Pollution-Induced Community Tolerance: a good indicator for long-term pollution assessment in coastal phytoplankton communities

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The use of chemical treatments is increasing

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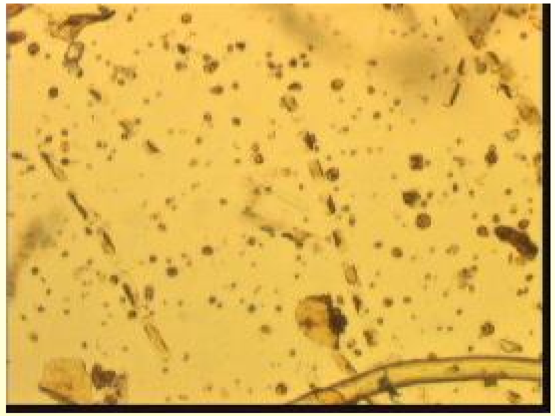
Transfert towards non-target organisms

Long-term effects are suspected; peut-on les détecter ?

Ex: phytoplankton



Two Hypotheses

1 - the PICT concept of Blanck (1988)

2 - the physiological adaptation of the organism to survive

1-Pollution-Induced Community Tolerance:

«… a toxicant exerts its effect on communities by excluding… species that are sensitive to that particular toxicant.

At the same time tolerant organisms will be favoured.

…a damaged community will change its structure in a manner that increases community tolerance.

The degree of tolerance is quantified by short-term community level tests using … (a) metabolic process… expressed as the effect concentration inhibiting 50% of the activity. »

Blanck and Dahl, 1996

The primary production was measured under short-term toxicity stress.

The sample was experimentally contaminated by a pesticide mixture of 5 commercial formulations.

Mixture composition (equal concentrations):

Basamais (bentazone)

Milagro (nicosulfuron)

Mikado (sulcotrione)

Frontière (dimethenamid)

Opus (epoxiconazole)

