

SUNSCREENS AND UV FILTERS AQUATIC TOXICITY ASSESSMENT

AN INDUSTRY PERSPECTIVE

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LEARNING MORE ABOUT WHAT IS KNOWN ABOUT THE ECO-TOXICOLOGICAL EFFECTS OF UV FILTERS AND THEIR BREAKDOWN PRODUCTS ON AQUATIC ECOSYSTEMS.

UV filters and other ingredients of sunscreens

Data available in international data bases: ECHA, US EPA

No foreseeable risk for the aquatic environment based on these data

Fulfill regulatory requirements

Further investigation (eg.EU CoRAP)

Sufficient to answer societal concerns ?

Breakdown products impact ?

Direct release of sunscreens : Ocean, Lakes, Rivers

Recreational activities
worldwide



Societal concern



ADDITIONAL AQUATIC TOXICITY DATA ?

L'Oreal commitments to,

- Generate complementary marine toxicity data
- Contribute to refine marine exposure assessment



- Develop alternative methods to adult fish toxicity assays

Animal testing ban : EU + worldwide trend (eg. California)

Eg. No Fish chronic toxicity assay (OECD 210), no Fish bioconcentration test (OECD 305), no Fish sexual development test (extended OECD 210), no Amphibian metamorphosis assay (OECD 231), etc...

ADDITIONAL AQUATIC TOXICITY DATA

Proprietary ingredients

Sunscreen formulas

- Complementary species
- Standardized tests

3

STANDARD TESTS with FRESH WATER Planktonic species

Micro-crustaceans
Daphnia magna



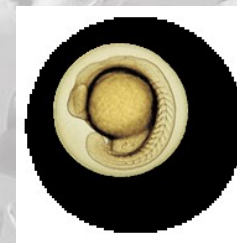
Reproduction inhibition
NF ISO 20665 (February
2009)
(7 d: chronic)

Micro-algae Chlorophycées
Selenestrum capricornutum

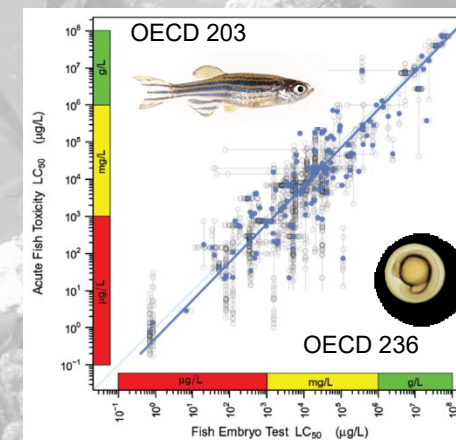


Growth Inhibition
OECD 201
(4 d: chronic)

Fish eggs
Danio rerio



Lethality
OECD 236
(5 d: acute)

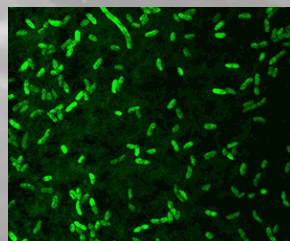


S. Belanger & G. Carr (2013)

3

FURTHER VOLUNTARY TESTS with MARINE Planktonic species

Bacteria
Vibrio fischeri



Luminescence inhibition
ISO 11348-3:2007
(15 mn: acute)

Micro-algae Diatoms
Pheodactylum tricornutum



Growth Inhibition
ISO 10253:2016
standard(4 d: chronic)

Sea urchin larva (Echinoderms)
Paracentrotus lividus



Embryo larval development
Env. Canada publication 1/RM/58 2014
(2 d: sub-chronic)

L'ORÉAL

Research & Innovation

WHAT ARE THE MOLECULAR TARGETS OF SUNSCREEN COMPONENTS IN AQUATIC ORGANISMS? .

- What are the acute or chronic toxicity endpoints?
- What is the biological and environmental relevance of these endpoints?

I- Standard tests : apical endpoints of adverse effects

- Acute Tox. : high conc. / Lethality ; immobility / Individuals
- Chronic Tox. : low conc. / reproduction, embryonic development / Population growth, ...

II- Predictive and alternative toxicity assessment methods development

- 1- Coral toxicity assay
- 2- Hyalella Bioaccumulation assay
- 3- Fish chronic toxicity prediction with the fish embryo model

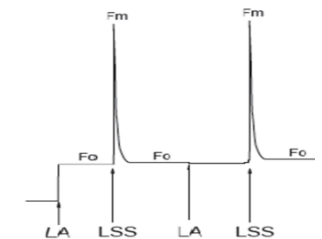
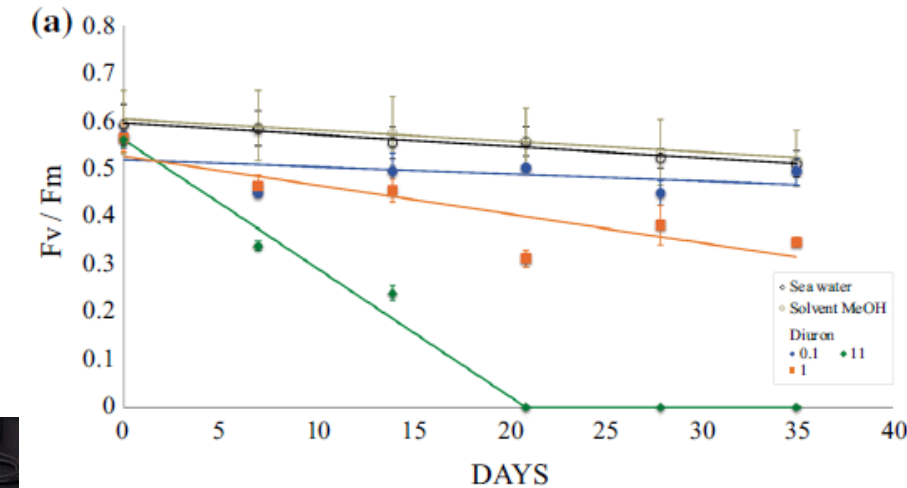
1- CORAL TOXICITY METHOD DEVELOPMENT

