An Bord Achomhairc Um Cheadúnais Dobharshaothraithe
Aquaculture Licences Appeals Board

Supplemental EIS submission

from Galway Bay Against Salmon Cages

dated 10 January 2019

Cúirt Choill Mhinsí, Bóthar Bhaile Átha Cliath, Port Laoise, Contae Laoise, R32 DTW5
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OHara, Mary

From: Billy Smyth <billysmyth0@gmail.com>
Sent: 10 January 2019 11:07
To: Alab, Info; Ohara, Mary (Alab)
Subject: Fwd: Submission re Supplemental EIS Ref: AP2/1-14/2015
Attachments: Bechmann (1).pdf; Prof. Mark Costello letter.pdf

Aquaculture Licence Appeals Board
Kilminchy Court,
Dublin Rd.
Portlaoise, Portlaoise,
County Laois.

Submission on behalf of Galway Bay Against Salmon Cages Re. Marine Harvest Supplemental EIS. Ref. AP2/1-14/2015

Galway Bay Against Salmon Cages (GBASC) believe that the Marine Harvest (MH) EIS is mainly based on computer modelling programs in relation to tide,current and sea lice movements and cannot predict what way nature will perform at any given time, this is why we believe that the Supplemental EIS is not worth the paper that it is written on. On page 40 of the SUB. EIS it states, "In the case of salmon farming, modelling is now used to a greater or lesser degree in all salmon farming countries. Modelling on sea lice dispersal has now been conducted, in at least Norway, Scotland, Chile, Canada and in Ireland, as reported herein." Evidence from Canada, Norway, Scotland and Ireland in the last number of years has proven that computer modelling on sea lice dispersal does not work as these countries wild salmon and sea trout stocks in rivers close to salmon farms are near extinction. Their Lobster, Shrimp and Crap stocks are also at risk as a result of toxic chemicals which include Hydrogen Peroxide, Slice, Tefuberzuron etc. being used to treat these sea lice infestations.

The computer models are based on the assumption that sea lice have no movement of their own but any competent marine scientist will dispute this.
On page 44 of the Sub. EIS it is suggested that out-migrating wild salmon smolts are infested by sea lice as they emerge from the mouth of their natal rivers by sea lice which originated from incoming wild adult salmon stocks, again this assumption is wrong as any experienced marine scientist will say that out-migrating wild salmon smolts will follow the path of the fresh water emerging from the river out to the sea. A seatrout/sealice research document from the Marine Institute, Central Fisheries Board and Bord Iascaigh Mhara from 2001 states that sea lice can be found at least 30 kilometers from salmon farms but "while it was possible to show high and low mean lice levels on sea trout at sites close to fish farms, the high lice levels were never recorded distant from fish farms." This research paper debunks the theory that salmonids are infested with sea lice by returning wild adult salmon near shore. It is well known in the marine science world, that sea lice do not function well in low salinity water and will not therefore attach to the out-migrating wild smolts in low salinity water. It is only when the wild smolts get further out into the bays where the salmon farms are located and the salinity is higher which enables the sea lice to function more effectively to attach to passing wild salmon smolts. Heavy or low rain fall emanating from salmonid rivers and low salinity in bays is now factored in to all research papers on sea lice by Gargan et al but this does not seem to have occurred in the research carried out for the Jackson et al paper quoted in the Sub. EIS and which MH rely heavily on to prove that sea lice are only responsible for 1% of mortality's in wild salmon smolts. On reading the Jackson paper you will find that there is no mention of heavy rainfall being factored into the equation during the years 2001 and 2009 when the research for this paper was carried out. According to a former marine scientist who worked for the Marine Institute at the time of the research for the Jackson paper, there was heavy rainfall in the years and during the months of out-migration of the salmon smolts at the eight river locations from where the experimental releases occurred, which would

mean low salinity in the bays that the wild smolts had to pass through which contained a number of salmon farms. As was stated earlier, sea lice don't function well in low salinity water, so if the treated and untreated controlled salmon smolts had very few lice attaching in the low salinity waters, this would render the calculations for the percentage of mortalities flawed as the treated and untreated control fish would have similar returns as adults to fresh water. See also document attached below which contains a letter to former minister for Agriculture, Food and the Marine Simon Coveney from marine scientist Professor Mark Costello in relation to sea lice on salmon farms. This letter was sent to Minister Coveney during the period of the BIM application for the Galway Bay salmon farm.

In relation to the Freshwater Pearl Mussel (FPM). If there is less wild adult salmonids returning to rivers due to sea lice infestation in Bantry Bay then this is going to affect the FPM in those rivers. Even if some of these rivers have problems from increased sediment loads and/or eutrophication we should not be putting another man made problem in the way of their recovery. The precautionary principle must be adhered to in this regard.

On page 28 of the Sub. EIS, MH state that they have only needed to treat stocks at the Roancarrig / Ahabeg sites six times between 2008 and 2016. This statement may be misleading as these treatments may be referring to toxic pesticides only and not to fresh water bath treatments that are now regularly used by MH and other salmon farm operators to kill sea lice and Amoebic Gill Disease on their farms. It needs to be clarified by ALAB if MH are using fresh water bath treatments in Bantry Bay which includes the use of Hydrogen Peroxide in the last 20 to 40 minutes of each fresh water bath treatment to kill Amoebic Gill Disease and sea lice. If it is clarified that MH are using Hydrogen Peroxide to kill sea lice on their farms in Bantry Bay then this could have serious consequences for the Shrimp stocks in Bantry Bay, as according to a recent research paper from the Norwegian independent Research Institute (IRIS) has found that Hydrogen Peroxide and a number of other toxic chemicals used to kill sea lice on farmed salmon are more harmful to Shrimp than previously thought. This document is attached below.

GBASC again ask ALAB that the precautionary principles of the EU Habitats Directive be applied and that the MH Shot Head licence application be refused.

On behalf of Galway Bay Against Salmon Cages

Billy Smyth
Chairman, GBASC
10 Colmans Rd,
Shantalla Galway
Phone 0863511628

Ref. documents.
Review of sea lice monitoring and seatrout/sealice database R.Poole, N.O Maoileidigh, D. Jackson (MI) P.Gargan (CFB) M. Keating (BIM) January 2001
Impact of Lepeophtheirus Salmonis infestations on migrating Atlantic salmon. D. Jackson et al 2013

Strandbúnaður

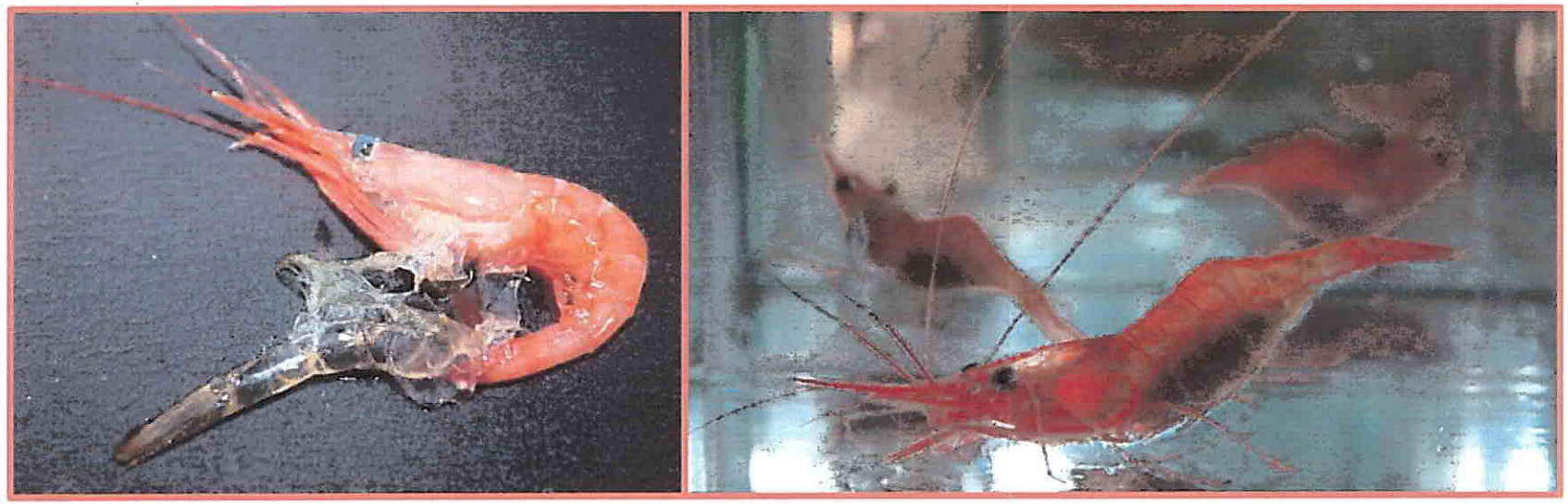
STRANDBÚNAÐUR 2018

Grand Hótel Reykjavík, 19. – 20. mars 2018

IRIS

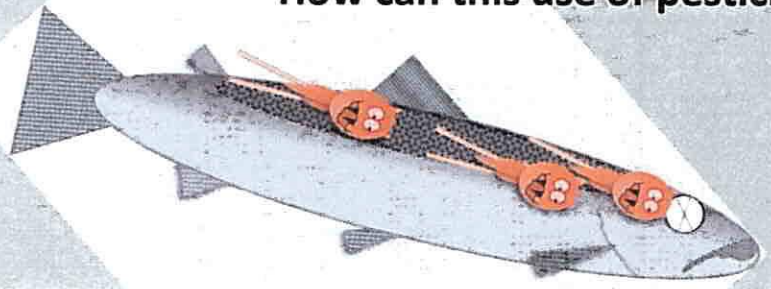
Renée Katrin Bechmann

Environmental effects of chemicals used against salmon lice

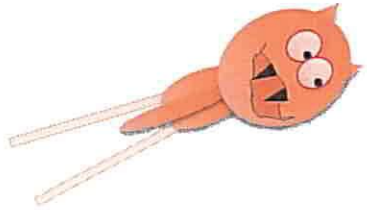


In aquaculture, pesticides are used against parasitic salmon lice to protect the health of farmed and wild Atlantic salmon.

- How can this use of pesticides as medicine affect our coastal marine environment?