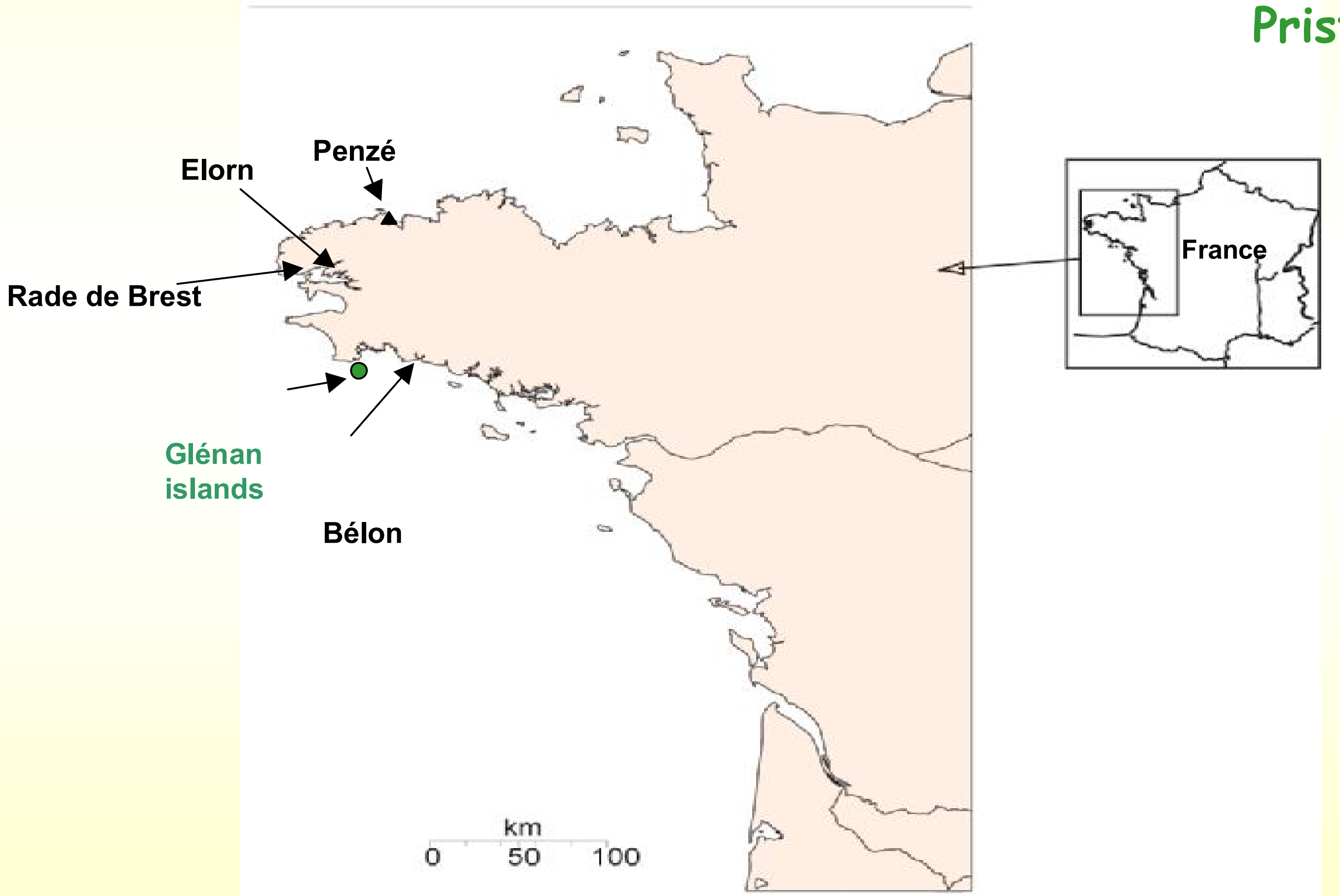
Selected coastal areas

Sensitive sites

Agriculture: Penzé, Bélon, Elorn

Harbour: Rade de Brest

Pristine: Glénan islands

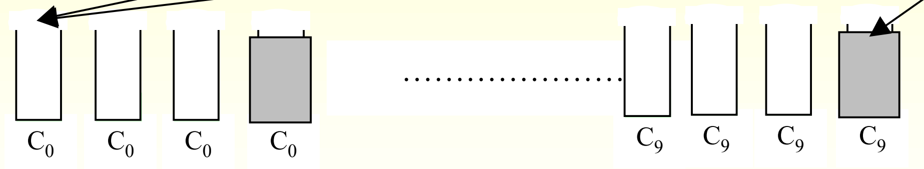


Protocol for primary production measurement

250 μL culture + 250 μL pesticide

