ENVIRONMENTAL RISK ASSESSMENT OF PESTICIDES IN RESERVOIRS OF SOUTH OF PORTUGAL

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Instituto Politécnico de Beja Escola Superior Agrária

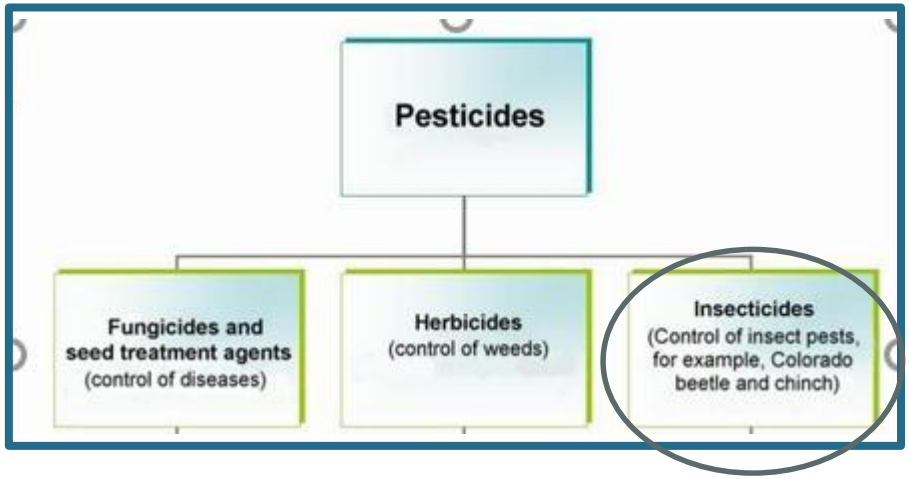
ICT Instituto de Ciências da Terra

ALOP Alentejo Observation and Prediction systems

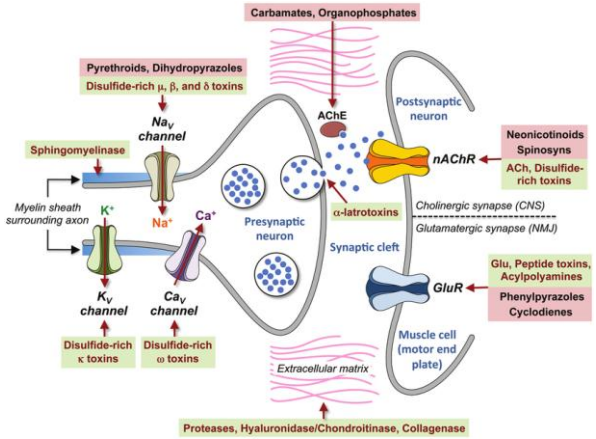
WHAT ARE PESTICIDES?

PESTICIDES ARE GOOD OR BAD SUBSTANCES?

GROUPS OF PESTICIDES?

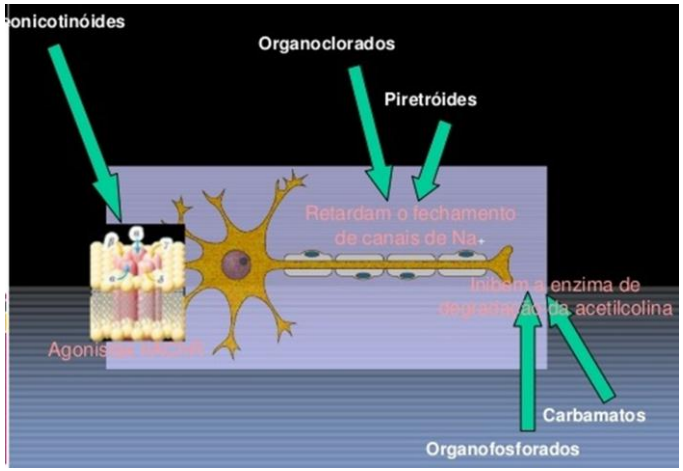


ACTION AT NERVOUS SYSTEM



ENDOCRINE DISRUPTION

(Graham Mills, 2014. water, water everywhere, but is it to fit to drink?)



PESTICIDES ARE GOOD OR BAD SUBSTANCES?

FRAMERS, INDUSTRY

PESTICIDES ARE GOOD

BIOLOGISTS, TOXICOLOGISTS ECOLOGISTS……

PESTICIDES ARE BAD

WORK TOGETHER FOR THE SUSTAINABLE USE OF PESTICIDES

WORLD ECONOMIC PRESSURE

FITOFARMGEST

PESTICIDES PLAYS AN IMPORTANT ROLE IN HARVEST QUALITY AND FOOD PROTECTION, PROVIDING BENEFITS FOR INCREASING PRODUCTION, SUCH AS THE REDUCTION OF PESTS.

BUT……..ITS MASSIVE GLOBAL USE HAS PROMOTED THE INCREASE OF RESISTANCE TO PLAGUES AND CONTAMINATION OF FOOD PRODUCTS AND ABIOTIC COMPARTMENTS

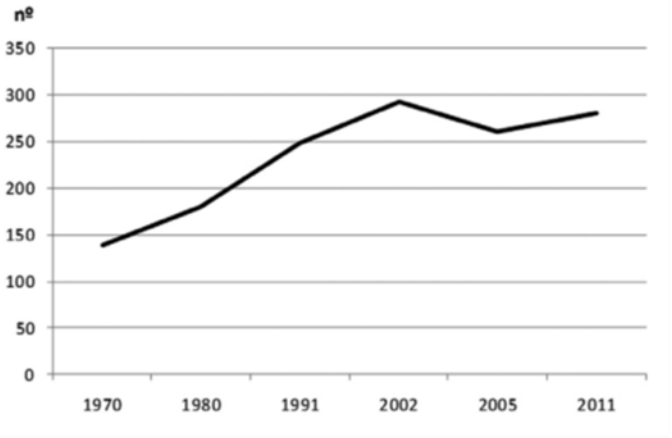
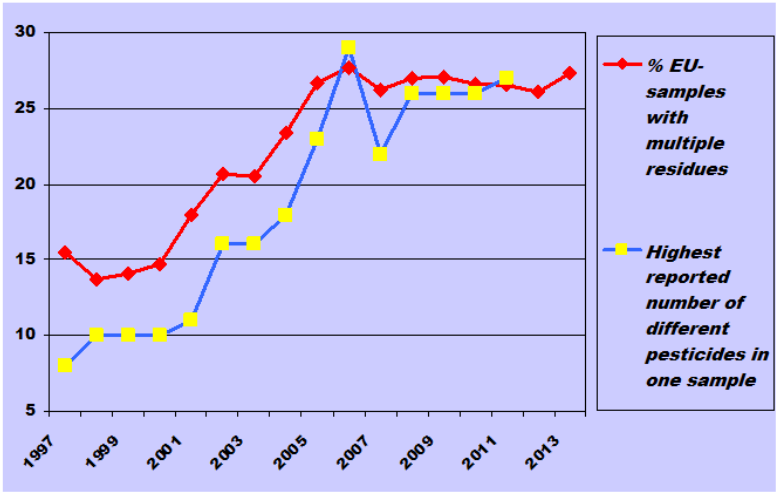
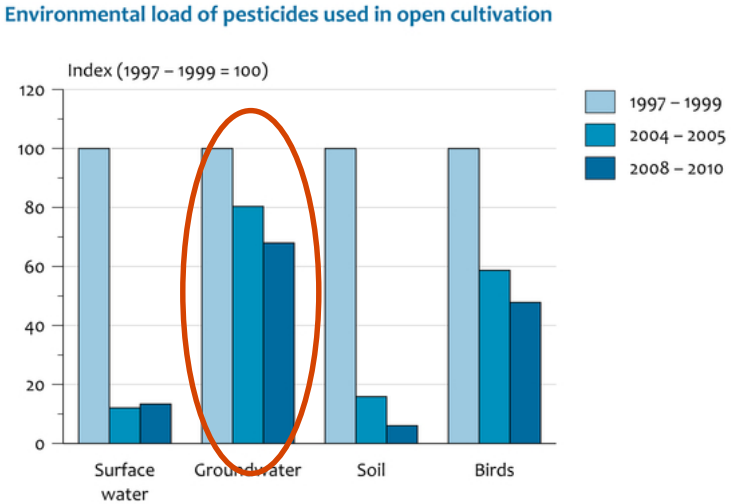