Salmon lice and the war against lice



How to get rid of lice

- Kill them with chemicals
- Use cleaner fish and other non-chemical methods
- Protect the salmon from lice in (semi-)closed cages

Economic consequences

- Costs billions for the aquaculture industry

Environmental concequences

- Animal welfare for farmed and wild salmon
- Risk for reduced stocks of wild salmon
- Animal welfare and overfishing of cleaner fish
- Risk for non-target crustaceans, and the rest of the coastal ecosystem

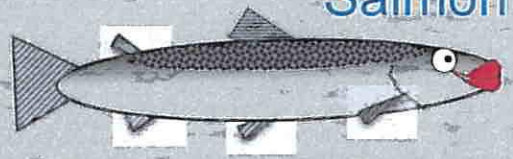
IRIS

The perfect anti-salmon lice medicine

Low toxicity to:

Humans

Salmon



Must eat the chemical or swim in a solution

✓ Fast depuration after treatment of the fish

The environment

including *non-target* crustaceans

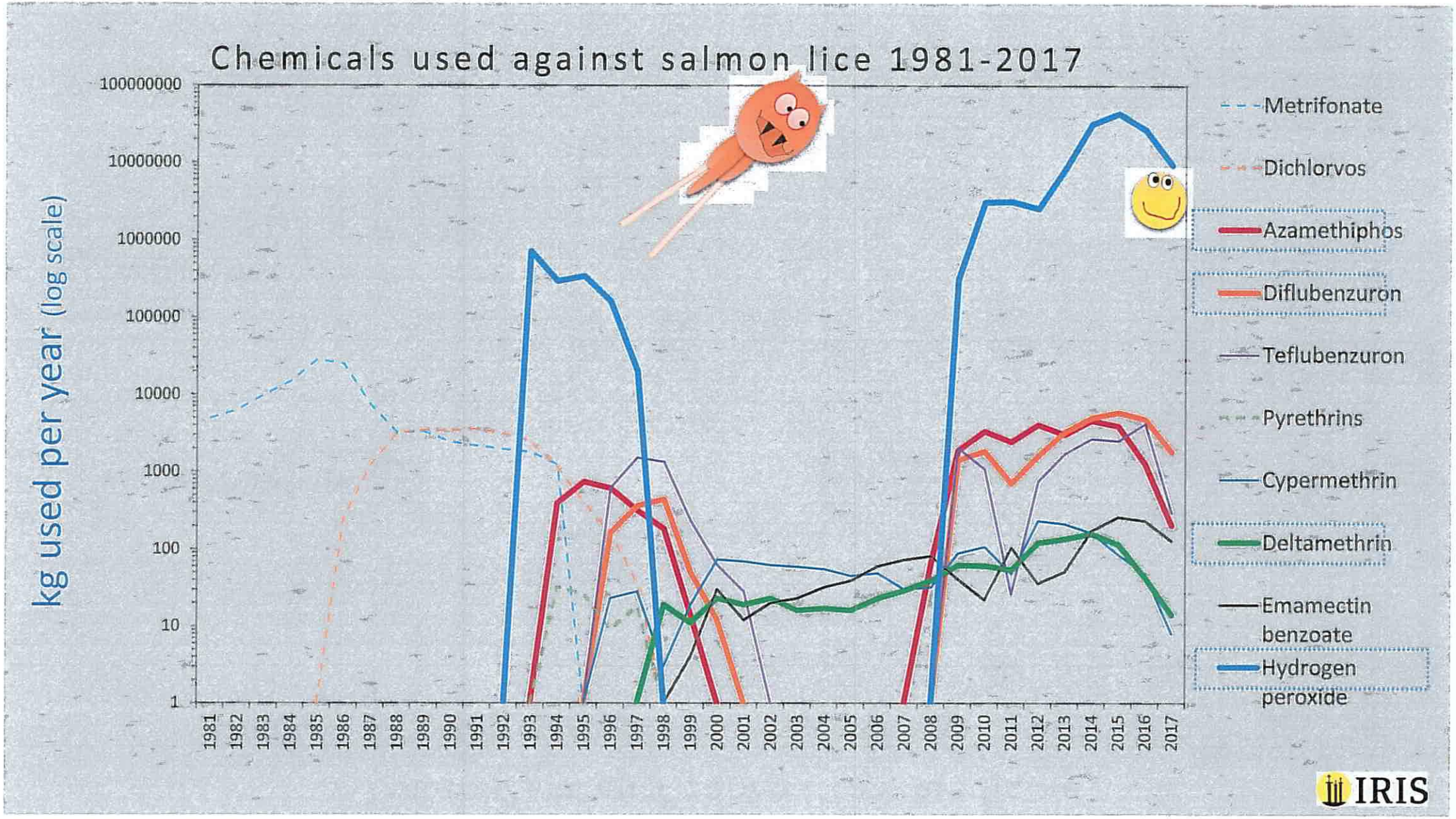
✓ Fast degradation
✓ Low bioavailability
✓ Low toxicity

High toxicity to:

Salmon lice
= target crustaceans

Must die!
... and not develop resistance

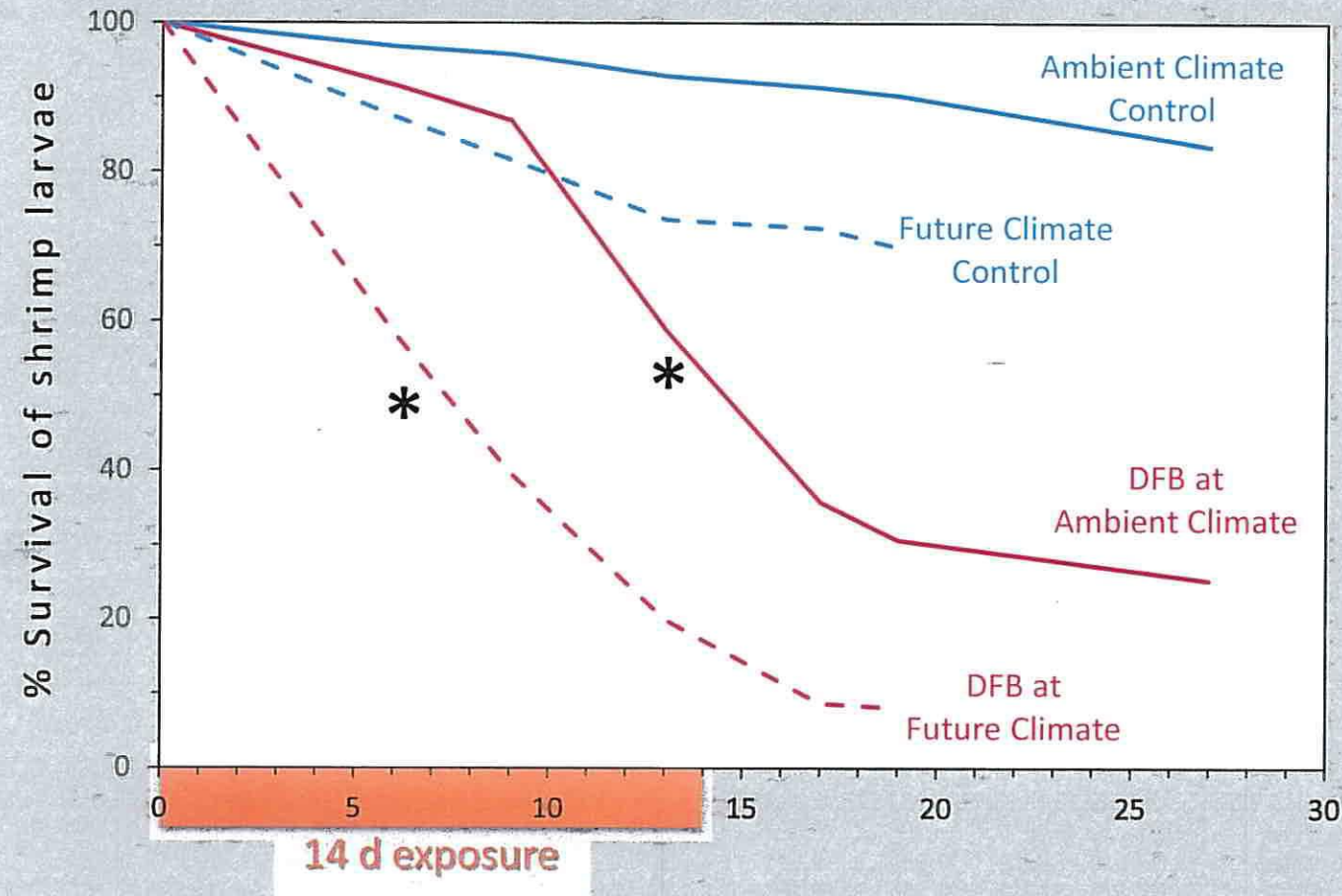
IRIS

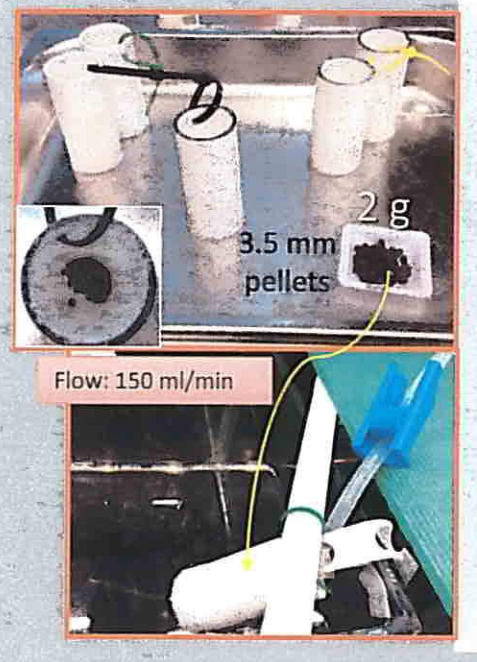

Chemicals used against salmon lice 1981-2017
kg used per year (log scale)
100000000
10000000
1000000
100000
10000
1000
100
10
1
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
Metrifonate
Dichlorvos
Azamethiphos
Diflubenzuron
Teflubenzuron
Pyrethrins
Cypermethrin
Deltamethrin
Emamectin benzoate
Hydrogen peroxide
IRIS

Effects of Releeze medicine feed containing diflubenzuron

IRIS

High mortality of shrimp larvae exposed to tiny particles of medicated feed with diflubenzuron (DFB) as the active ingredient