- *Stylophora pistillata*
- Exposure 5 weeks.
- Aquariums 15 L
- From low to high conc. ($> 10 \mu\text{g/L}$)
- Tested concentrations analytically controlled
- Weekly renewal
- Observation : bleaching
- Measure : symbiotic microalgae photosynthesis (PAM)

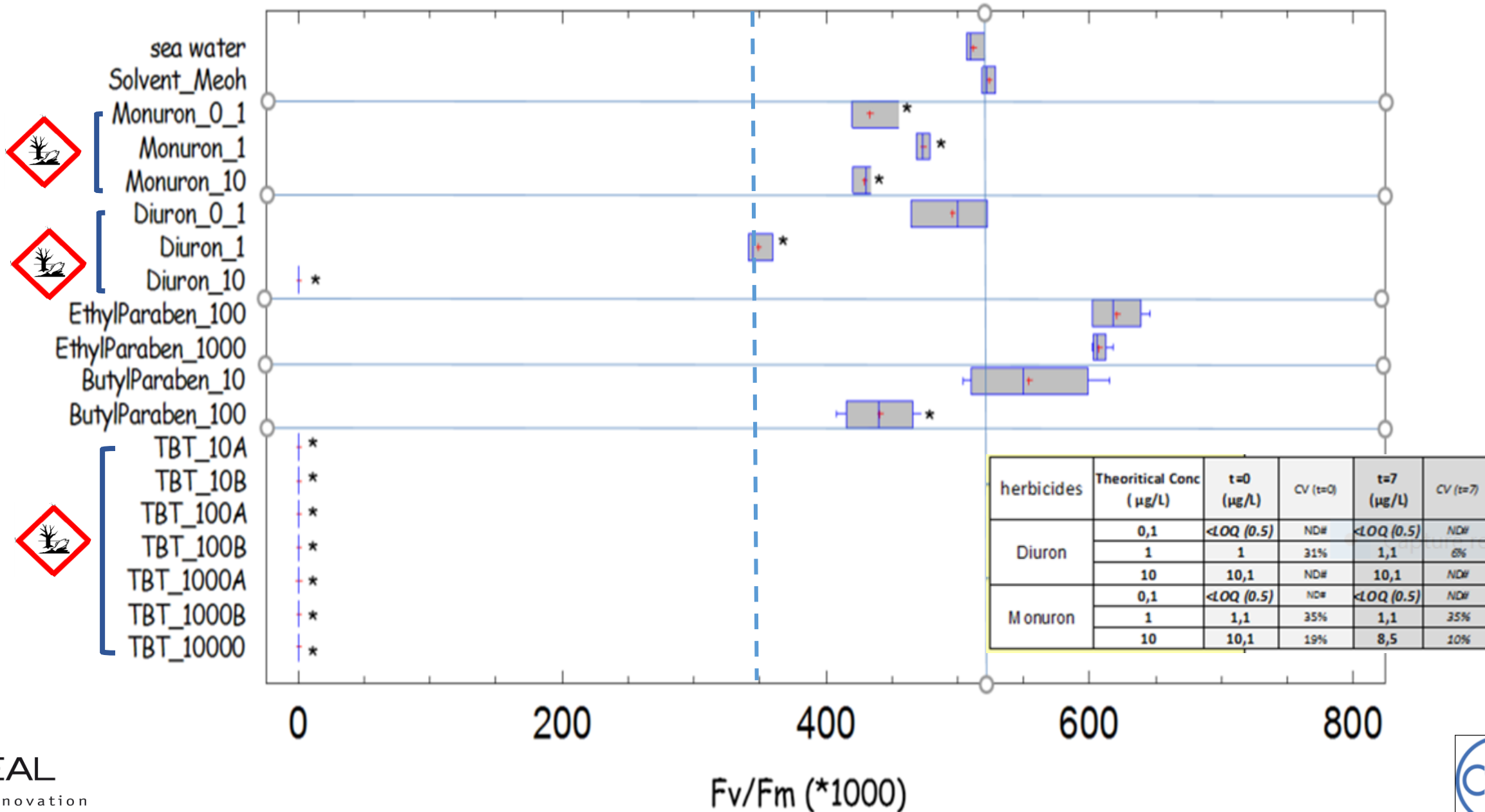
UV Filters : Mexoryl SX, Mexoryl XL, Ethylhexyltriazone, Octocrylene, Avobenzone

Positive control references : Monuron, Diuron , TBT

Fel et al. Coral Reefs (2019) 38:109–122



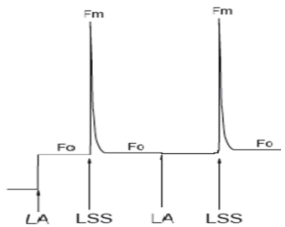
Mean Fv/Fm from d35 to d37 measured on 4 nubbins of *Stylophora pistillata*