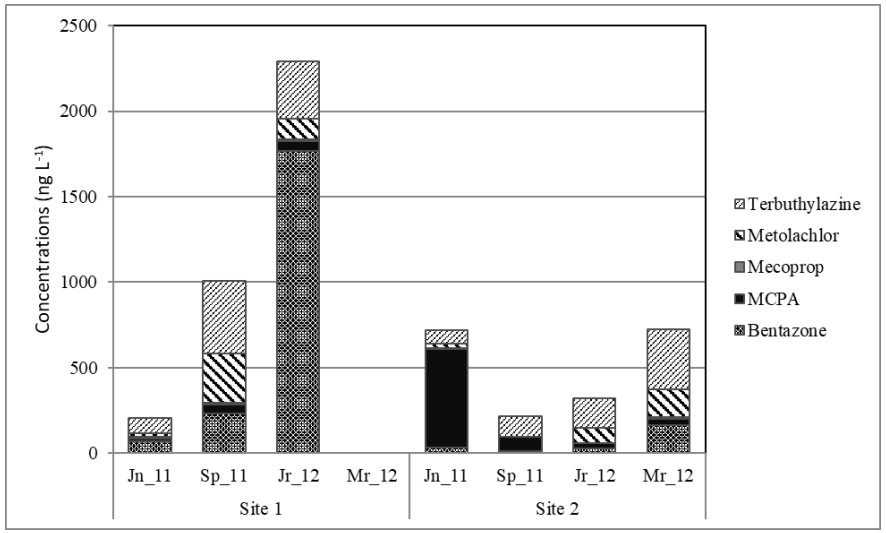
Figura 1 – Evolução do número de insecticidas, fungicidas e herbicidas, entre 1970 e 2011, em Portugal (Amaro, P. 2012. Revista das Ciências Agrárias).



https://www.pan-europe.info/issues/pesticide-use-europe

SEVERAL STUDIES HAVE REPORTED THE PRESENCE OF PESTICIDES IN RIVERS AND GROUNDWATERS, IN ASSOCIATION WITH THE WIDE RANGE OF AGRICULTURE PRACTICES (Azevedo et al., 2000; Cerejeira et al., 2003; Palma et al., 2018; Melo et al., 2012; Silva et al., 2012).





Concentrations of pesticides (ng L^{-1}) quantified in Brejo do Cagarrão stream (Alentejo coast, South of Portugal) (Palma et al., 2018)

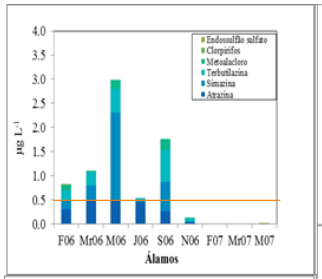
WHAT ABOUT RESERVOIRS?????

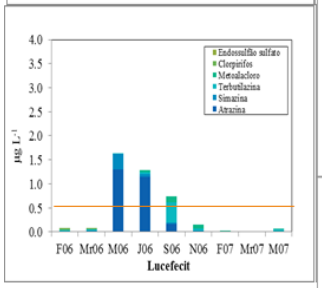
FEW STUDIES HAVE INVESTIGATED THE IMPACT OF PESTICIDES IN HEAVILY MODIFIED WATERS.

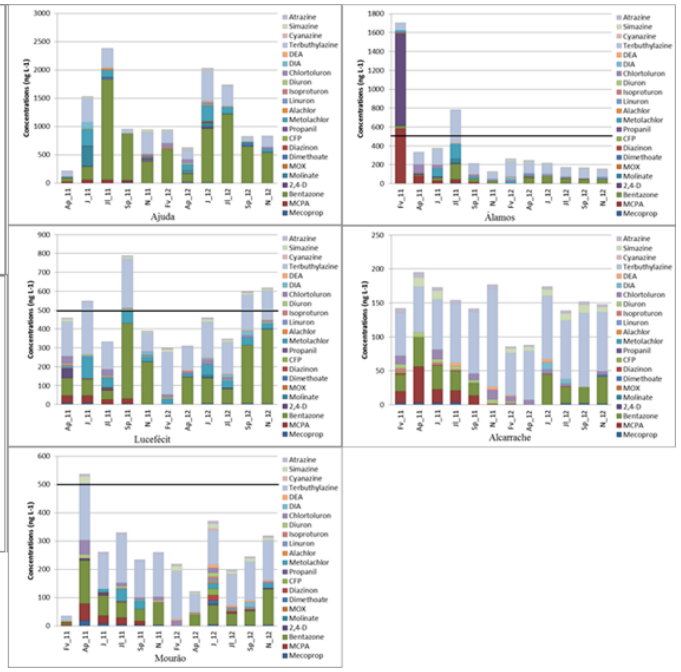
HOWEVER, AT THE PRESENT…….

…….ARE THE MOST IMPORTANT WATER SOURCES FOR IRRIGATION AND PUBLIC WATER SUPPLY AT ALENTEJO REGION (SOUTH PORTUGAL).

THE ECOSYSTEMS OF THESE WATER BODIES ARE ESPECIALLY ENDANGERED BECAUSE OF THE RISK OF HIGH POLLUTANT LOADS IN SHALLOW WATERS WITH LOW DILUTION CAPACITY







Palma et al., 2009. Environment International. 35(3): 545-551.
Palma et al. 2014,. Sci. Total Environ.; 488–489: 208–219.

SUSTAINABLE MANAGEMENT OF PESTICIDES IS BASED IN LEGAL NORMS:

WATER FRAMEWORK DIRECTIVE 2000/60/EC (EEC 2000): good ecological and good chemical status).

ENVIRONMENTAL QUALITY STANDARDS (2013/39/EC), establishing the limits of concentrations for: (i) PRIORITY SUBSTANCES alachlor, atrazine, chlorfenvinphos, chlorpyrifos, diuron, isoprotoron, simazine (CMA - maximum admissible concentration; MA - annual average); and (ii) PRIORITY HAZARDOUS SUBSTANCES: endosulfan, hexachlorobenzene (must be eliminated from water bodies).

'ANNEX I

ENVIRONMENTAL QUALITY STANDARDS FOR PRIORITY SUBSTANCES AND CERTAIN OTHER POLLUTANTS

PART A: ENVIRONMENTAL QUALITY STANDARDS (EQS)

AA: annual average.

MAC: maximum allowable concentration.

Unit: [µg/l] for columns (4) to (7)

[µg/kg wet weight] for column (8)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
No	Name of substance	CAS number (1)	AA-EQS (2) Inland surface waters (3)	AA-EQS (2) Other surface waters	MAC-EQS (2) Inland surface waters (3)	MAC-EQS (2) Other surface waters	EQS Biota (10)
(1)	Alachlor	15972-60-8	0,3	0,3	0,7	0,7	
(3)	Atrazine	1912-24-9	0,6	0,6	2,0	2,0	
(4)	Benzene	71-43-2	10	8	50	50	
(5)	Brominated diphenyl-ethers (7)	32534-81-9			0,14	0,014	0,0085
(6)	Cadmium and its compounds (depending on water hardness classes) (4)	7440-43-9	≤ 0,08 (Class 1) 0,08 (Class 2) 0,09 (Class 3) 0,15 (Class 4) 0,25 (Class 5)	0,2	≤ 0,45 (Class 1) 0,45 (Class 2) 0,6 (Class 3) 0,9 (Class 4) 1,5 (Class 5)	≤ 0,45 (Class 1) 0,45 (Class 2) 0,6 (Class 3) 0,9 (Class 4) 1,5 (Class 5)	
(6a)	Carbon-tetrachloride (7)	56-23-5	12	12	not applicable	not applicable	
(7)	C10-13 Chloro-alkanes (8)	85535-84-8	0,4	0,4	1,4	1,4	
(8)	Chlorfen-vinphos	470-90-6	0,1	0,1	0,3	0,3	
(9)	Chlorpyrifos (Chlorpyrifos-ethyl)	2921-88-2	0,03	0,03	0,1	0,1	
(9a)	Cyclodiene pesticides: Aldrin (7) Dieldrin (7) Endrin (7) Isodrin (7)	309-00-2 60-57-1 72-20-8 465-73-6	Σ = 0,01	Σ = 0,005	not applicable	not applicable	

WATCH LIST (2015/495/CE) stablishing a watch list of substances for monitoring in the field of the water policy.