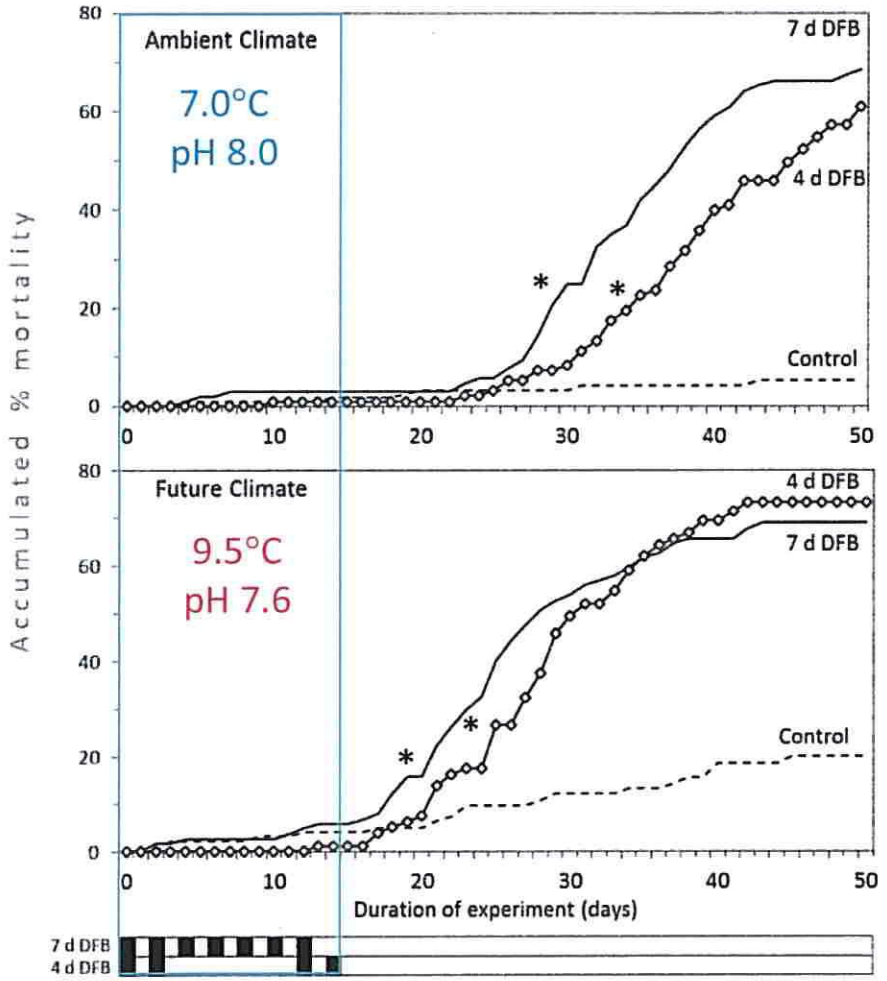


Pandalus borealis

Ambient climate: pH 8.0, 7.0 °C
Future Climate: pH 7.6, 9.5 °C

IRIS

Mortality



Female shrimp were fed Releeze a few times before moulting

High mortality of adult shrimp eating a few pellets Releeze

- Control shrimp moulted successfully
- Hardly any shrimp exposed to medicine feed for two weeks managed to moult, and most died during moulting
- 4 pellets Releeze (ca 0.1 gram) is enough to kill adult shrimp that need to moult during the next 2-3 weeks
- 8 million kg of this medicine feed was used in 2016

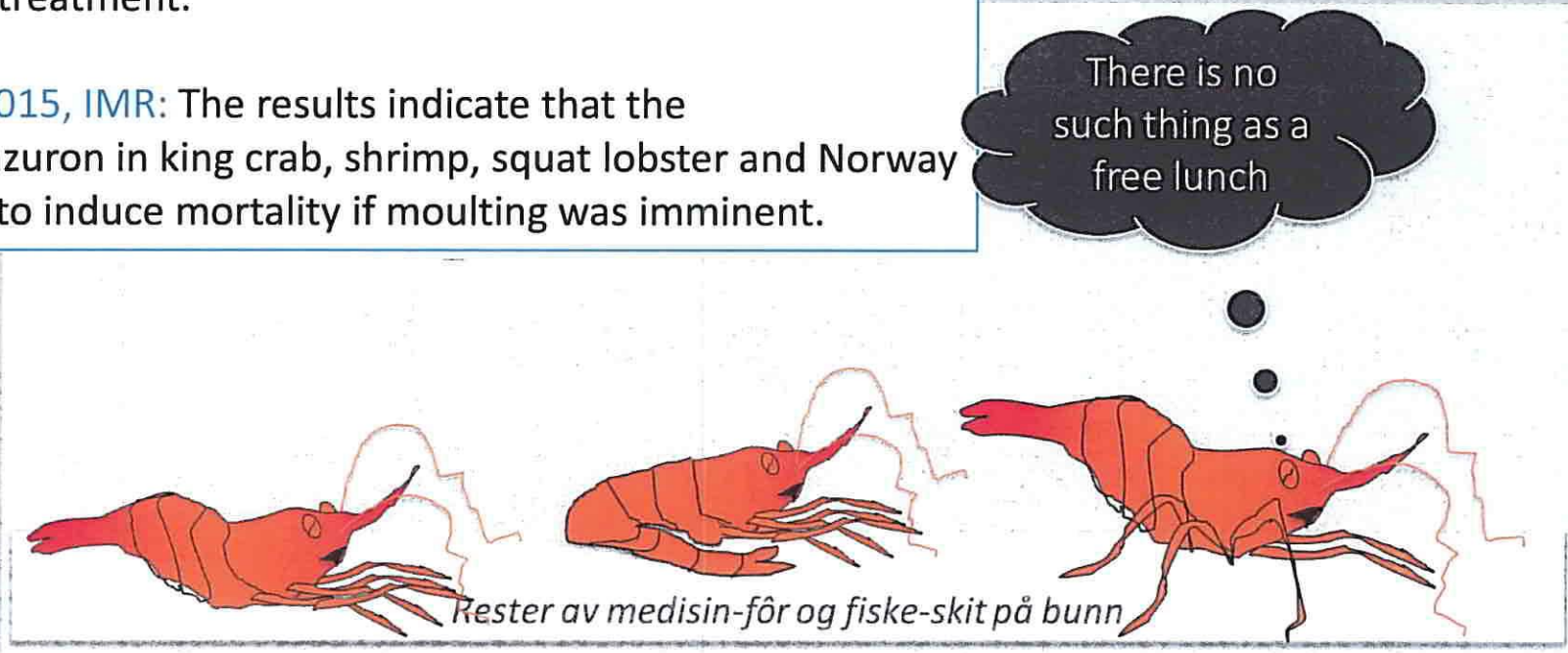
Mean for 6 replicate tanks with 17 shrimps in each

IRIS

- Are flubenzurones (from feed) bioavailable for crustaceans in the field?

- Yes

- ✓ Langford *et al.* 2014, NIVA: Diflubenzuron and teflubenzuron were detected in shrimp, crab and blue mussels sampled 3 weeks after treatment.
- ✓ Samuelsen *et al.* 2015, IMR: Teflubenzuron was still detected in crustaceans and polychaets 8 months after treatment.
- ✓ Samuelsen *et al.* 2014 & 2015, IMR: The results indicate that the concentrations of teflubenzuron in king crab, shrimp, squat lobster and Norway lobster were high enough to induce mortality if moulting was imminent.



IRIS

Effects of «bath chemicals»