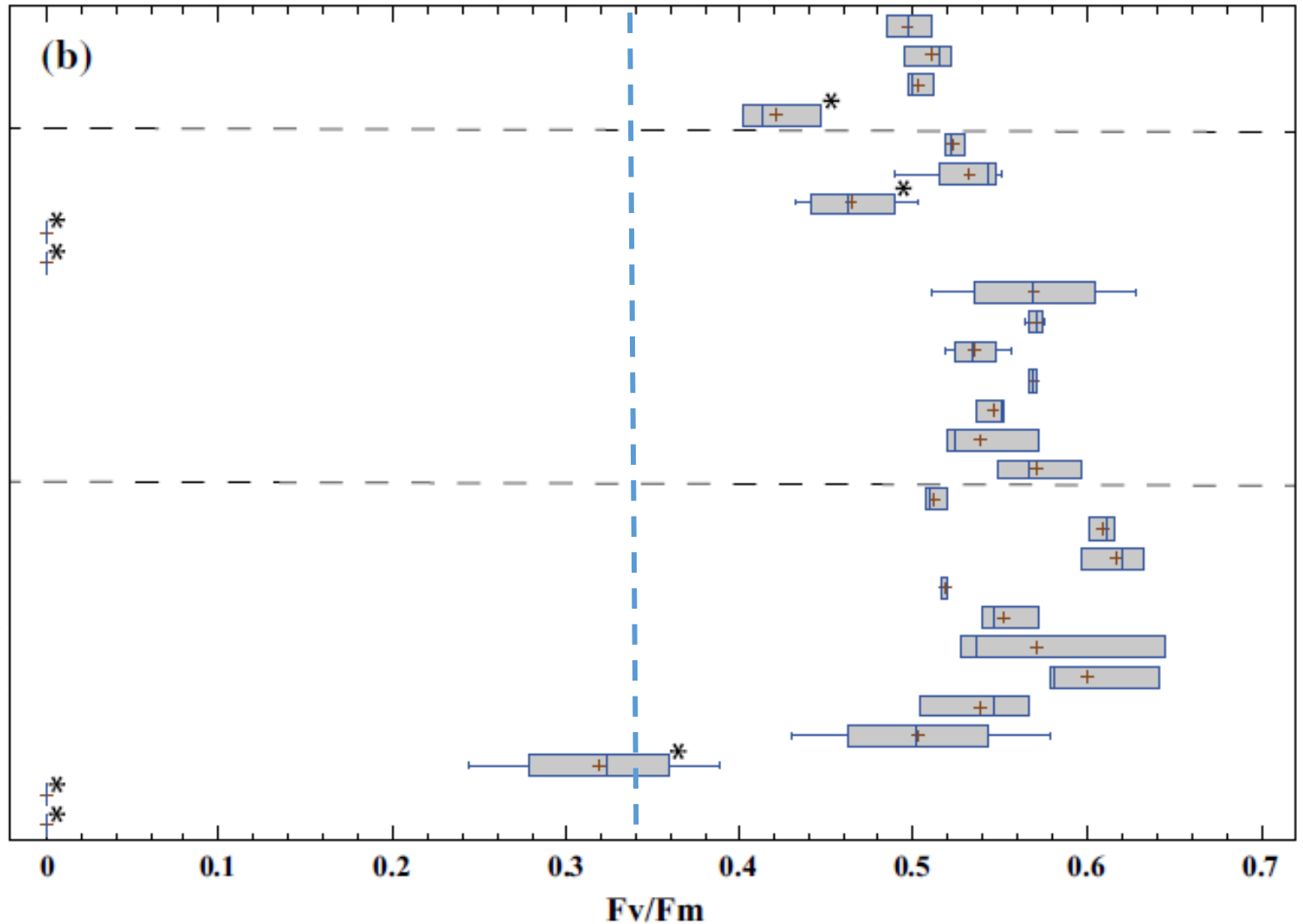
Effects on corals of some UV FILTERS

5 weeks.

$\mu\text{g/L}$



Solvent MeoH 1
Octocrylene 100
Octocrylene 1000
Octocrylene 5000
Solvent MeoH 2
Avobenzone 10
Avobenzone 1000
Avobenzone 5000 A
Avobenzone 5000 B
UvinulT150 100
UvinulT150 1000
UvinulT150 5000
Mexoryl XL 10
Mexoryl XL 1000A
Mexoryl XL 1000B
Mexoryl XL 5000
sea water
Mexoryl SX 10
Mexoryl SX 100A
Mexoryl SX 100B
Mexoryl SX 1000A
Mexoryl SX 1000B
Mexoryl SX 5000A
Mexoryl SX 5000B
Zn²⁺ 10
Zn²⁺ 100
Zn²⁺ A 1000
Zn²⁺ B 1000



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CONCLUSIONS

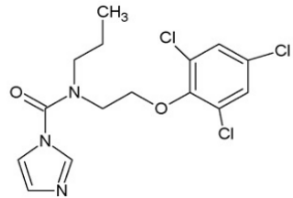
The organic UV filters UV Mexoryl SX, Mexoryl XL, Ethylhexyltriazone, Octocrylene and Avobenzone had no adverse effects on corals in this study design,

... even at concentrations much higher than the one reported in natural conditions (up to 100 000 times higher)

2- HYALELLA BIOACCUMULATION ASSAY

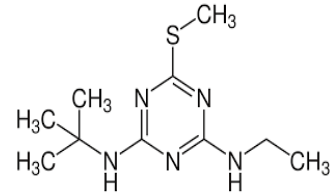
Alternative to fish Bioconcentration test OECD 305