PORTUGAL

ANNEX

Watch list of substances for Union-wide monitoring as set out in Article 8b of Directive 2008/105/EC

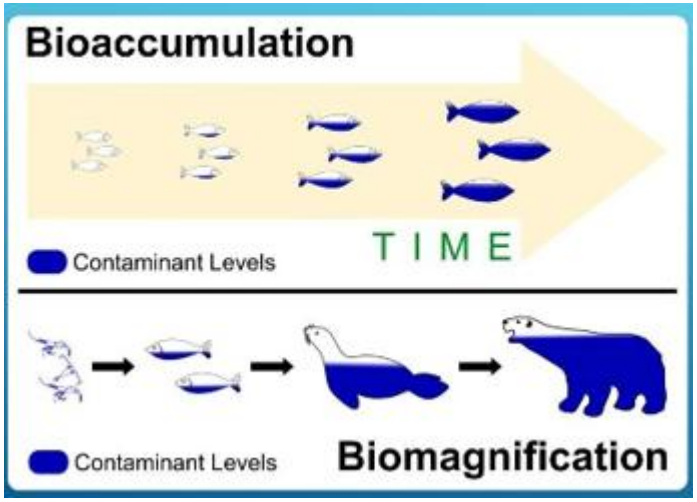
Name of substance/group of substances	CAS number (1)	EU number (2)	Indicative analytical method (3) (4) (5)	Maximum acceptable method detection limit (ng/l)
17-Alpha-ethinylestradiol (EE2)	57-63-6	200-342-2	Large-volume SPE — LC-MS-MS	0,035
17-Beta-estradiol (E2), Estrone (E1)	50-28-2, 53-16-7	200-023-8	SPE — LC-MS-MS	0,4
Diclofenac	15307-86-5	239-348-5	SPE — LC-MS-MS	10
2,6-Ditert-butyl-4-methylphenol	128-37-0	204-881-4	SPE — GC-MS	3 160
2-Ethylhexyl 4-methoxycinnamate	5466-77-3	226-775-7	SPE — LC-MS-MS or GC-MS	6 000
Macrolide antibiotics (6)			SPE — LC-MS-MS	90
Methiocarb	2032-65-7	217-991-2	SPE — LC-MS-MS or GC-MS	10
Neonicotinoids (7)			SPE — LC-MS-MS	9
Oxadiazon	19666-30-9	243-215-7	LLE/SPE — GC-MS	88
Tri-allate	2303-17-5	218-962-7	LLE/SPE — GC-MS or LC-MS-MS	670

(1) Chemical Abstracts Service.
(2) European Union number — not available for all substances.
(3) To ensure comparability of results from different Member States, all substances shall be monitored in whole water samples.
(4) Extraction methods:
LLE — liquid liquid extraction,
SPE — solid-phase extraction.
Analytical methods:
GC-MS — Gas chromatography-mass spectrometry,
LC-MS-MS — Liquid chromatography (tandem) triple quadrupole mass spectrometry.
(5) For monitoring 2-Ethylhexyl 4-methoxycinnamate in suspended particulate matter (SPM) or in sediment (size < 63 μm), the following analytical method is indicated: SLE (solid liquid extraction) — GC-MS, with a maximum detection limit of 0,2 mg/kg.
(6) Erythromycin (CAS number 114-07-8, EU number 204-040-1), Clarithromycin (CAS number 81103-11-9), Azithromycin (CAS number 83905-01-5, EU number 617-500-5).
(7) Imidacloprid (CAS number 105827-78-9/138261-41-3, EU number 428-040-8), Thiacloprid (CAS number 111988-49-9), Thiamethoxam (CAS number 153719-23-4, EU number 428-650-4), Clothianidin (CAS number 210880-92-5, EU number 433-460-1), Acetamiprid (CAS number 135410-20-7/160430-64-8).

DECREE-LAW No. 26/2013, of april 11, establishing the legal framework for monitoring procedures of pesticide uses, in order to reduce the risks of their application; and increment the protection of sensitive areas.

HOWEVER, EPISODES OF ABIOTIC CONTAMINATION CONTINUE TO BE REPORTED, WHICH MAY INCREMENT THE RISK FOR AQUATIC ECOSYSTEMS AND POPULATIONS DUE TO:

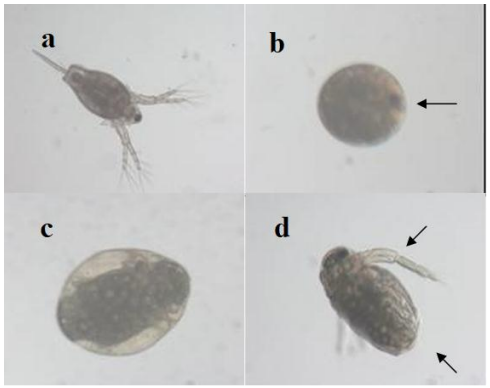
BIOACUMULATION AND BIOAMPLIFICATION PROCESSES IN THE TROPHIC CHAIN (Log Kow > 3)



ACUTE AND CHRONIC TOXIC EFFECTS

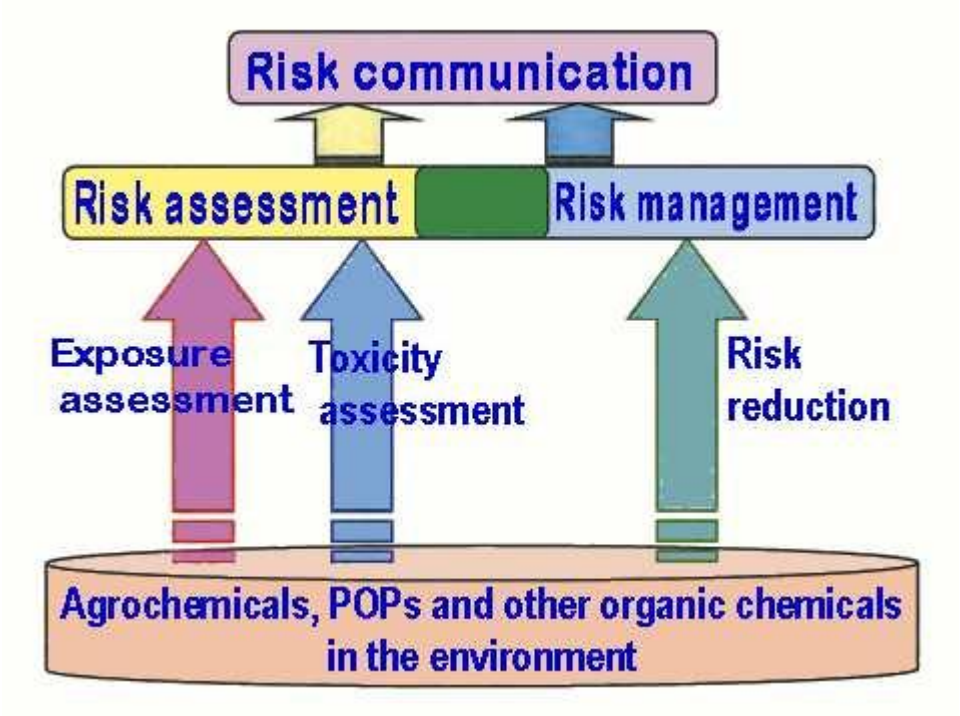
	EC_{50} (mg L^{-1})		
	Vibrio fischeri	*Thamnocephalus platyurus*	*Daphnia magna*
	30 min EC_{50}	24 h EC_{50}	48 h EC_{50}
Atrazina	69,4 (68,8-70,0)[a] (n=2) 39,9 (35,4-44,9)[b] > 39,9[c,*]	36,7 (23,2-50,3)[a] (n=3)	35,5 (26,3-44,7)[a] (n=4)
Endossulfão sulfato	11,2 (8,69-13,6)[a] (n=2)	0,58 (0,50-0,66)[a] (n=3)	0,92 (0,87-0,97)[a] (n=4) 2,12 (1,45-3,99)[e] 0,74 [f*]
Clorpirifos	2,84 (2,52-3,16)[a] (n=2) 46,0x10^{-3} [d*]	0,53x10^{-3} (0,26x10^{-3}-0,79x10^{-3})[a] (n=3)	0,74x10^{-3}(0,69x10^{-3}-0,79x10^{-3})[a] (n=4) 0,60x10^{-3} [g*] 0,17x10^{-3} [h*]