Dark incubation: heterotrophic activity

Fractionated sample



1 hour in culture chamber

Add 20 μL ^{14}C

2 hours in culture chamber

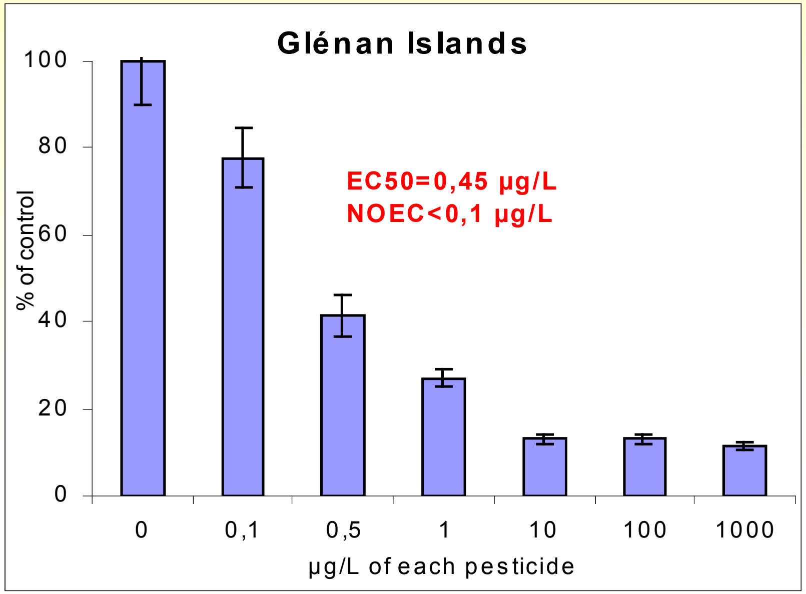
Stop the incubation: 100 μL acetic acid

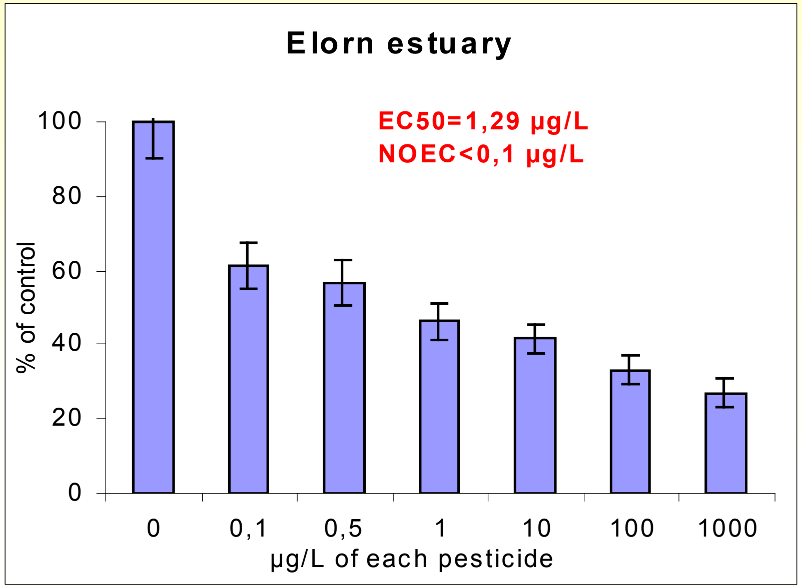
Scintillation liquid → Scintillation spectrometer