OECD intercalibration study



Imidazol fungicide **CAS: 67747-009-5**

Log_{kow}: 4,1

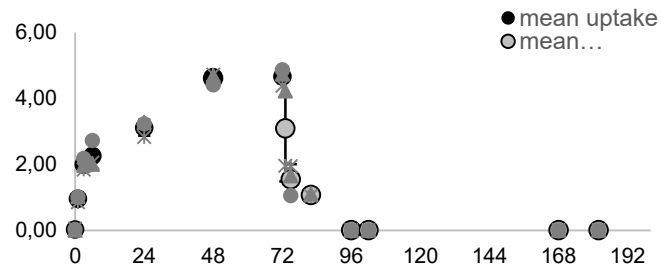


triazine herbicide **CAS: 886-50-0**

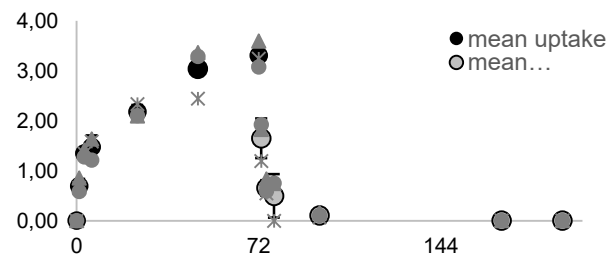
Log_{kow}: 3,6

50µg/l

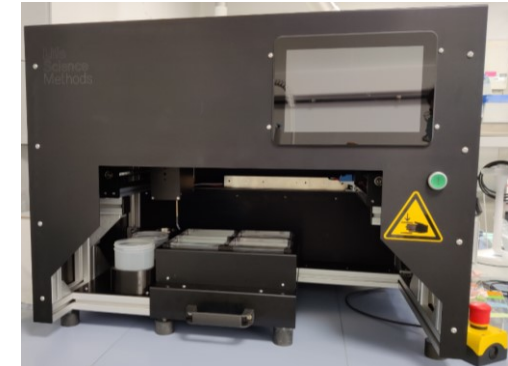
PROCHLORAZ



TERBUTRYN

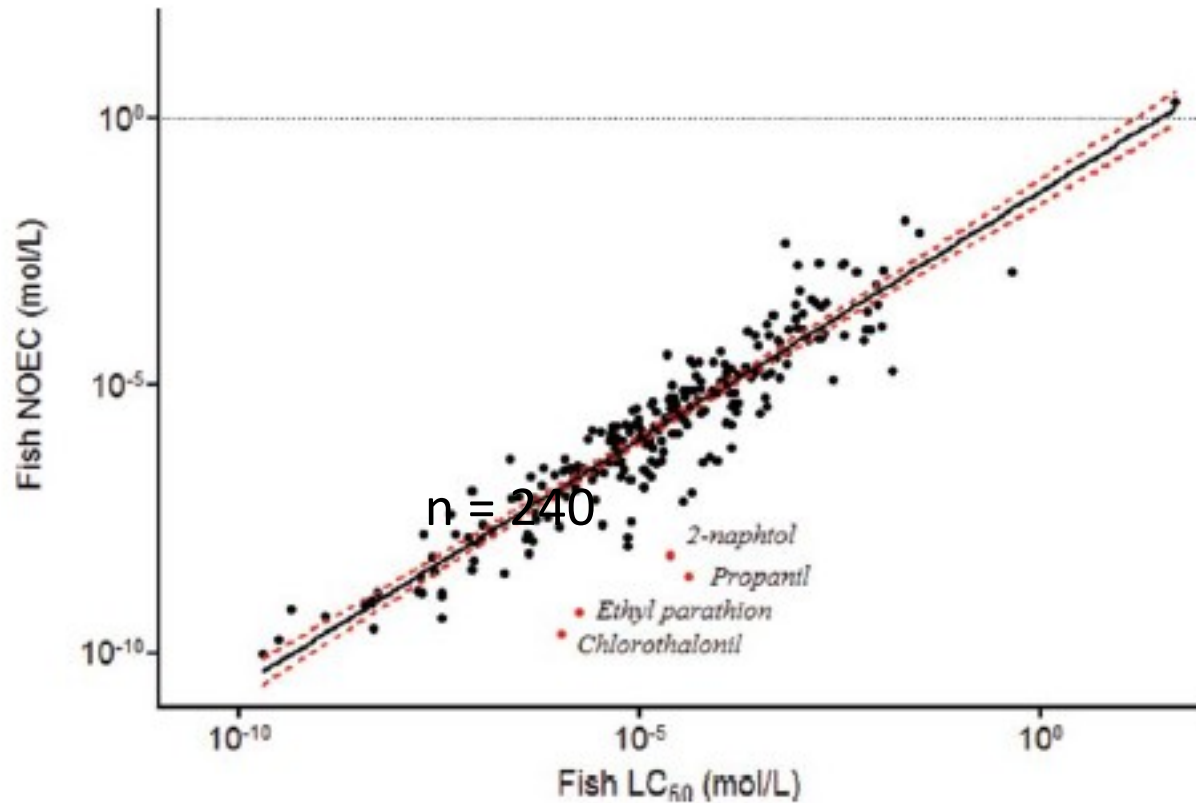


Analytics UPLC-MS/MS:



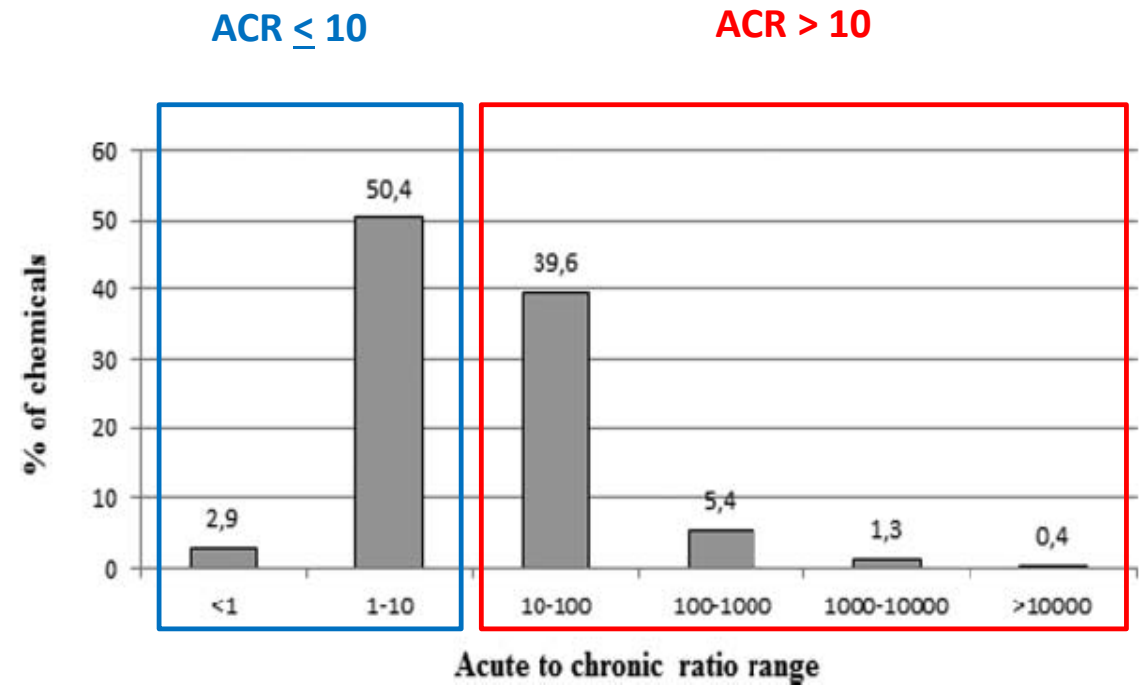
Life
Science
Methods

3- PREDICTING FISH CHRONIC TOXICITY FROM FISH ACUTE TOXICITY



Relationships between fish 96 h LC_{50} and fish NOEC values (geometric mean)