NOEL



ENVIRONMENTAL RISK ASSESSMENT (ERA) OF PESTICIDES IS VERY IMPORTANT TO EVALUATE THE REAL IMPACT OF PESTICIDES ON THE AQUATIC LIFE, INTEGRATING EXPOSURE (CONCENTRATIONS) AND HARMFUL EFFECTS ON ORGANISMS.

SOME PESTICIDES MAY BE PRESENT IN WATER BODIES AT LOW CONCENTRATIONS BUT ARE STILL SUFFICIENT TO CAUSE DELETERIOUS EFFECTS IN CERTAIN SPECIES BECAUSE OF THEIR HIGH TOXICITY.



PROPRIETIES OF PESTICIDES THAT INDUCE INCREMENT OF THE ENVIRONMENTAL CONCENTRATIONS (https://sitem.herts.ac.uk/aeru/ppdb/en/Reports/17.htm):

(I) ENVIRONMENTAL PERSISTANCE (HIGH "HALF-LIFE" (DT_{50}) IN SOIL AND WATER)

(II) HIGH SOLUBILITY IN ORGANIC SOLVENTS (ACCUMULATE AT FAT TISSUES)

(III) OCTANOL-WATER PARTITION COEFFICIENT (LogKow) > 3

(IV) GUS LEACHING POTENTIAL INDEX (>2.8 = High leachability)

Quadro 2 - Distribuição ambiental prevista (PED) para a água e o potencial de lixiviação dos pesticidas.

Pesticida	PED para a água (%)[a]	Índice Bacci e Gaggi[b]	Índice GUS[c]
Herbicida			
alacloro	47,3 (AM)	0,16 (L)	2,08 (T)
atrazina	77,7 (AE)	0,62 (L)	3,56 (L)
etofumesato	68,8 (AE)	0,20 (L)	2,17 (T)
metolacloro	58,1 (AM)	0,56 (L)	3,32 (L)
simazina	89,8 (AME)	0,56 (L)	3,35 (L)
terbutilazina	40,5 (AM)	0,44 (L)	3,18 (L)
trifluralina	1,56 (AMB)	0,02 (T)	0,17 (NL)
Metabolito			
3,4-dicloroanilina	67 (AE)	0,64 (L)	3,77 (L)
Inseticida			
Z-clorfenvinfos	13,5 (AMB)	0,11 (L)	1,87 (T)
E-clorfenvinfos	6,23 (AMB)	0,11 (L)	1,87 (T)
clorpirifos	2,15 (AMB)	1,08E-2 (T)	0,32 (NL)
α-endossulfão	1,96 (AMB)	8,79E-3 (NL)	-0,16 (NL)
β-endossulfão	1,75 (AMB)	8,79E-3 (NL)	-0,16 (NL)
lindano	25,7 (AB)	0,3 (L)	2,49 (T)

[a]Modelo de fugacidade de Mackay ('Nível I, versão 3.00, 2004, Universidade de Trentu, Canadá') se PED_A < 20%: Afinidade muito baixa (AMB); se 20% ≤ PED_A < 40%: Afinidade baixa (AB); se 40% ≤ PED_A < 60%: Afinidade média (AM); se 60% ≤ PED_A < 80%: Afinidade elevada (AE); se PED_A ≥ 80%: Afinidade muito elevada (AME).
[b]Se índice ≥ 1E-1: Lixiviável (L); se 1E-2 ≤ índice ≤9 E-2: Transição (T); se 1E-4 ≤ índice ≤ 9E-3: Não lixiviável (NL) (Bacci 1994).
[c]Se GUS > 2.8: Lixiviável (L); se 1.8 < GUS < 2.8: Transição (T); se GUS < 1.8: Não lixiviável (NL) (Gustafson 1989).

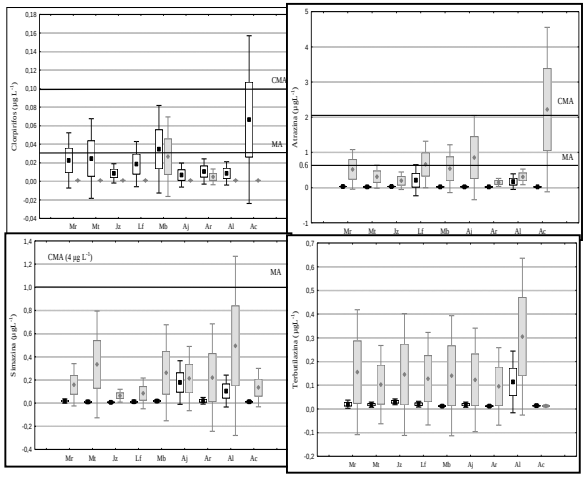
Compound	log K_{ow}
Triazines	
Atrazine	2.70
DEA	1.51
DIA	1.15
Simazine	2.30
Terbuthylazine	3.40
Cyanazine	2.10
Phenylureas	
Diuron	2.87
Chlortoluron	2.50
Isoproturon	2.50
Linuron	3.00
Chloroacetanilides	
Alachlor	3.09
Metolachlor	3.40
Propanil	2.29
Organophosphates	
Malathion	2.75
MOX	-
Diazinon	3.69
Dimethoate	0.70
Fenitrothion	3.32
FOX	-
CFP	3.80
Thiocarbamate	
Molinate	2.86
Acidics	
Mecoprop	-0.19
MCPA	-0.81
Bentazone	-0.46
2,4-D	-0.83

CHARACTERIZATION OF EXPOSURE ((MEASURE ENVIRONMENTAL CONCENTRATION (MEC))

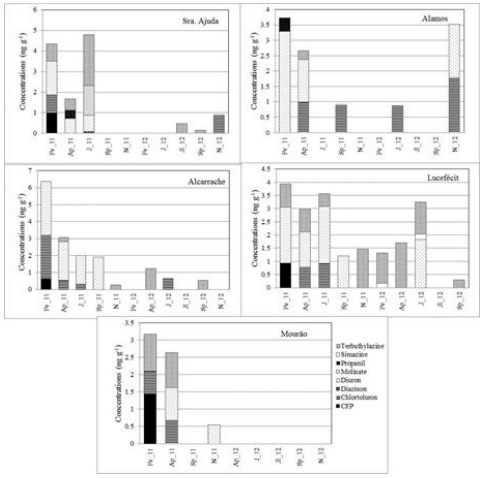
(I) BASEAD IN THE MEASUREMENT OF THE POLLUTANT AT DIFERENT COMPARTMENTS

(II) STUDY OF THE DISTRIBUTION OF THE POLLUTANT (SOURCE OF POLLUTION, TRANSPORT ROADS, PROCESSES OF DEGRATION, RUNOFF, LEACHING)