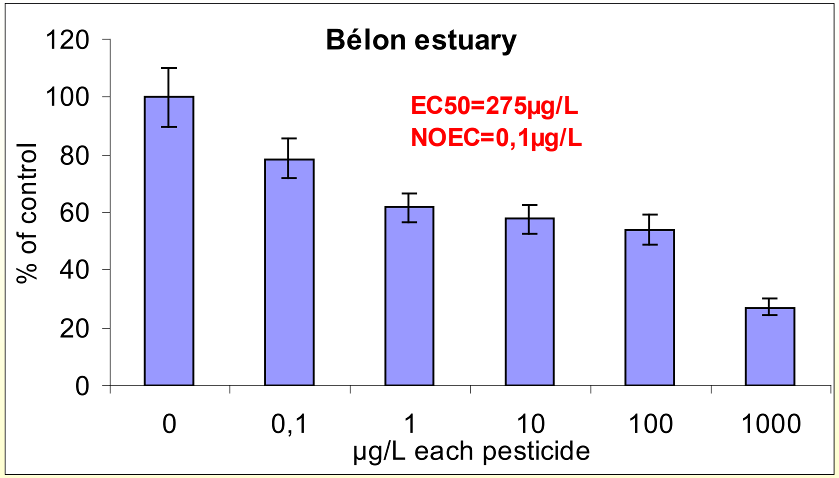
$NaH^{14}CO_3$ assimilation rate

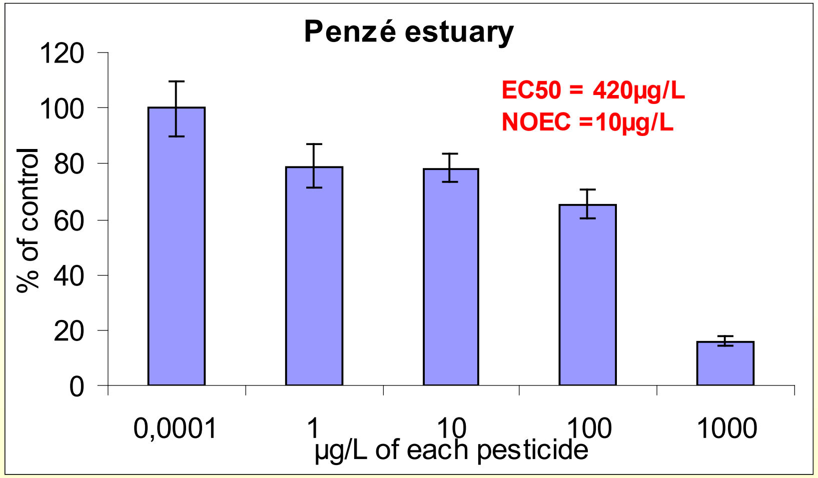
Results

Carbon assimilation, in % of concontrol vs µg/L pesticide in mixture





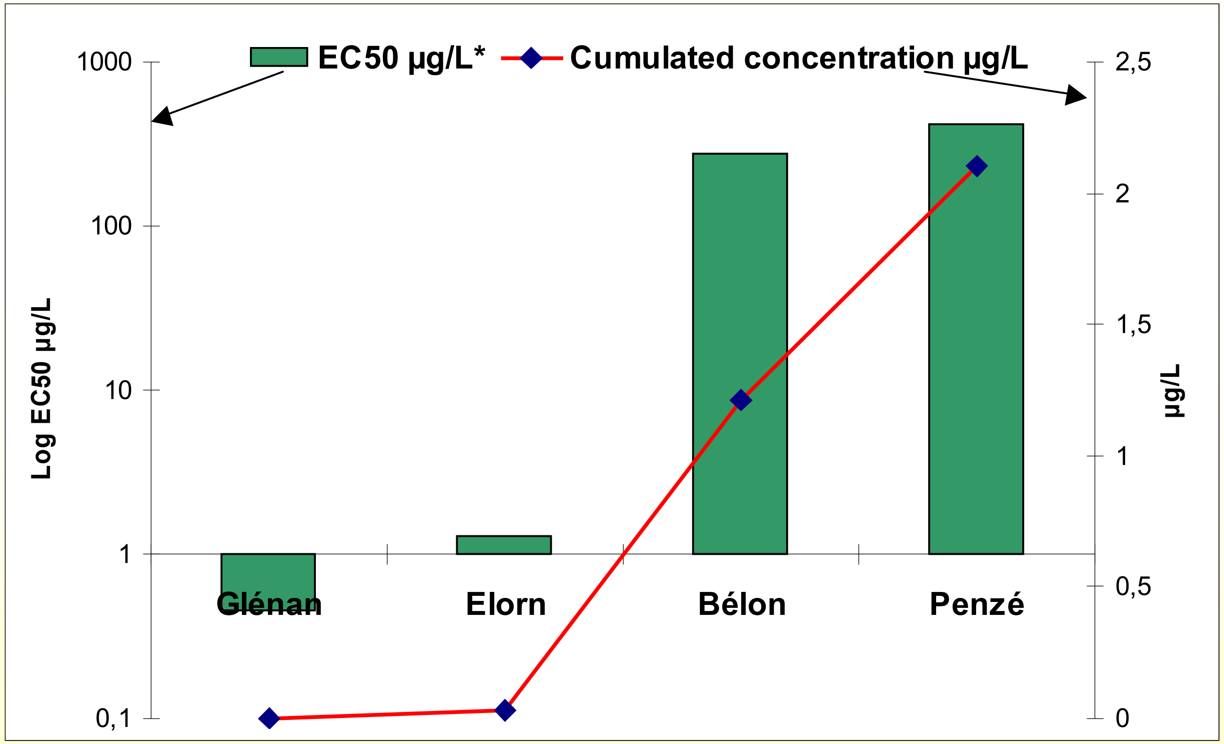




Comparison of the sample characteristics

	Glénan	Elorn	Bélon	Penzé
EC50 µg/L*	**0.45**	**1.3**	**275**	**420**
NOEC µg/L*	<0.1	<0.1	0.1	10
Nb detected ticides/searched	0/6	7/55	30/69	30/69
Cumulated centration µg/L	**0**	**0.031**	**1.211**	**2.102**