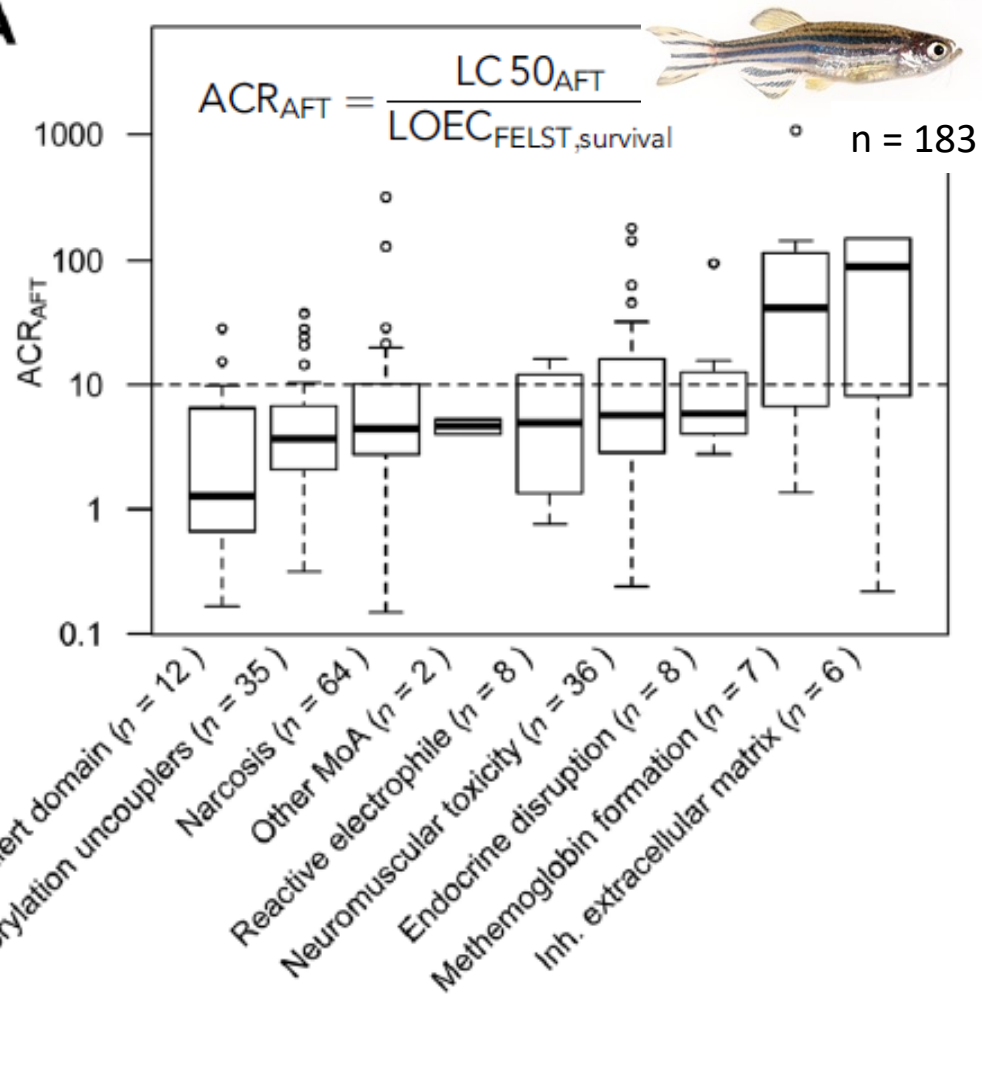
Dashed lines: 95% confidence interval.
Italics: outliers.



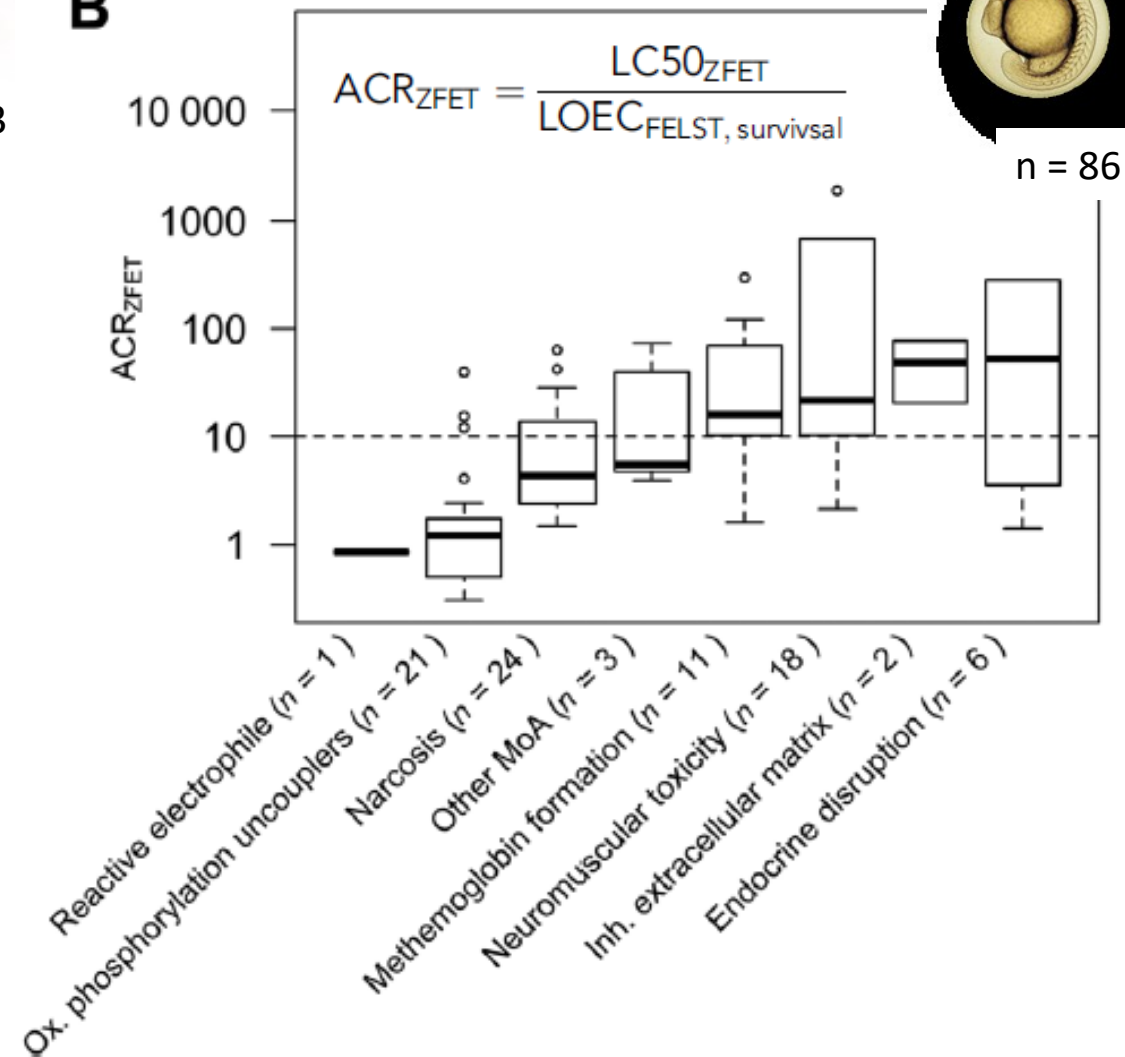
Kienzler et al. *Toxicological & Environmental Chemistry*, 2017
VOL. 99, NOS. 7–8, 1129–1151