(III) DETERMINATION OF THE ENVIRONMENTAL CONCENTRATIONS OF THE POLLUTANT



PESTICIDES CONCENTRATION IN SURFACE WATER
Palma et al., 2009. Environment International. 35(3): 545-551)



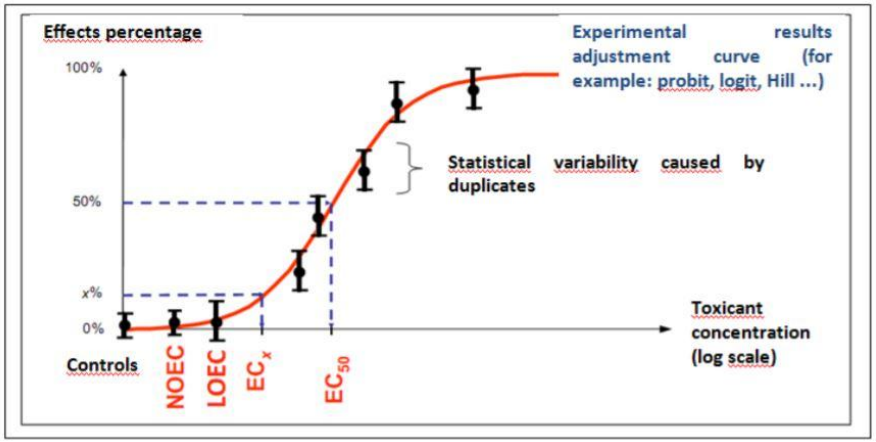
PESTICIDES CONCENTRATIONS IN SEDIMENTS
(Palma et al., 2015. Environmental Science and Pollution Research. 22: 7665-7675.)

CHARACTERIZATION OF EFFECTS ((PREDICTED NO-EFFECT CONCENTRATION (PNEC))

(I) DOSE-RESPONSE ASSESSMENT

(II) DETERMINATION OF THE TOXICOLOGICAL ENDPOINTS (NOEL, EC_{50}; https://cfpub.epa.gov/ecotox/; www. pesticideinfo.org)

(III) USE OF ASSESSMENT FACTOR (AF) FOR THE THREE TROPHIC LEVELS (ALGAE, CRUSTACEAN, FISH) TO NOEL OR EC50 VALUES TO OBTAIN PNEC VALUE



EC_{50} for 3 TROPHIC LEVELS	$<EC_{50}/1000$
Experiências no terreno ou modelos de ecossistemas	Caso a caso
2 NOEL for two trophic levels	<NOEL/50
NOEL for 3 species of 3 trophic level	<NOEL /10

Technical Guidance Document on Risk Assessment of the European Commission (ECC, 2003)

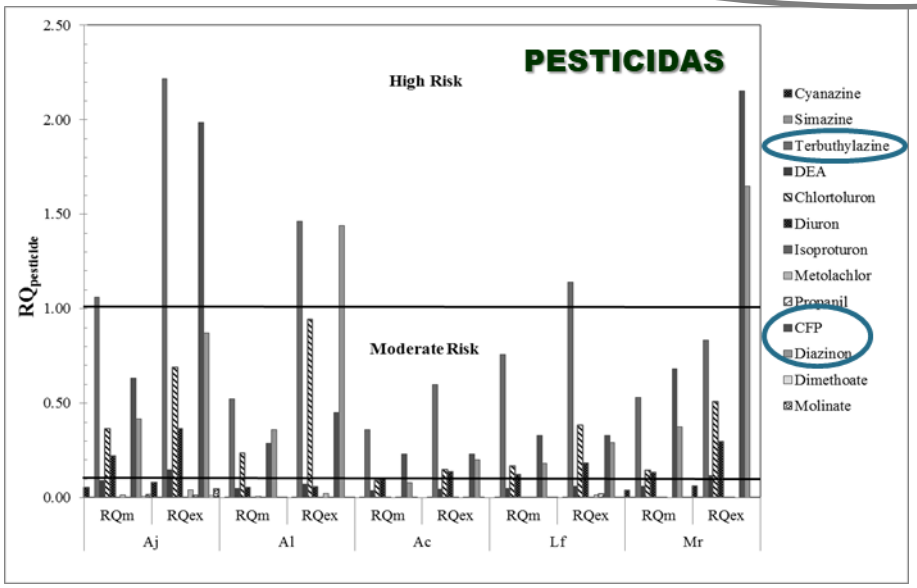
RISK CHARACTERIZATION (RISK QUONTIENT (RQ))

MEC/PNEC < 1 → **LOW RISK**

MEC/ PNEC = ?

MEC/PNEC > 1 → **RISK**

(Sanchez-Bayo et al., 2002)



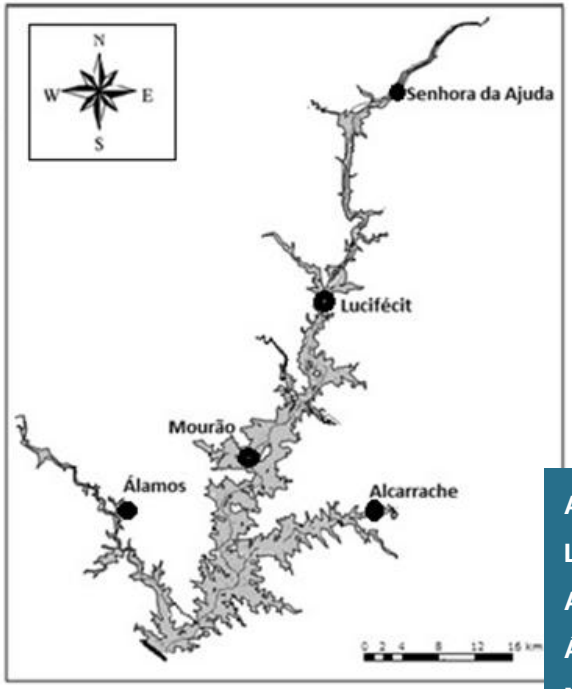
RISK MANAGEMENT

DEVELOP ACTIONS OF SPECIFIC MITIGATION FOR RESTORATION OF THE WATER BODY

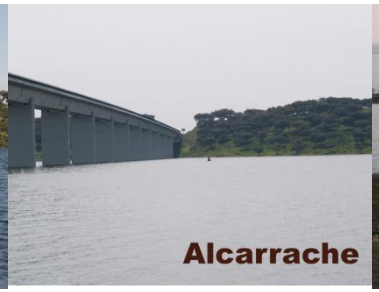
The Alentejo region (southern Portugal) is a semi-arid area with high levels of water scarcity and where agriculture is one of the main activities, highlighting the importance of Alqueva.

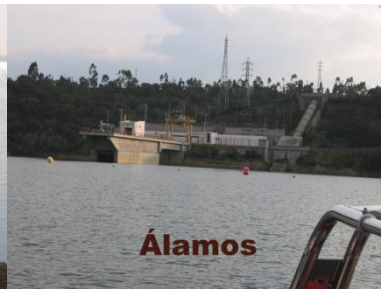
ALQUEVA ALLOWED

- **INCREMENT OF IRRIGATION AREA;**
- **INTENSIFICATION OF IRRIGATION CROPS (CORN, OLIVE GROVE AND VINEYARD);**
- **INCREASE OF PESTICIDES APPLICATION????**
- **INCREASE THE TOXIC EFFECTS FOR THE ECOSYSTEM????**