Hydrogen peroxide – in Paramove

Strong **oxidizing** agent, **non-specific**

Azamethiphos – in Salmosan

Neurotoxic acetylcholinesterase inhibitor

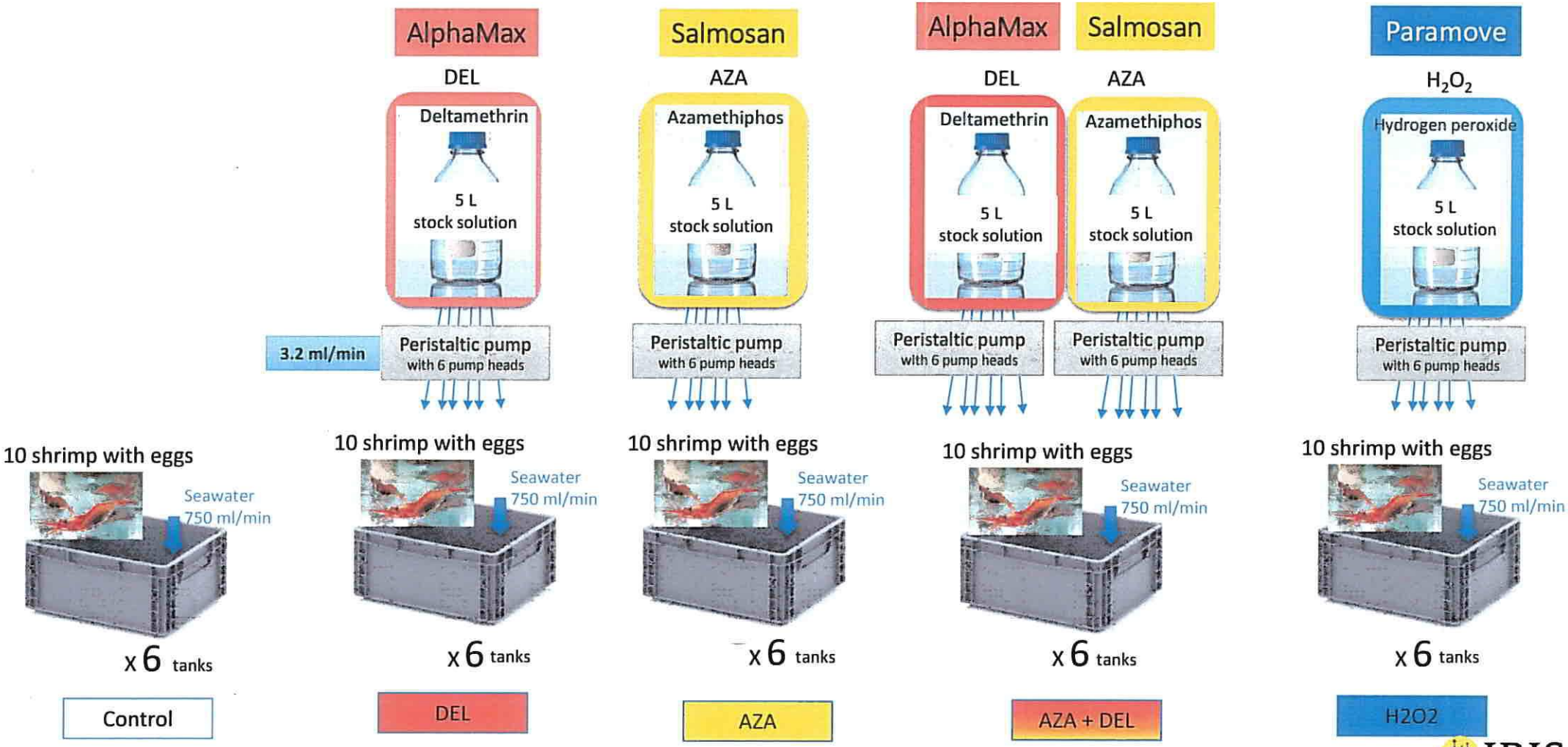
..... leading to **paralysis**

Deltamethrin – in AlphaMax

Neurotoxic ... leading to **paralysis**

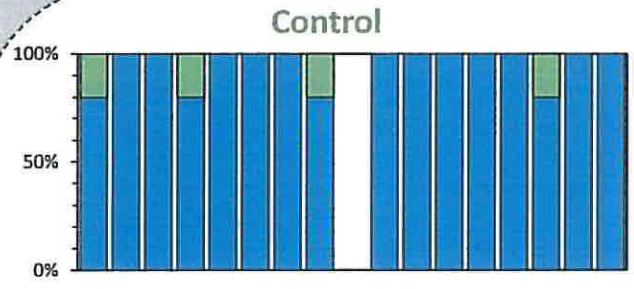
IRIS

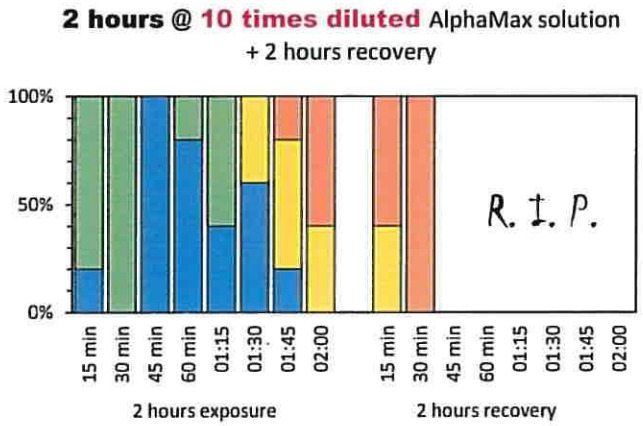
Experiment with shrimp (*Pandalus borealis*)

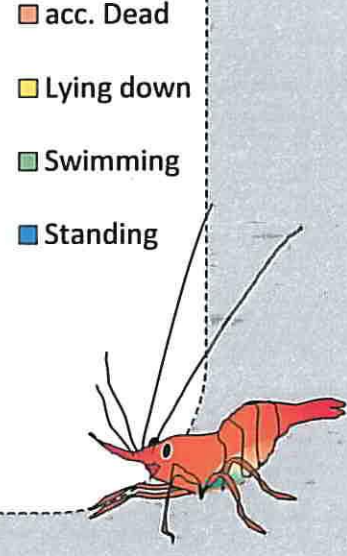


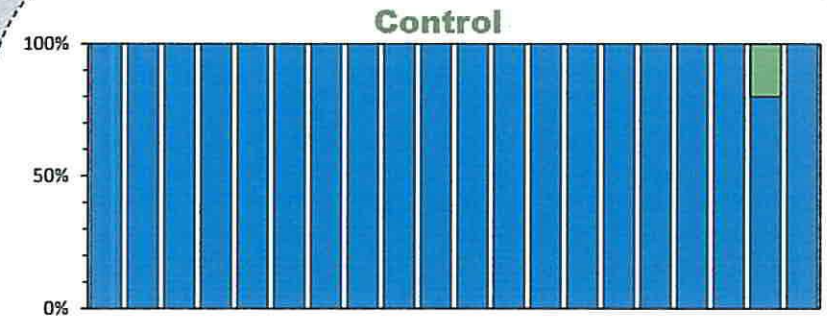
IRIS

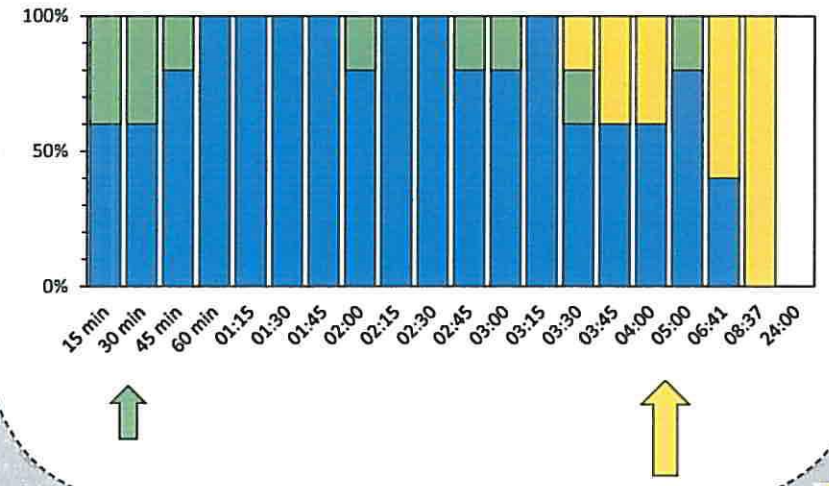
Sceening tests with AlphaMax (deltamethrin)









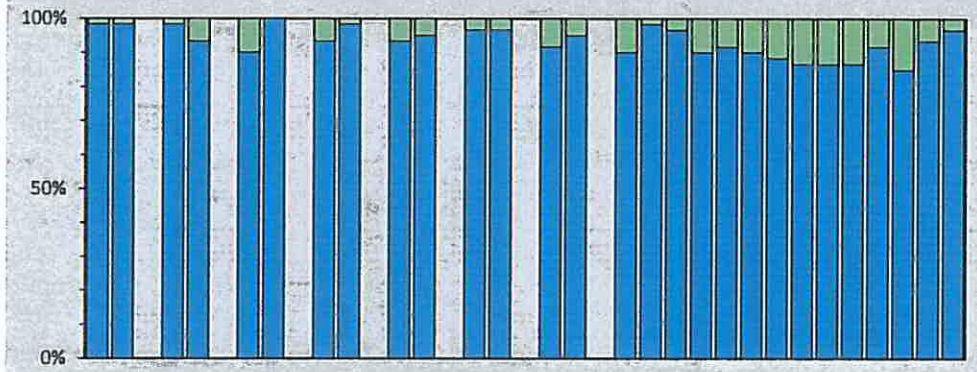


IRIS

Main experiment, adult shrimp, means, n = 6

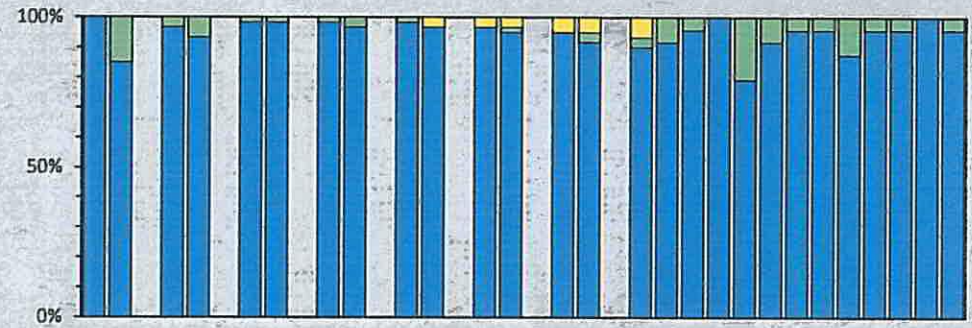
acc. Dead
Lying down
Swimming
Standing

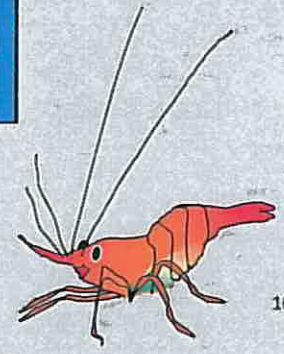
Control



2 ng/L deltamethrin

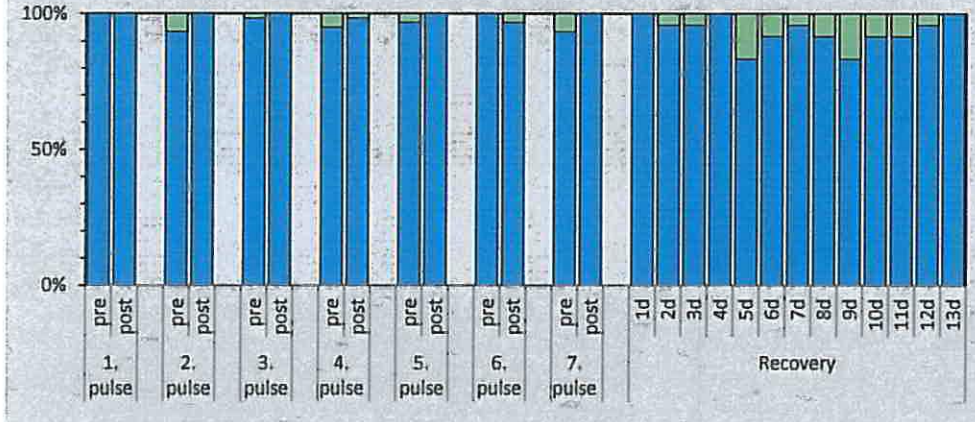
1000 times diluted salmon treatment concentration of AlphaMax