FISH ACUTE TO CHRONIC RATIOS (ACRS)

A



B



Scholz et al. (2018) Environ Toxicol Chem. Vol 37. Nb4 pp 955-969

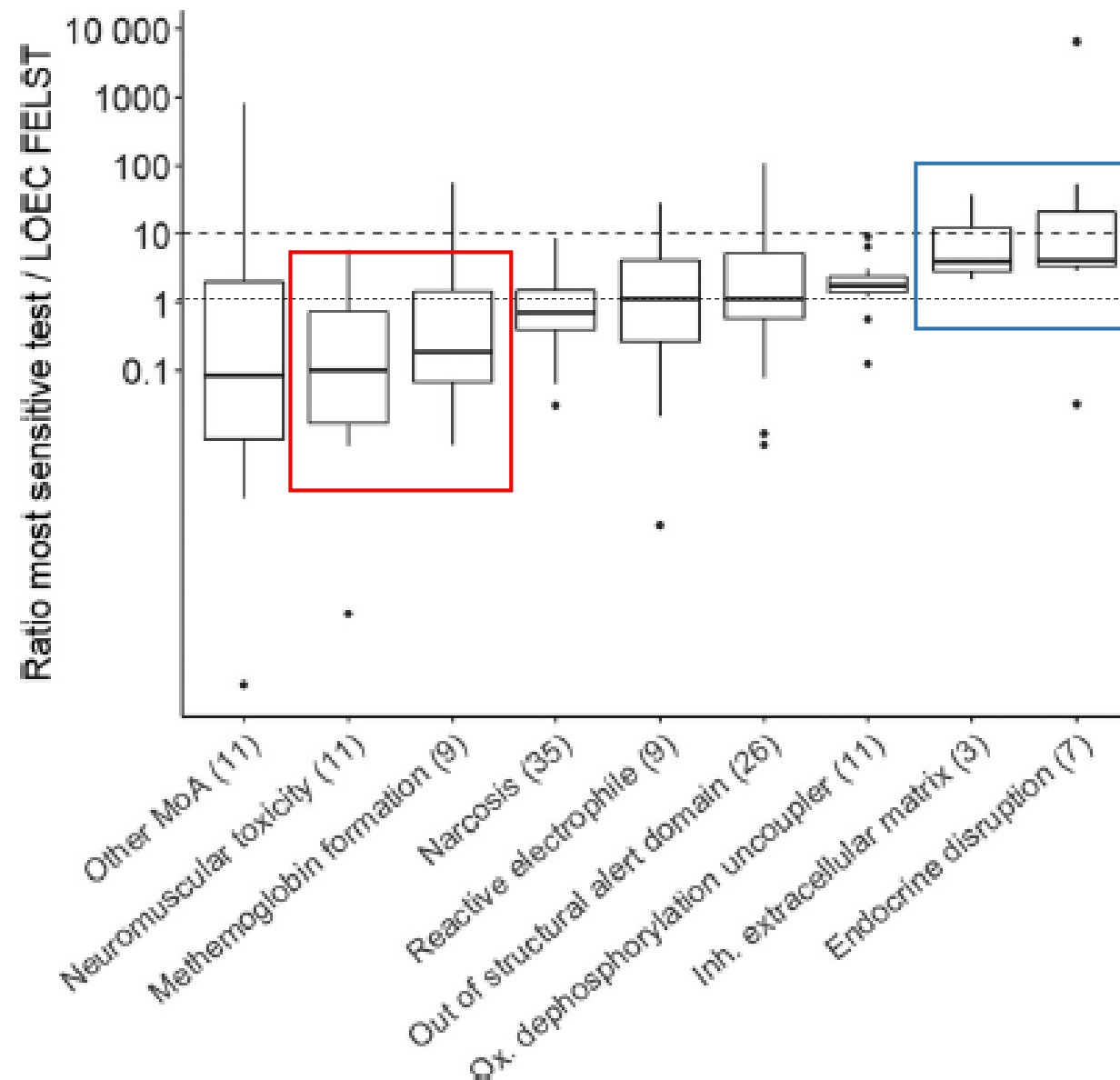
CHRONIC FISH TOXICITY

versus

ALGAE & DAPHNIDS CHRONIC TOXICITIES

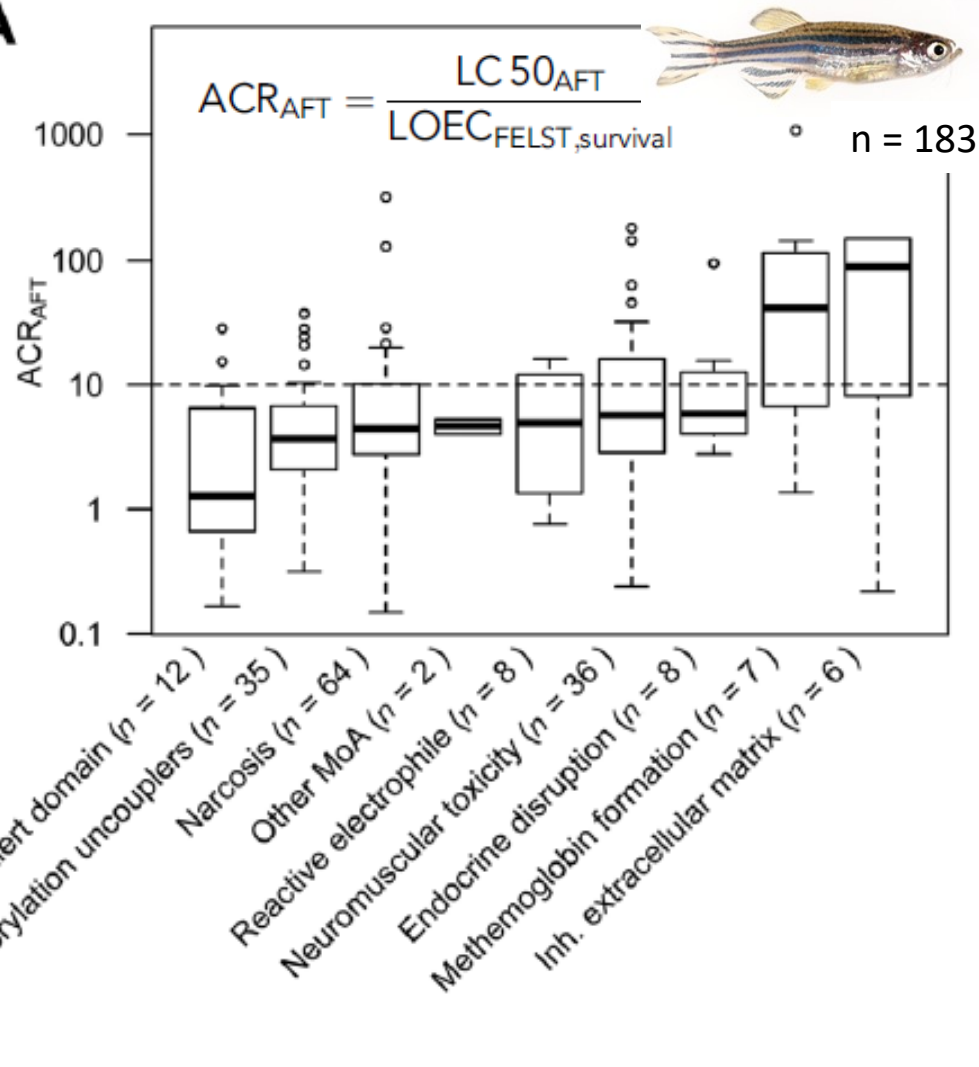