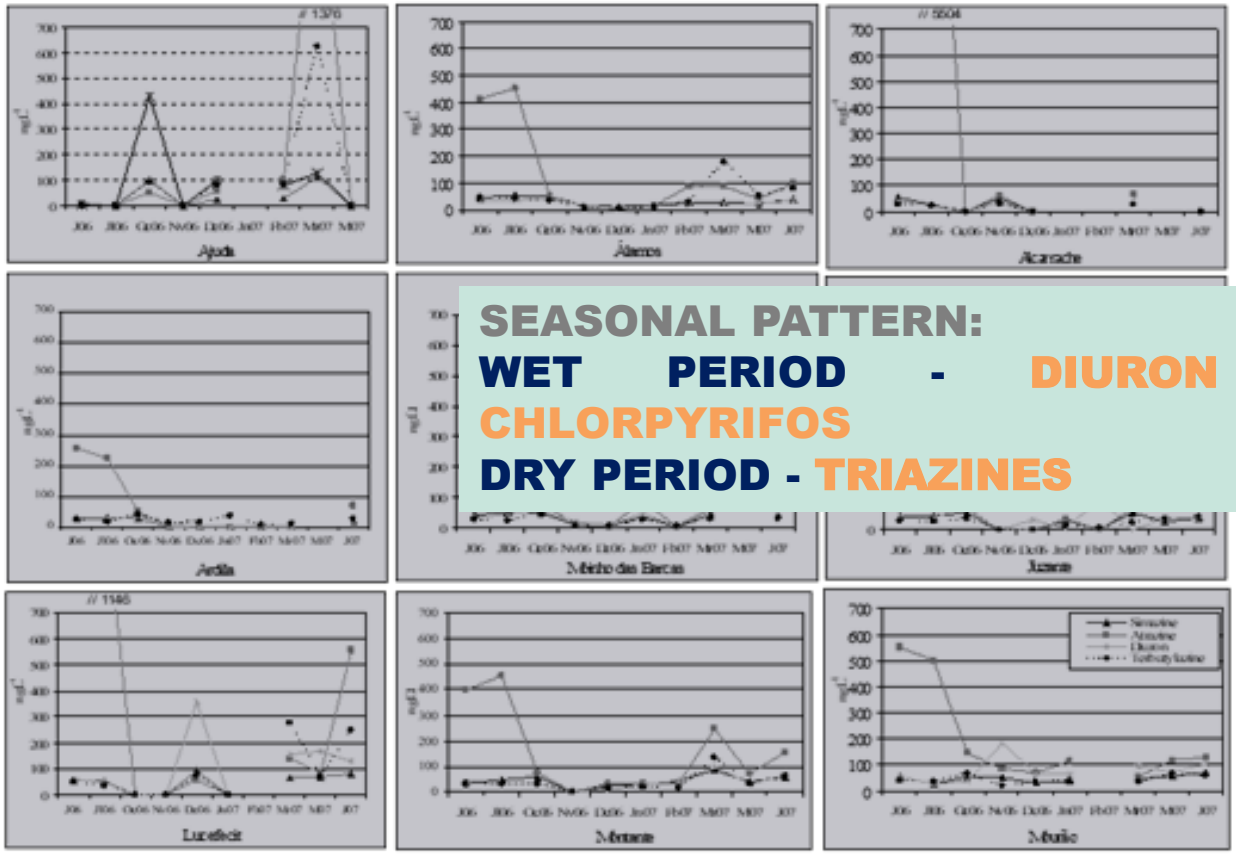


Ajuda (Aj; 38°46'28.56"N, 7°10'47.00“W);
Lucefécit (Lf; 38°33'6.32"N, 7°17'52.86“W);
Alcarrache(Ac;38°19'1.53"N,7°19'51.10“W;
Álamos (Al; 38°20'30.00"N, 7°34'40.00"W);
Mourão (Mr; 38°23'60.00"N, 7°23'25.80“W).





2006/2007 (WATER COLUMN)



SEASONAL PATTERN:
WET PERIOD - DIURON CHLORPYRIFOS
DRY PERIOD - TRIAZINES

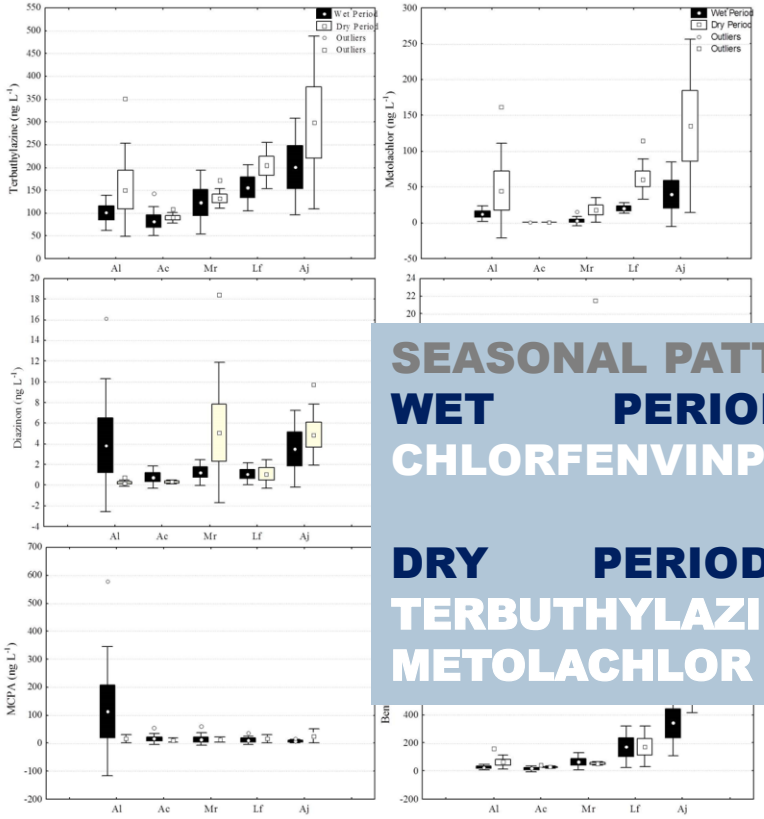
DIURON and ATRAZINE surpassed occasionally their EQS (Palma et al., 2009).

Endosulfan sulfate (surpassed always the EQS).

Atrazine, simazine, terbuthylazine and chlorpyrifos showed a sazonal variability.

Project - POCI: Recursos hídricos da Albufeira do Alqueva (2006-2007)

2011/2012 (WATER COLUMN)



SEASONAL PATTERN

WET PERIOD – DIAZINON, CHLORFENVINPHOS (INSECTICIDES)

DRY PERIOD - BENTAZONE, TERBUTHYLAZINE, MCPA AND METOLACHLOR (HERBICIDES)

TERBUTHYLAZINE DETECTED AT 100% OF THE SAMPLES, WITH A MAXIMUM INDIVIDUAL CONCENTRATION OF 532 ng L $^{-1}$ AT SRA . AJUDA.

THE LIMIT OF TOTAL PESTICIDES IN FOR HUMAN ng L^{-1}; ECC, 1998), AT 91% OF THE . AJUDA, 36% FROM % OF THE SAMPLES

ng L^{-1} (WATER SUPPLY; 98/83/CE) WAS SURPASSED BY TERBUTHYLAZINE, BENTAZONE AND METOLACHLOR AT 62, 33 AND 12 % OF THE SAMPLES.

ECOTOXTOOLS: Ferramentas ecotoxicológicas para a avaliação do risco ambiental em grandes albufeiras do sul de Portugal (2011-2012)

Palma et al. 2014,. Sci. Total Environ.; 488–489: 208–219.

WHAT ABOUT SEDIMENTS?
ARE IMPORTANT FOR PESTICIDES RISK ASSESSMENT?

CONTAMINATED SEDIMENTS MAY REPRESENT A SERIOUS RISK FOR AQUATIC ORGANISMS AND ECOSYSTEMS ONCE:

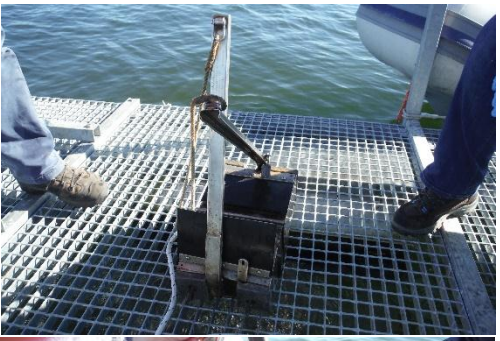
(i) they accumulate contaminants and serve as a sink and source of pollution to the ecosystem they are connect with (Allen Burton Jr 2002; Delistry and Yokel 2007);

(ii) they integrate pollutants concentration over time (Ayyamperumal et al. 2006; Roig et al. 2011);

(iii) they are extremely important to the food chain and serve as a reservoir of contaminants for bioaccumulation and trophic transfer (Kwok et al. 2010);

(iv) their contaminants concentration may be several orders of magnitude higher than in the water column (Tuikka et al. 2011).