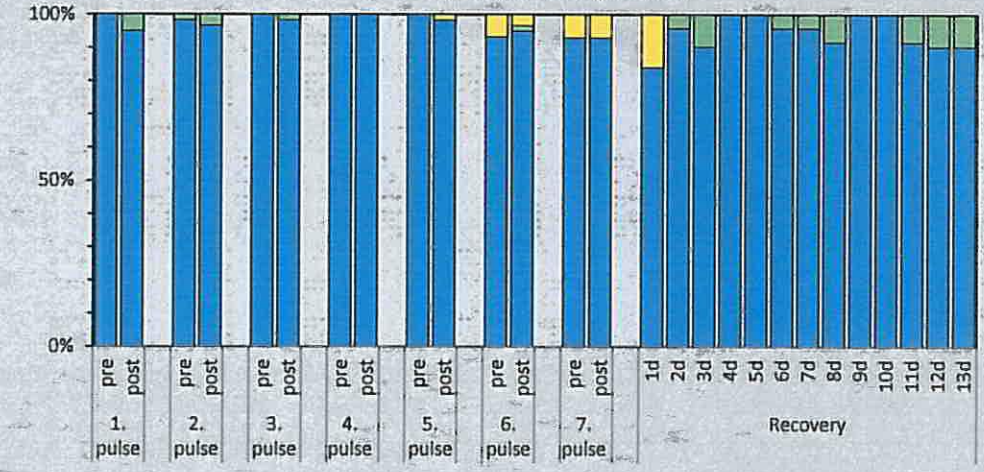
0.1 µg/L azamethiphos

1000 times diluted salmon treatment concentration of Salmosan



0.1 µg/L azamethiphos + 2 ng/L deltamethrin

1000 times diluted of the salmon treatment concentrations of Salmosan and AlphaMax



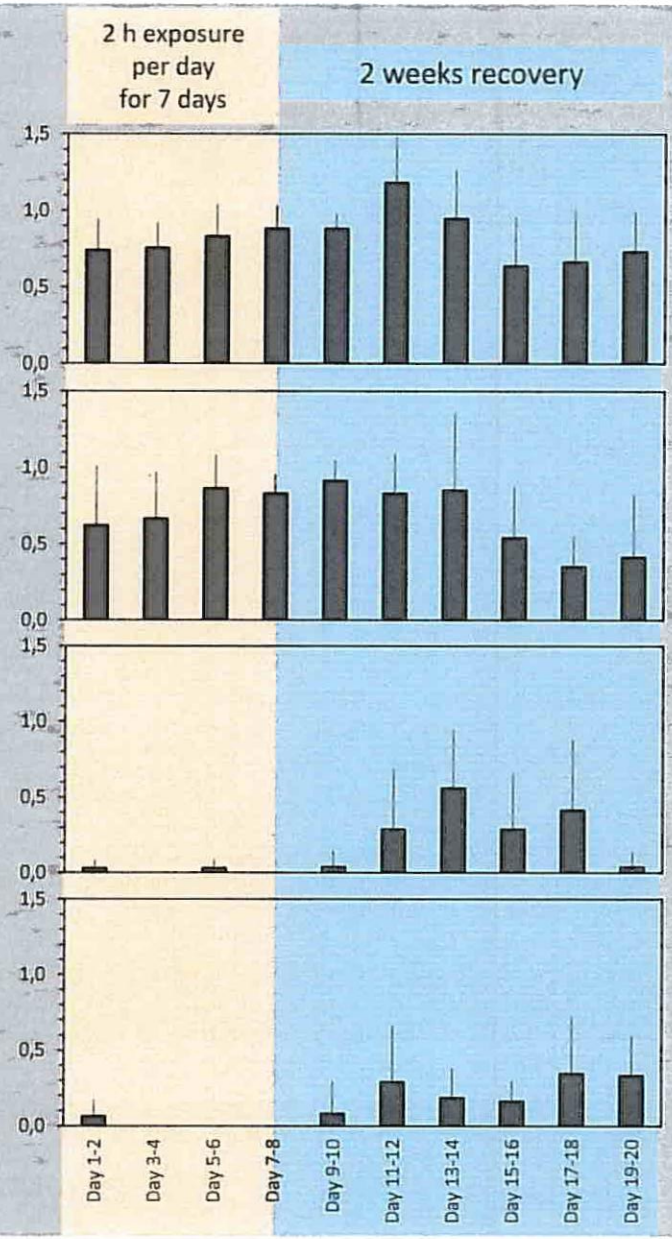
1 dead shrimp after 7 pulses

IRIS

1000 times diluted AlphaMax solution caused reduced feeding for adult shrimp

Feeding rate for shrimp

Number of pellets consumed per shrimp per day (mean + SD)



Control

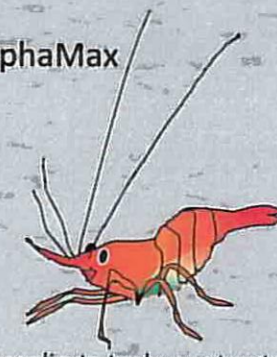
0.1 µg/L azamethiphos

1000 times diluted salmon treatment concentration of Salmosan

2 ng/L deltamethrin (AlphaMax)

1000 times diluted salmon treatment concentration of AlphaMax

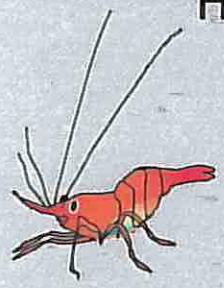
1000 times diluted mix of Salmosan and AlphaMax



n = 6 replicate tanks per treatment, each with 10 shrimp at start

IRIS

Histological assessment of adult shrimp – Digestive gland alterations *(work in progress)*



7 x 2 hours exposure to 1000 times diluted treatment water of Salmosan and/or AlphaMax

Control

Salmosan

Rc

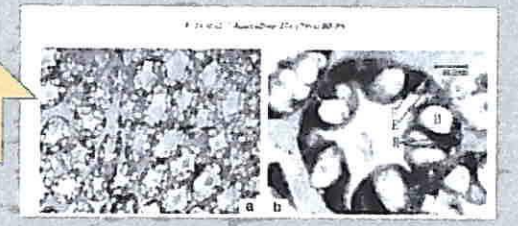
AlphaMax

Rc

Salmosan + AlphaMax

Rc

Bc



Abnormal lumen (ABL) and hemocytic infiltration ( ) in the interstitial sinus (IS) were observed.

<u>Preliminary</u> conclusion:

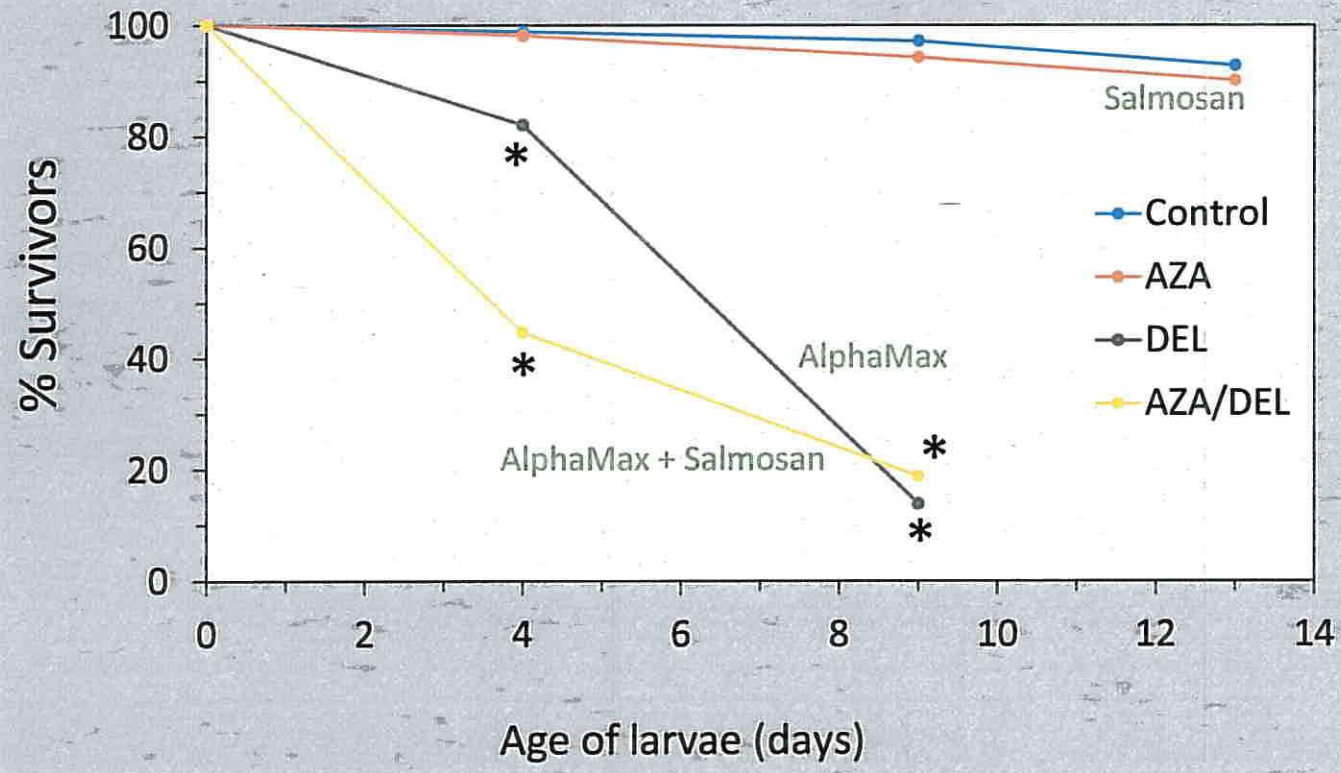
Both Salmosan and AlphaMax caused tissue damage, and it was worse in the combined exposure