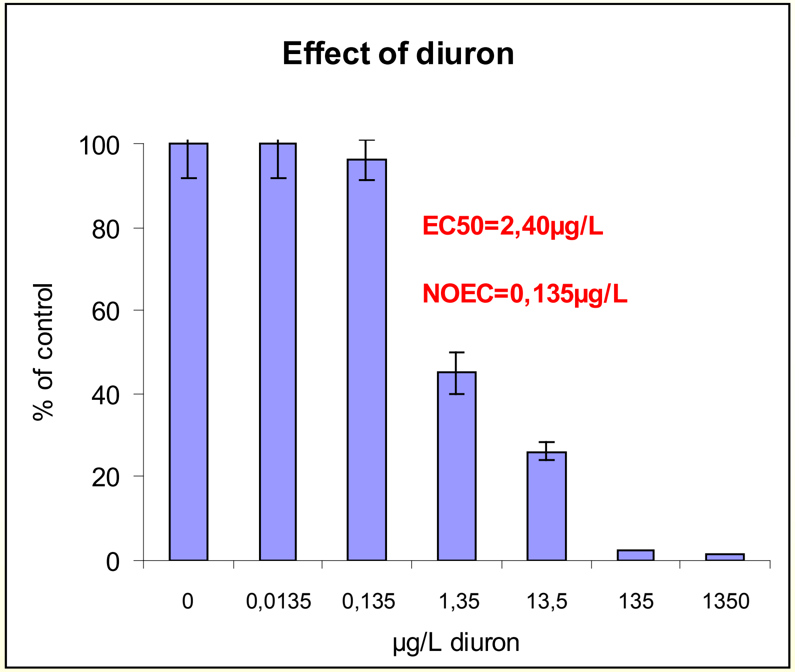
There is a relationship between the tolerance to the pesticide and the initial pesticide concentrations