SEDIMENTS CAN ACT BOTH AS IMPORTANT RESERVOIRS AND AS SECONDARY SOURCES OF PESTICIDES IN THE AQUATIC SYSTEM



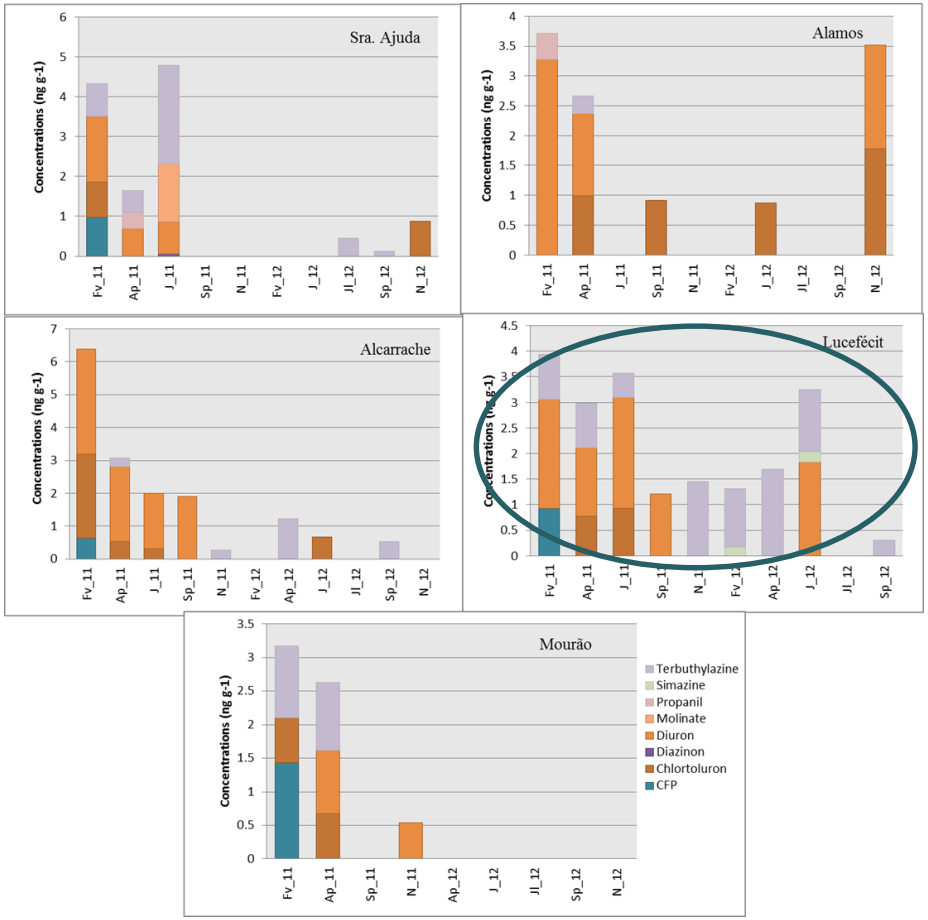
STUDY OF SEDIMENTS´ POLLUTION IS ESSENTIAL

…….**TO MAP** the possible exposure pathways of pesticides…

To the aquatic organisms

To the human populations

……FOR ALLOW AN APPROPRIATE AND INTEGRATIVE ENVIRONMENTAL RISK MANAGEMENT OF THE AQUATIC ENVIRONMENT

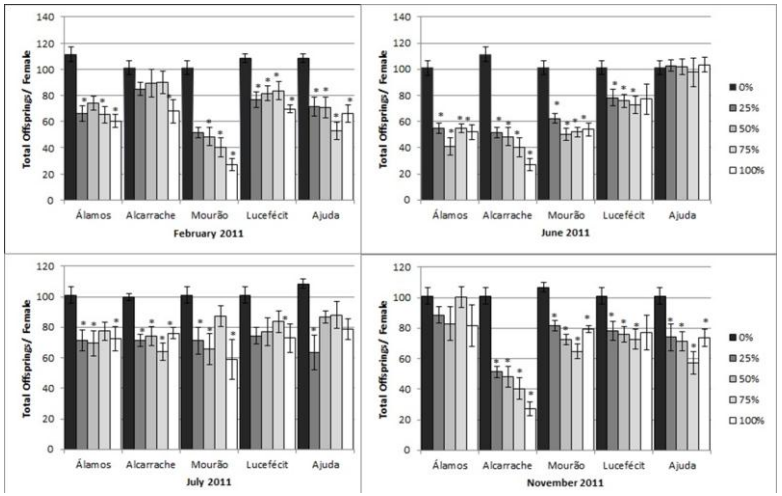


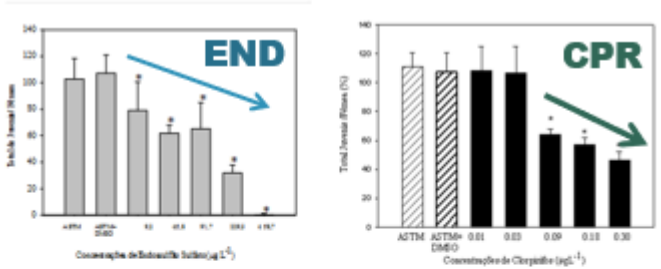
- **LOW CONCENTRATIONS OF THE TARGET PESTICIDES (< 4 ng L^{-1})**
- **LUCEFÉCIT THE MOST POLLUTED AREA**

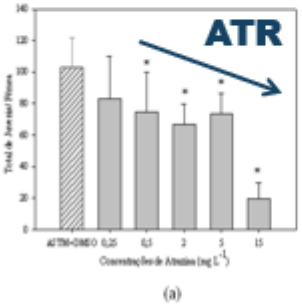
- **DIURON > TERBUTHYLAZINE > CHLORTOLURON.**
- **DIURON AND CHLORTOLURON WITH HIGHER CONCENTRATIONS AT WET PERIOD.**
- **TERBUTHYLAZINE WITH HIGHER CONCENTRATIONS AT DRY PERIOD.**

THE SURFACE SEDIMENTS OF ALQUEVA NOT REPRESENT AN IMPORTANT SOURCE OF CONTAMINATION BY PESTICIDES.