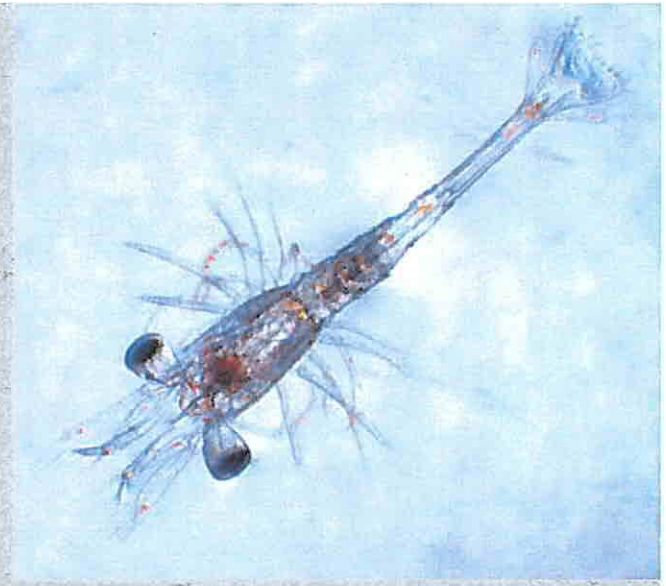
IRIS

DIRECT EXPOSURE OF SHRIMP LARVAE

High mortality of larvae exposed for 2 hours to **1000 times diluted**

AlphaMax or AlphaMax + Salmosan





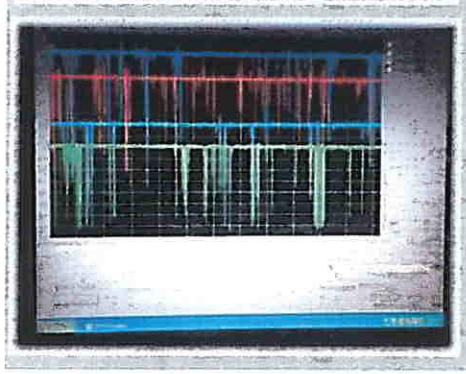
2 hour exposure
+ two weeks recovery

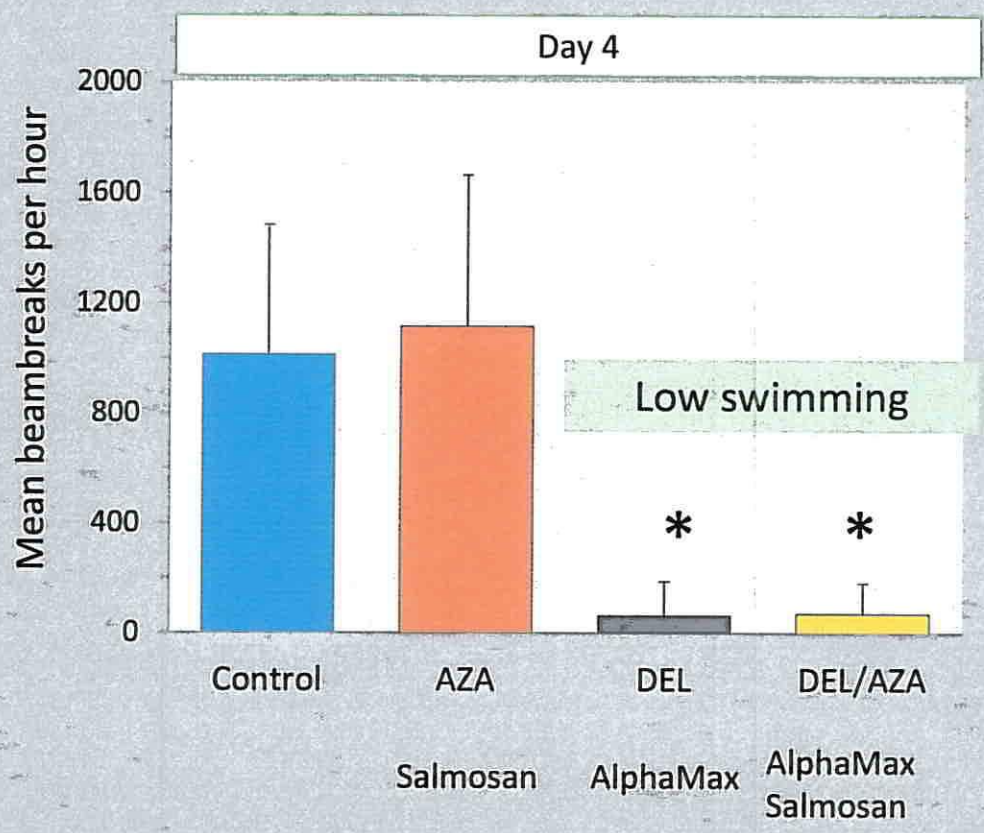
IRIS

DIRECT EXPOSURE OF SHRIMP LARVAE

Low swimming activity of larvae exposed for 2 hours to **1000 times diluted**

AlphaMax or AlphaMax + Salmosan





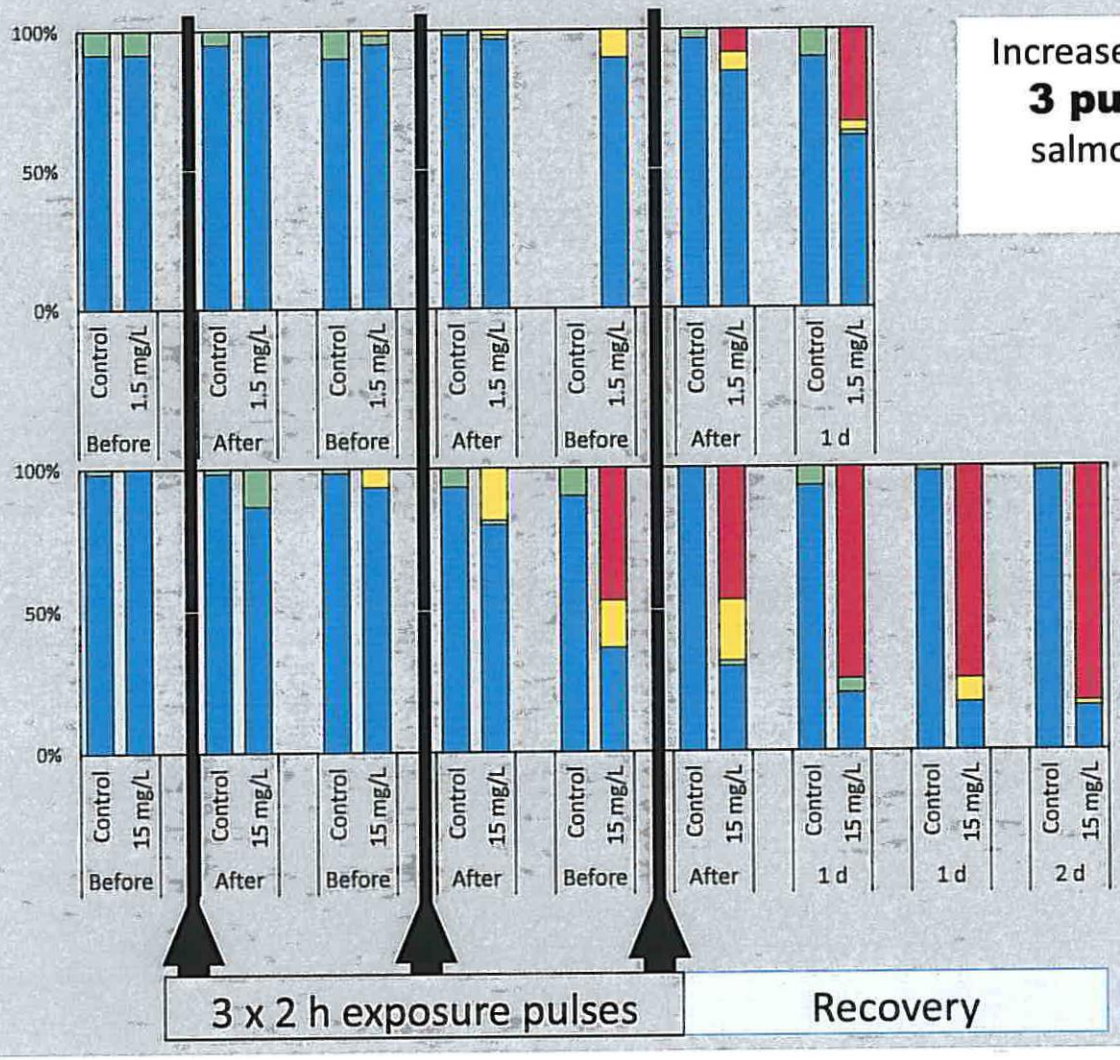
2 hours exposure
+ two weeks recovery

IRIS

- How do shrimp respond to pulses of diluted Paramove (H_2O_2) treatment water?

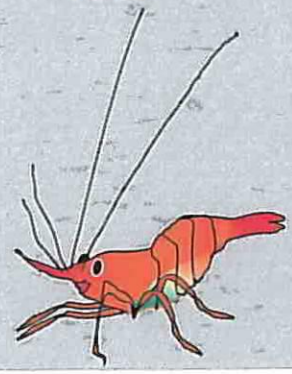
IRIS

High mortality of adult shrimp exposed to diluted Paramove (H_2O_2)



Dead
Immobilized
Swimming
Standing

Increased mortality after exposure to **3 pulses** of <u>1000 times diluted</u> salmon treatment concentration



Very high mortality after exposure to **3 pulses** of <u>100 times diluted</u> salmon treatment concentration

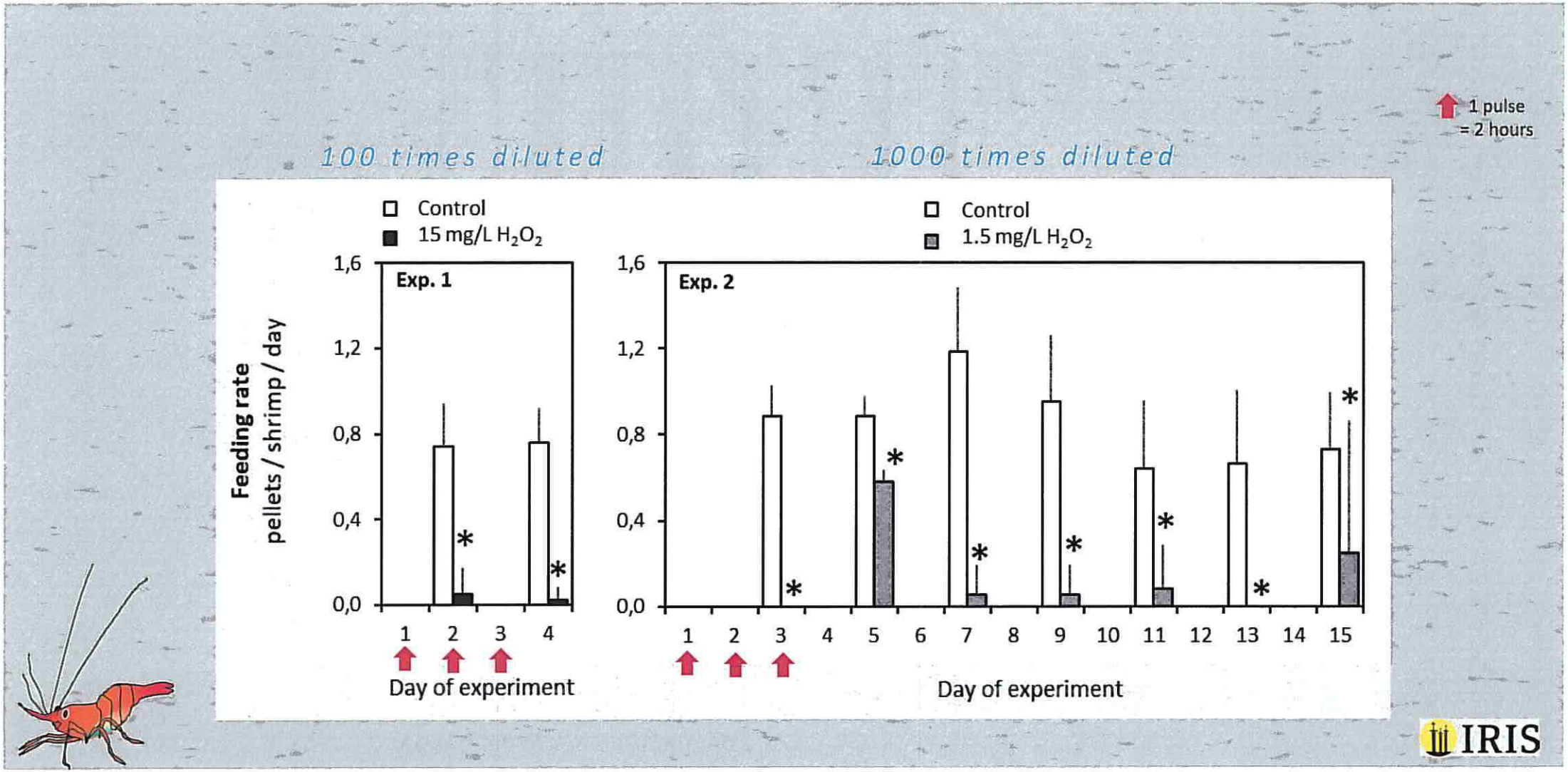
Mortality also increased 3 days after **1 pulse** exposure:

