, n-C29 o n-C31. Terrestrial vascular plants  
 Even/Odd ratio: 0,04 - 0,26. Biogenic source

The reference value for non-contaminated sites, TPH 10 $\mu$ g/g (UNEP), was exceeded in sites 3 and 4. However, the non detection of PAHs in addition to the evaluation indexes show a biogenic source of the detected compounds.

### Heavy Metals

Metal	Sediments		Water	
	Mean $\mu$ g/g	SD $\mu$ g/g	Mean $\mu$ g/L	SD $\mu$ g/L
As	5.39	2.39	5.36	1.32
Cd	3.49	0.31	0.34	0.02
Cr	21.18	4.45	0.99	0.50
Cu	15.37	6.67	2.68	1.60
Pb	33.44	6.71	1.92	1.18
Zn	66.08	23.96	9.01	2.96
Hg	<LOQ		<LOQ	
B	24.16	23.28	56.05	15.60
Ba	24.16	21.25	61.34	33.49

Heavy metals levels do not show trends that could be attributed to the agro industrial activity.



TELs: Threshold Effect Levels  
 PELs: Probable Effect Levels

- Below the TEL: the minimal effect range within which adverse effects rarely occur.
- Between the TEL and PEL; the possible effect range within which adverse effects occasionally occur.

### Pesticide Residues

Maximum values  
 Clorpyrifos : 23 ng/g  
 pp'DDE: 54 ng/g  
 pp'DDD: 0,14 ng/g  
 Endosulphan sulphate: 0,24 ng/g

No OP and carbamates pesticide residues were detected along the sub-basin, except for isolated cases where chlorpyrifos was detected in sediments of farmland drains.

Detection of organochlorine pesticide residues in some sediment samples (pp'DDE) can be attributed mainly to an historical origin.

Low detection of organophosphorus and carbamate pesticides can be attributed to a greater number of producers applying integrated pest management and replacement by other active ingredients of less toxicity.

However, crop diversification can bring in new pests and the application of other active principles that will need to be controlled.

### Macroinvertebrates Assessment

78 taxa of macroinvertebrates were determined, taxa with greater abundance were Diptera, Crustacea, Ephemeroptera and Mollusca. The analysis of the structure of the assemblages did not show significant differences in taxonomic richness, abundance and diversity among the sampled sites of the basin.

*Hyalrella Curvispina* (Crustacea)

Leptophlebiidae (Ephemeroptera)

*Lymnaea* (Gastropoda)

## CONCLUSION

As a preliminary conclusion the ecological status of the water body can be classified as good (DIRECTIVE 2000/60/CE) with very minor anthropogenic alterations from those normally associated with undisturbed conditions. This is an initial recognition survey from which an ordinary monitoring program is strongly recommended.