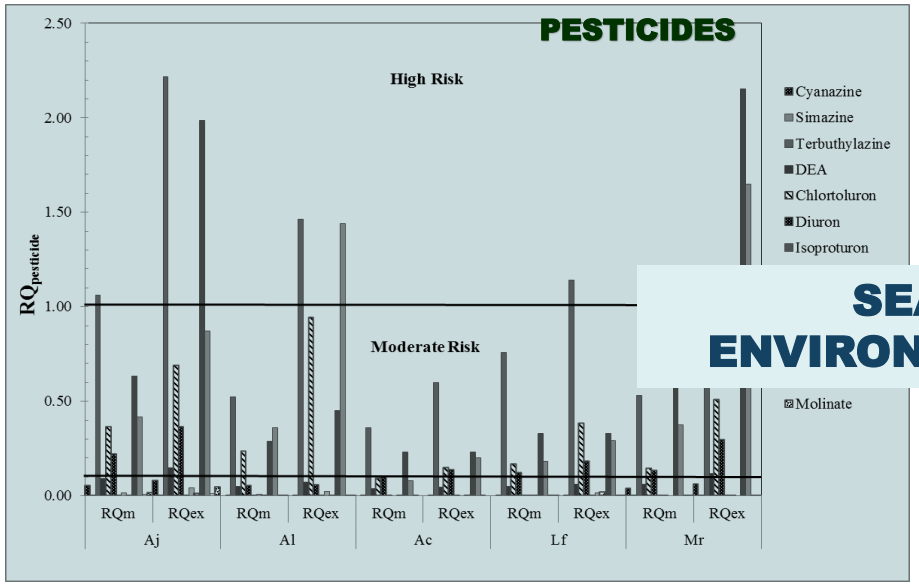
Compound	Algae	Aquatic Invertebrates	Fish	PNEC
Triazines				
Atrazine	100	250	2000	NOEC: 100
DEA	100 (EC_{50})	-	-	EC_{50}: 100
DIA	-	-	-	-
Simazine	600	2500	700	NOEC: 600
Terbuthylazine	12 (EC_{50})	19	90	EC_{50}: 12
Cyanazine	9	48000 (EC_{50})	1000 (EC_{50})	NOEC: 9
Phenylureas				
Diuron	2.7 (EC_{50})	96	410	EC_{50}: 2.7
Chlortoluron	1	16700	400	NOEC:1
Isoproturon	52	120	1000	NOEC: 52
Linuron	10	180	100	NOEC: 10
Chloroacetanilides				
Alachlor	20	220	190	NOEC: 20
Metolachlor	5710 (EC_{50})	707	3900 (EC_{50})	NOEC: 707
Propanil	110 (EC_{50})	86	5400 (EC_{50})	NOEC: 86
Organophosphates				
Malathion	13000 (EC_{50})	0.06	91	NOEC: 0.06
MOX	-	-	-	-
Diazinon	6400 (EC_{50})	0.56	700	NOEC: 0.56
Dimethoate	32000	40	400	NOEC: 40
Fenitrothion	100	0.087	88	NOEC:0.087
FOX	-	-	-	
CFP	1000	0.10	30	NOEC: 0.10
Thiocarbamate				
Molinate	500 (EC_{50})	380	390	NOEC: 380
Acidics				
Mecoprop	56000	22000	109000	NOEC: 22000
MCPA	60000	50000	15000	NOEC: 15000
Bentazone	25700	120000	48000	NOEC: 25700
2,4-D	100000	46200	27200	NOEC: 27200

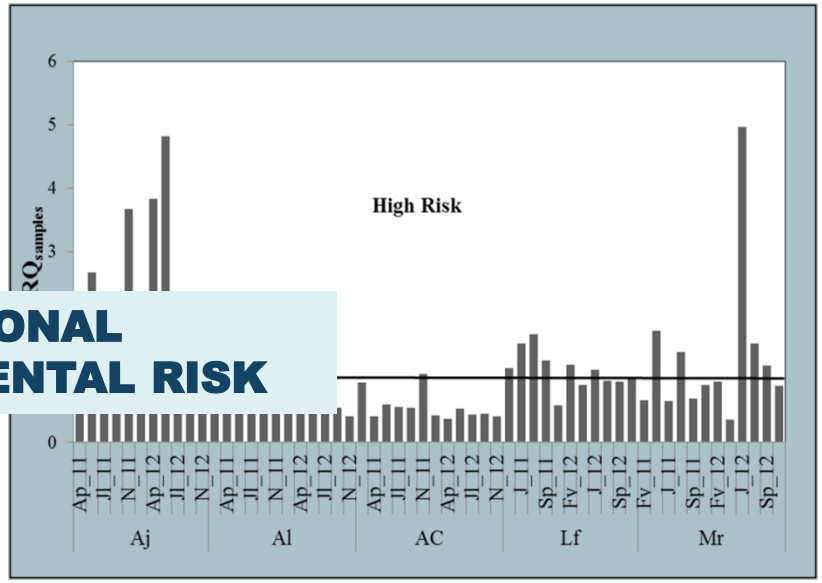






Palma, P. (2010). Environmental Science and Pollution Research. 17:703-716
Palma, P. (2016). Science of the Total Environment. 541:119-129.





SEASONAL ENVIRONMENTAL RISK

- **CFP, DIAZINON AND TERBUTHYLAZINE WITH HIGH RISK FOR MAXIMUM CONCENTRATIONS;**
- **CHLORTOLURON AND DIURON WITH MODERATE RISK**

SAMPLES WITH HIGHER RISK: SRA. AJUDA, LUCEFÉCIT, ÁLAMOS.

ALCARRACHE UNDER LESS ECOTOXICOLOGICAL RISK (9% OF THE SAMPLES WITH RQ > 1).

DRY PERIOD WITH A GREATER NUMBER OF HIGH RISK SAMPLES.

There are no sediment quality guidelines for the protection of aquatic life considering the pesticides detected in Alqueva (CCME, 2002).

The critical concentrations for sediment dwelling organisms were not surpassed by any of the individual pesticides quantified.

LOW ECOTOXICOLOGICAL RISK

BUT……..

Compound	K_{oc} (mL g^{-1})	LogK_{ow}	Gus Index-Leachability	Critical value for sediment dwelling organism (pore-water) (mg L^{-1}) *Chironomus riparius*	PPBT index
Triazines					
Simazine	130	2.30	2.00	-	Medium
Terbuthylazine	231	3.40	3.07	0.5 (NOEC)	Medium
Phenylureas					
Diuron	1067	2.87	1.83	-	High
Chlortoluron	205	2.50	2.82	-	Medium
Chloroacetanilides					
Propanil	400	2.29	0.72	1.9 (NOEC)	Low
Organophosphates					
Diazinon	643	3.69	1.14	0.023 (EC_{50})	Low
CFP	680	3.80	1.87	-	Low
Thiocarbamate					
Molinate	190	2.86	2.49	-	Low

RISK OF CONTAMINATION OF THE AQUATIC COMPARTMENT BY RUNOFF:

- **DIURON** high risk, high particle-bound transport (PPBT)
- **TERBUTHYLAZINE, CHLOROTOLURON** medium risk

RISK ASSESSMENT INDICATED THAT ALTHOUGH ALL PESTICIDE COMPLIED WITH THE EQS, THE POTENTIAL RISK ASSOCIATED WITH THE PESTICIDES SHOULD NOT BE NEGLECTED, PARTICULARLY IN LOCATIONS LIKE SRA. AJUDA AND LUCEFÉCIT WHERE HIGH-RISK SAMPLES WERE FOUND CONSISTENTLY THROUGHOUT THE YEAR.

LOST OF BIODIVERSITY
RISK FOR PUBLIC HEALTH

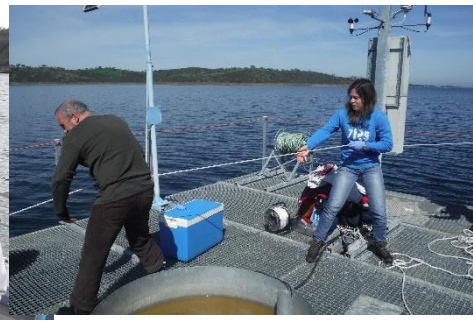
THE SURFACE SEDIMENTS OF ALQUEVA DO NOT REPRESENT AN IMPORTANT SOURCE OF CONTAMINATION BY PESTICIDES FOR THE WATER COLUMN OF THE RESERVOIR

LOW RISK OF PESTICIDES FROM SEDIMENTS TO AQUATIC COMMUNITIES

FURTHER STUDIES ARE NEEDED TO ASSESS PATTERNS OF PESTICIDES IN DEPTH SEDIMENTS AND PROCESSES OF BIACCUMULATION AND BIOAMPLIFICATION IN THE ECOSYSTEM

SOME ACTIONS MUST BE IMPLEMETENT/ INCREMENT:

- EQS– GOOD CHEMICAL POTENTIAL.
- GOOD AGRICULTURAL PRACTICES.
- SUSTAINABLE USE OF PESTICIDES.
- MONITORING PROCESSES.



THANK FOR YOUR ATTENTION!

ALOP
Alentejo Observation and Prediction systems

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