Delayed effects!

IRIS

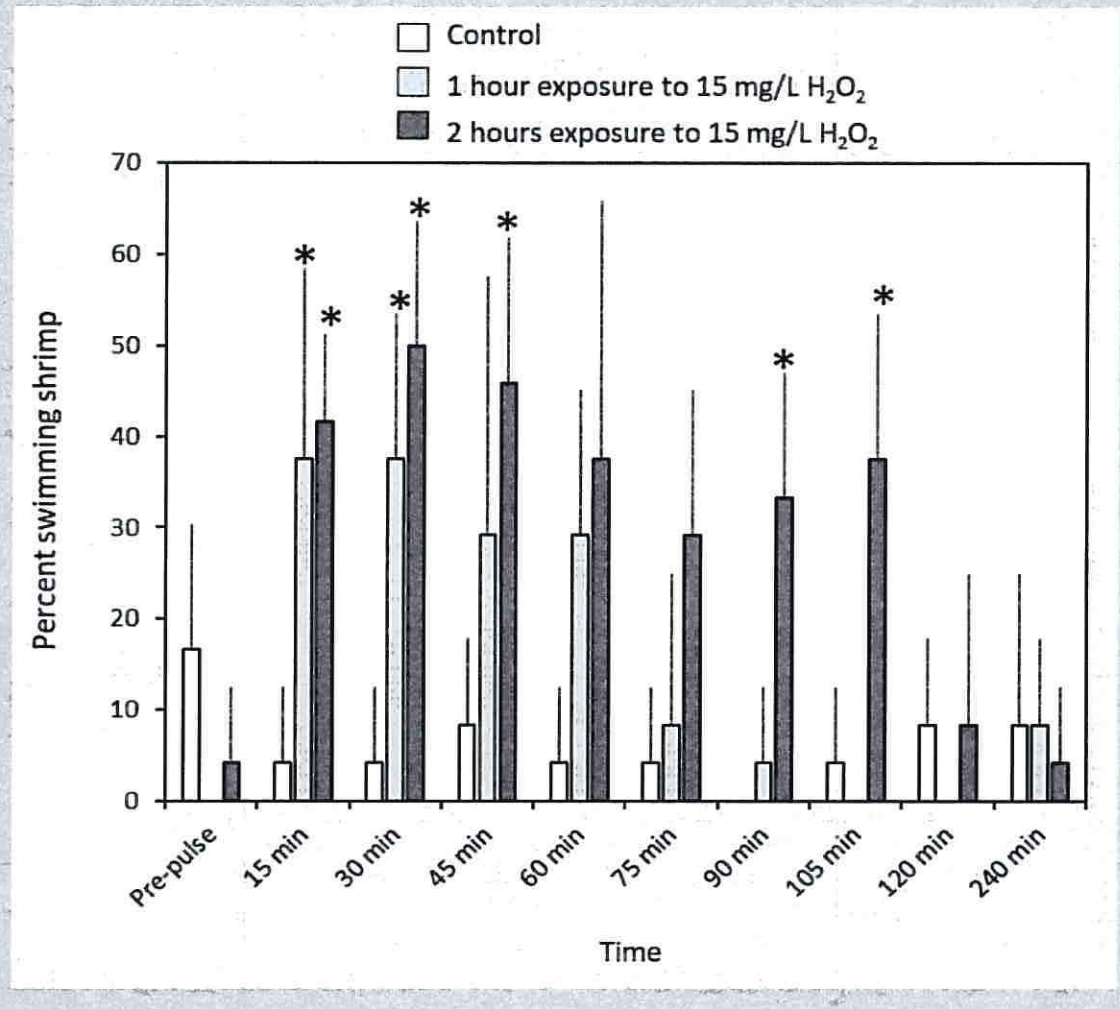
Significantly **reduced feeding rate** for shrimp during and after exposure to

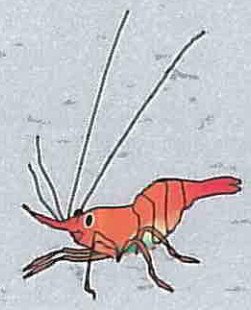
3 pulses of 15 mg/L and 1.5 mg/L H_2O_2



Increased swimming activity during exposure to 15 mg/L H_2O_2

100 times diluted salmon treatment concentration of Paramove



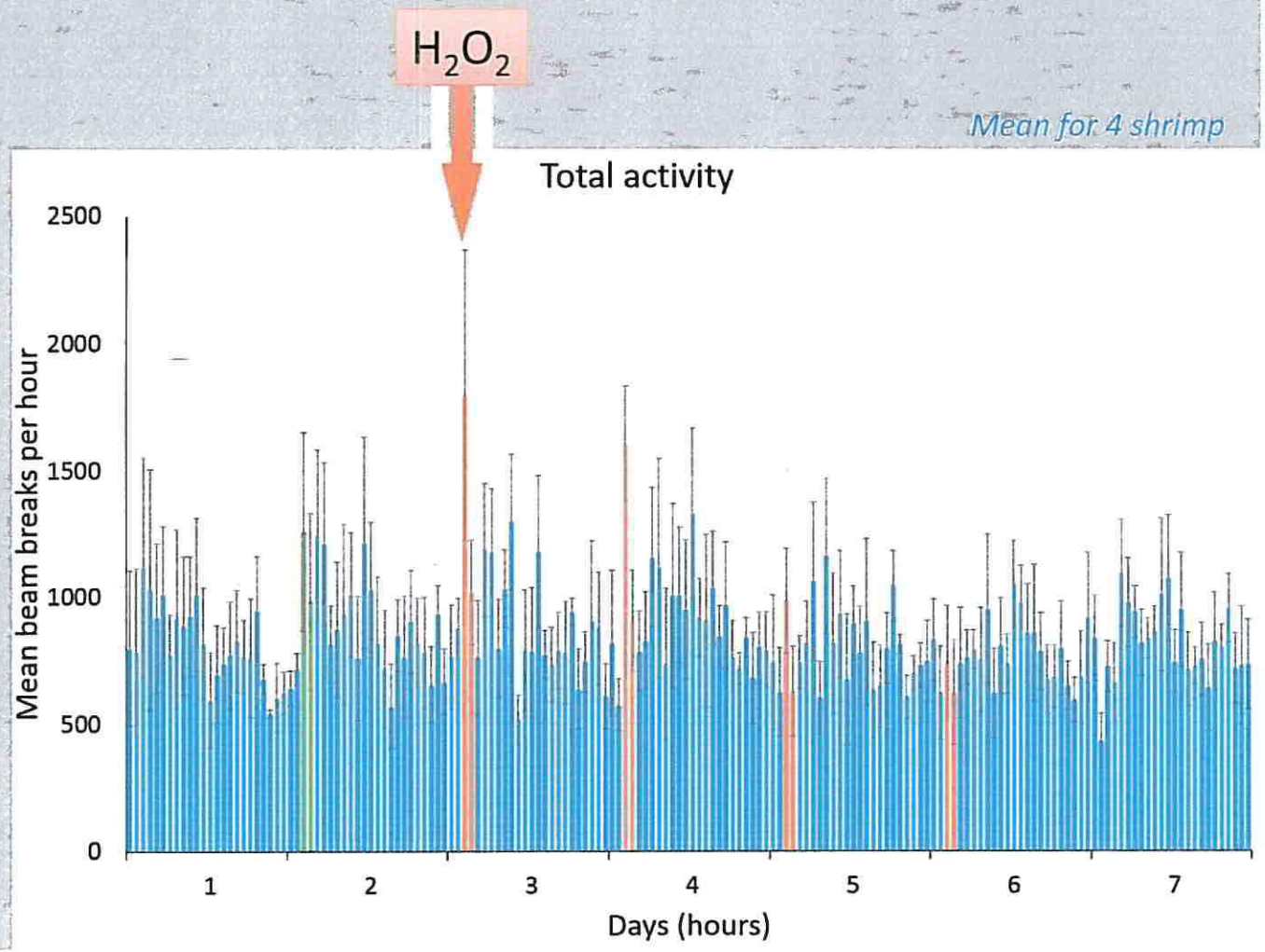


IRIS

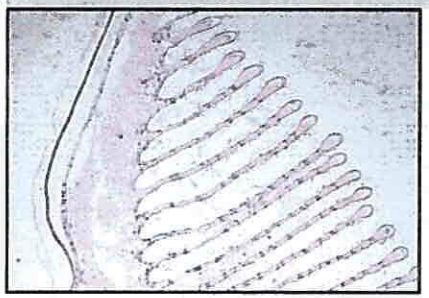
Indications of increased swimming activity for adult shrimp also after exposure to

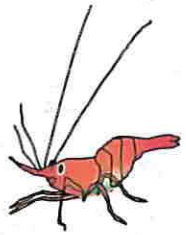
1000 times diluted treatment concentrationof Paramove