$n = 125$

US EPA ECOTOX, OECD QSAR toolbox,
eChem Portal, EnviroTox database

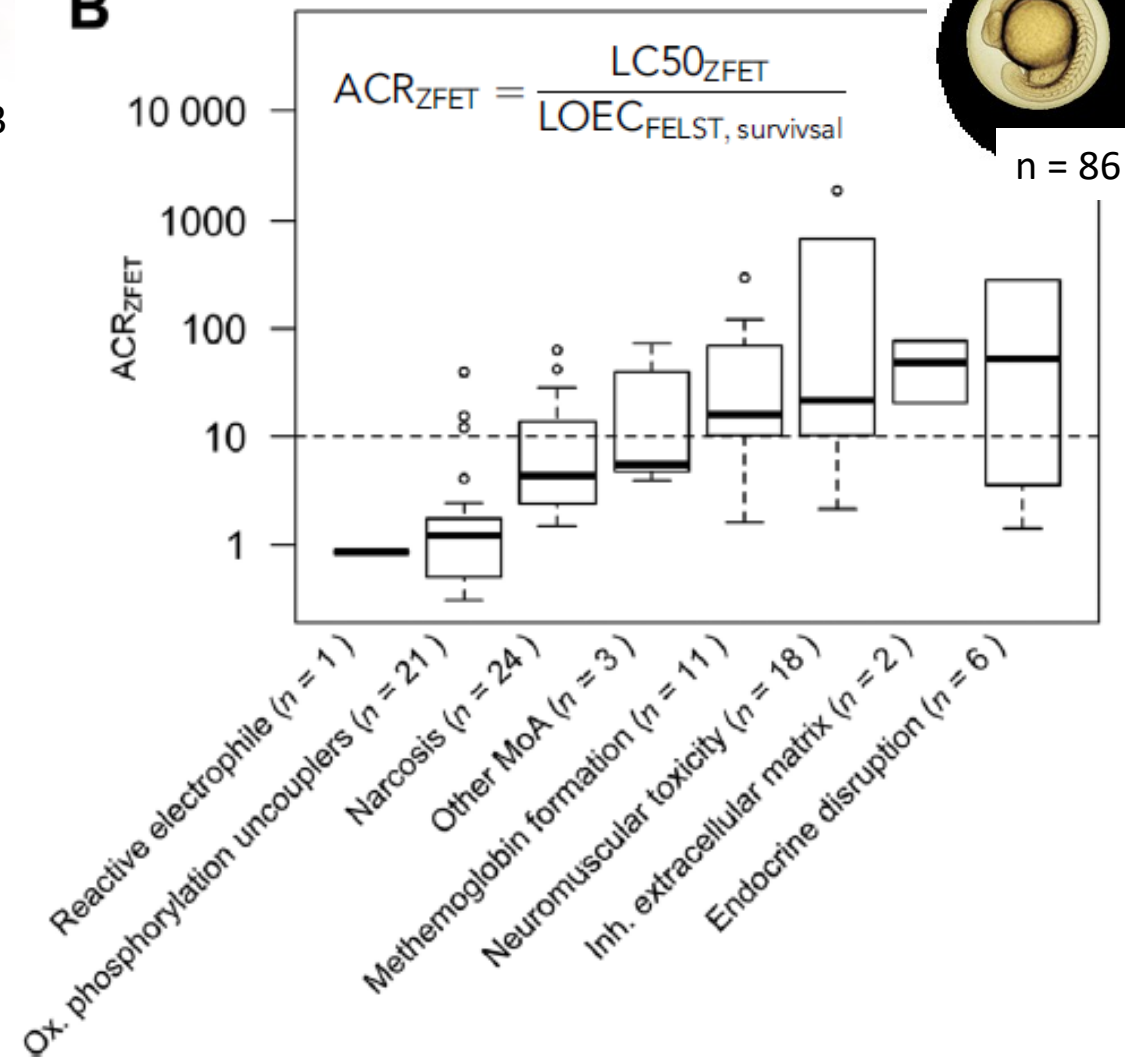


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HOW CAN EXPOSURE TO UV FILTERS AND OTHER STRESSORS IMPACT ECOSYSTEM FUNCTION?