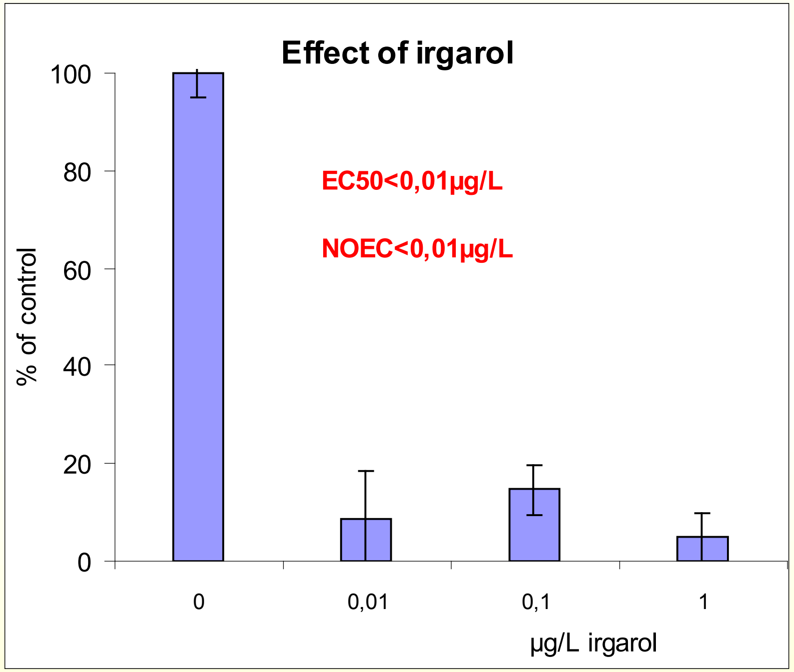


The case of Rade de Brest

Pesticides: antifouling

Irgarol, Diuron





Results

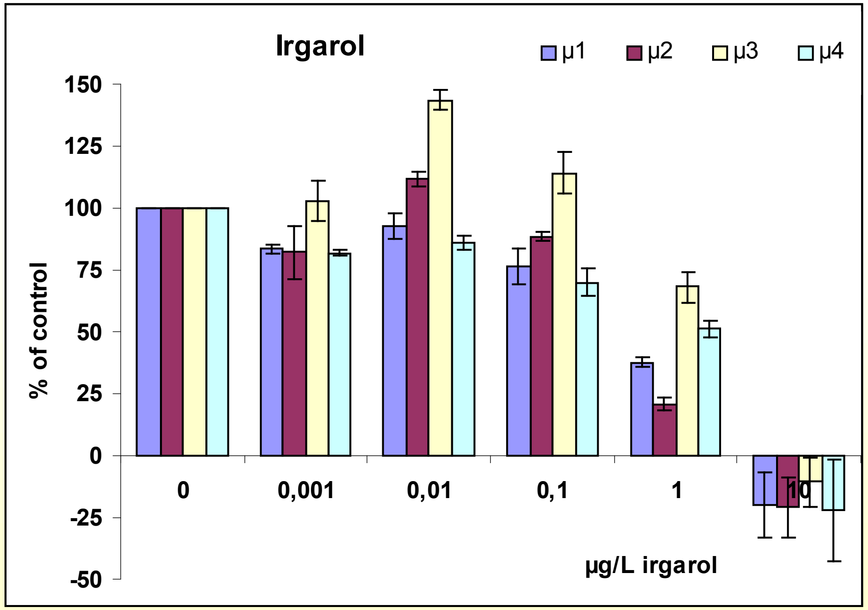
	Experiment on	
	Diuron (07/03/2005)	Irgarol (17/03/2005)
EC50 µg/L	2.40	<0.01
NOEC	0.14µg/L	<0.01µg/L
Nb detected pesticides/searched	12/52	11/52
Cumulated concentrations µg/L	0.166 (diuron 0.110)	0.263 (irgarol:0.0254)

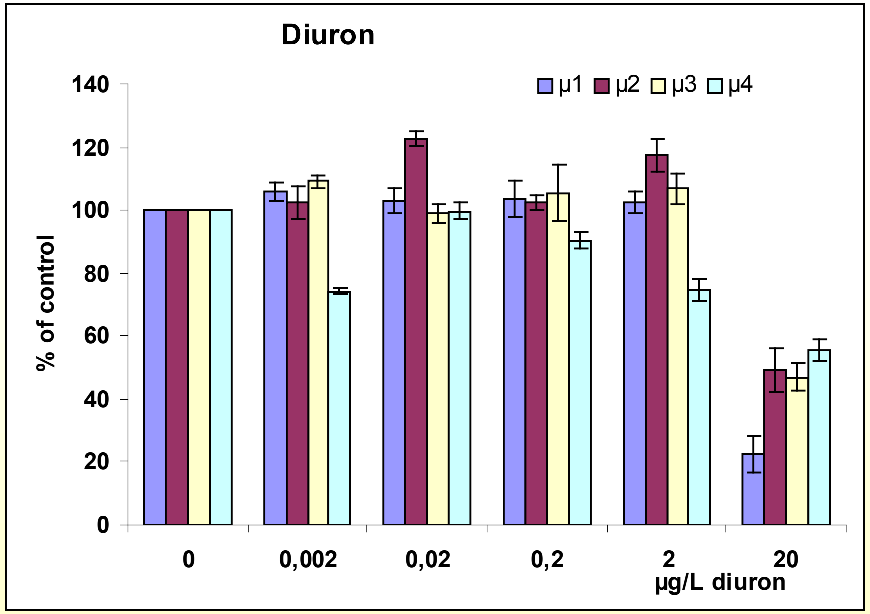
Natural populations of phytoplankton present higher tolerance towards diuron than towards irgarol

2 - Is it possible to stimulate tolerance ?

Adaptation of the diatom *Chaetoceros gracilis* to diuron and irgarol: 3 re-inoculations implemented to secure a constant supply of antifouling Irgarol: 0 -10µg/L Diuron: 0 - 20µg/L

Comparison of the growth rates in each culture





Results

	µg/L Irgarol		µg/L Diuron	
	NOEC	EC50	NOEC	EC50
Culture 1	<0.001	**0.34**	2	**9.9**
Culture 2	<0.001	**0.27**	2	**16.7**
Culture 3	0.1	**0.36**	2	**17.7**
Culture 4	<0.001	**0.5**	0.2	**46.3**

It is possible to increase the tolerance of the diatom *Chaetoceros gracilis* towards diuron.

Conclusions

-The chronic contamination by pesticides induces a higher tolerance of natural populations of phytoplankton, as demonstrated by the PICT concept

-However in some cases the concentration of toxicants *in situ* can reach the limit of tolerance

- Sometimes it is possible to induce specific tolerance:
  *selection of tolerant individuals?
  *physiological modification? (study in progress)