1- Refining exposure assessment

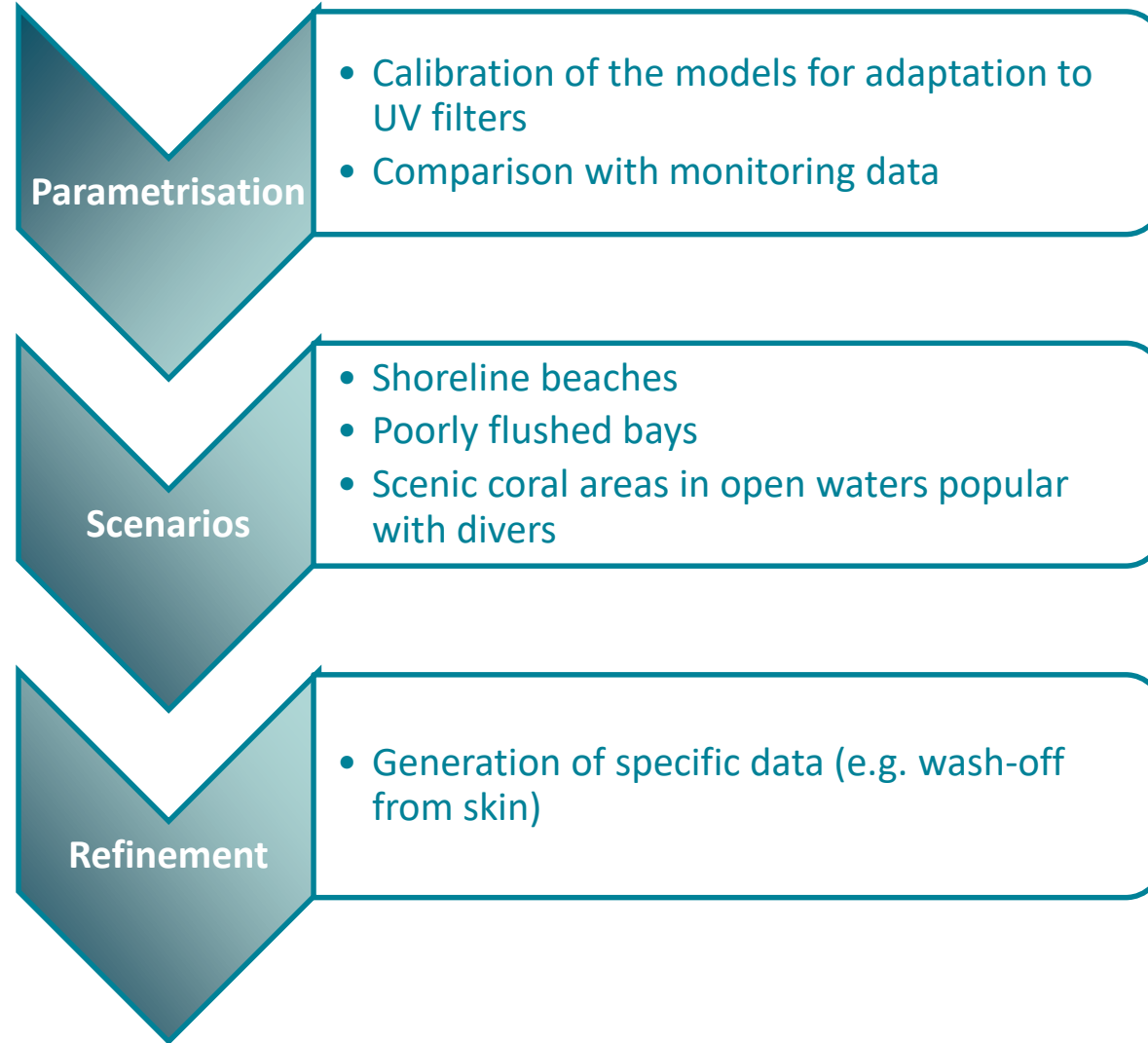
- Direct release assessment
- *In situ* monitoring
Eg. Mitchelmore et al . (Hawaiï, Florida)



2- Sunscreen Formulas (mixtures) aquatic toxicity Assessment

- Calculation (GHS bridging or summation methods)
- Formula Ecotoxicity testing

REFINING DIRECT EXPOSURE ASSESSMENT



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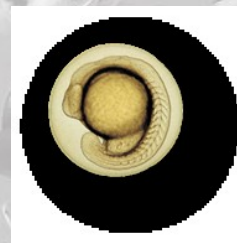
Selenestrum capricornutum



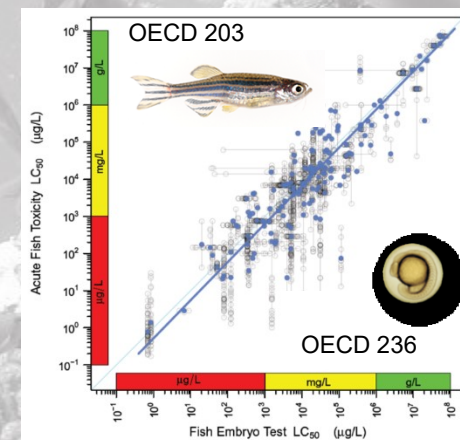
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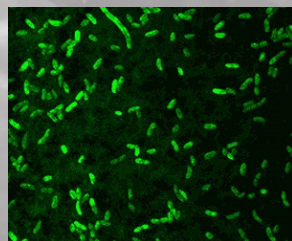
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THANK YOU FOR YOUR ATTENTION