Activity of shrimp monitored continuously over seven days

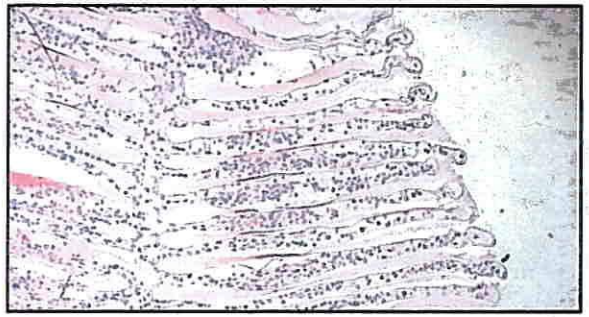


One hour exposure to 1.5 mg/L and 15 mg/L H_2O_2 caused **gill damage** in adult shrimp



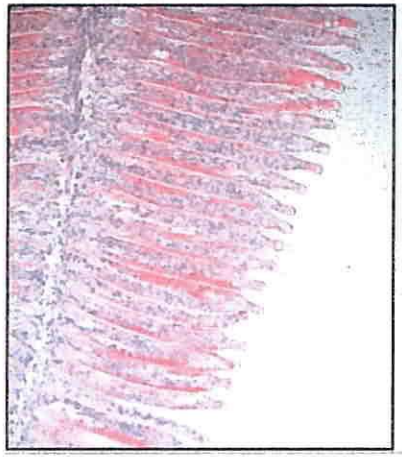


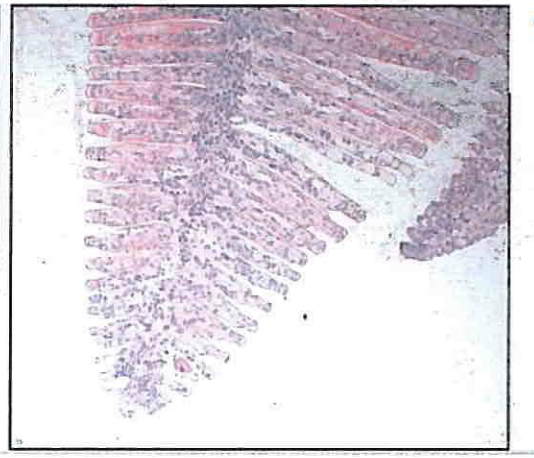
Control



1000 times diluted
treatment solution for salmon

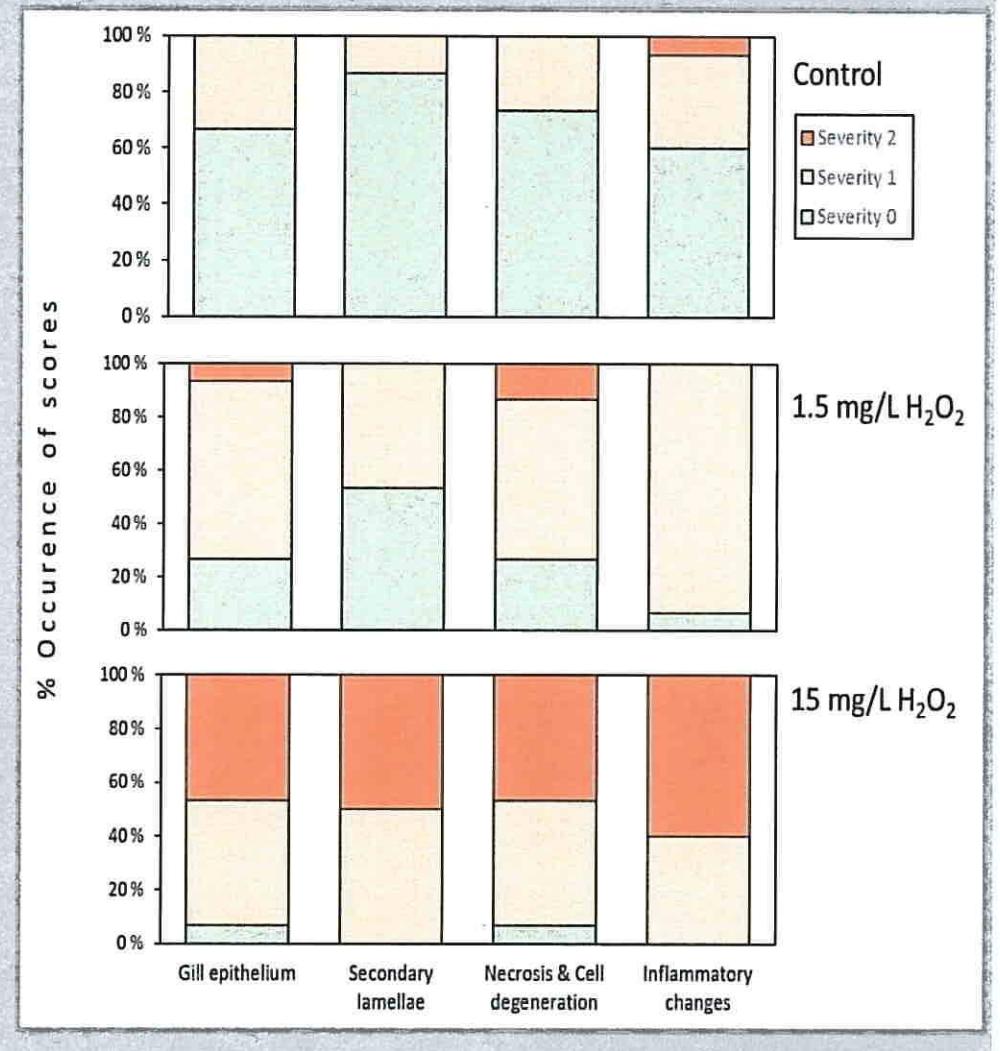
1.5 mg/L
H_2O_2





100 times diluted

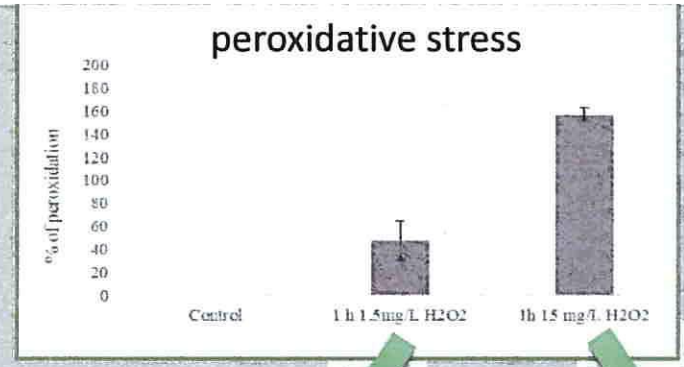
15 mg/L
H_2O_2

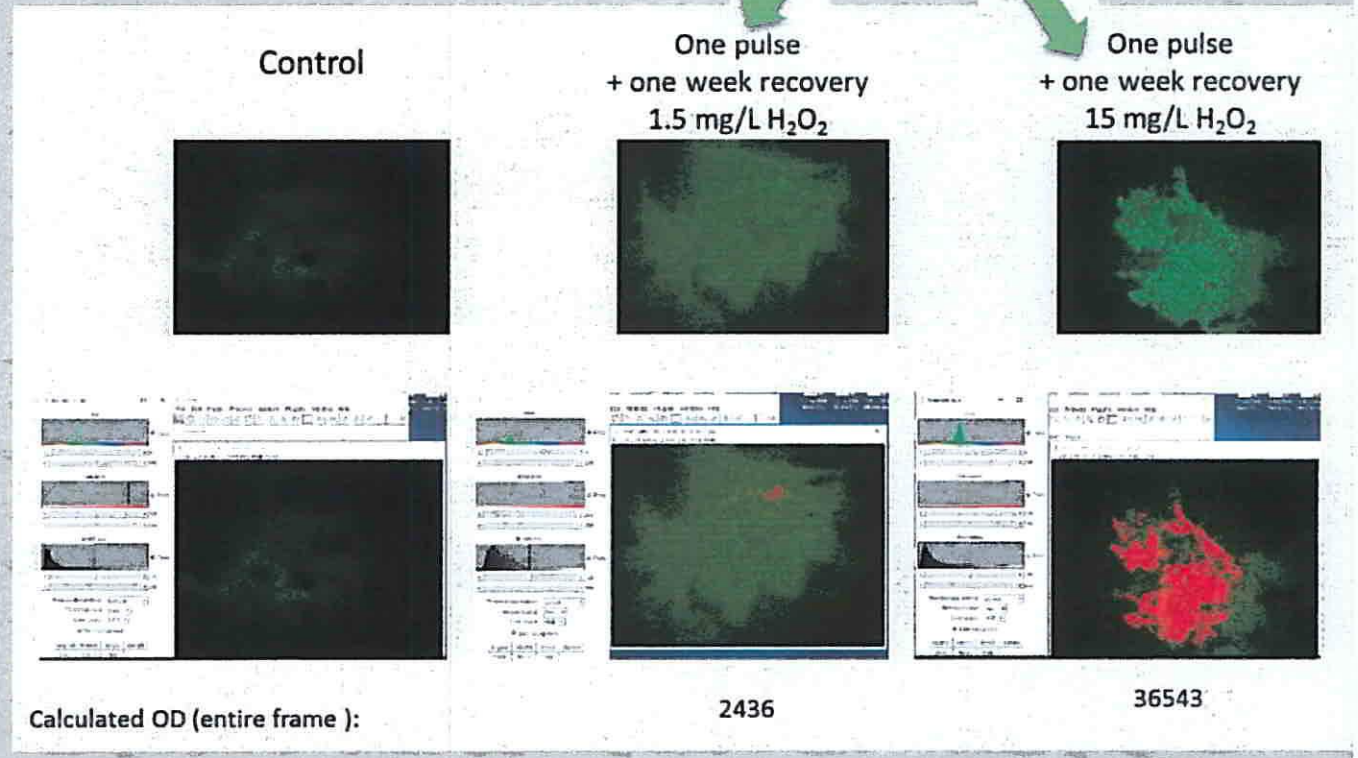


Significant **tissue damage**

in the digestive glad of adult shrimp

exposed to 1.5 mg/L and 15 mg/L H_2O_2





IRIS

1000 times diluted treatment water of AlphaMax & Paramove, or a few pellets of Releeze medicine feed can kill shrimp

- Is dilution the solution when pesticides are used as medicine?

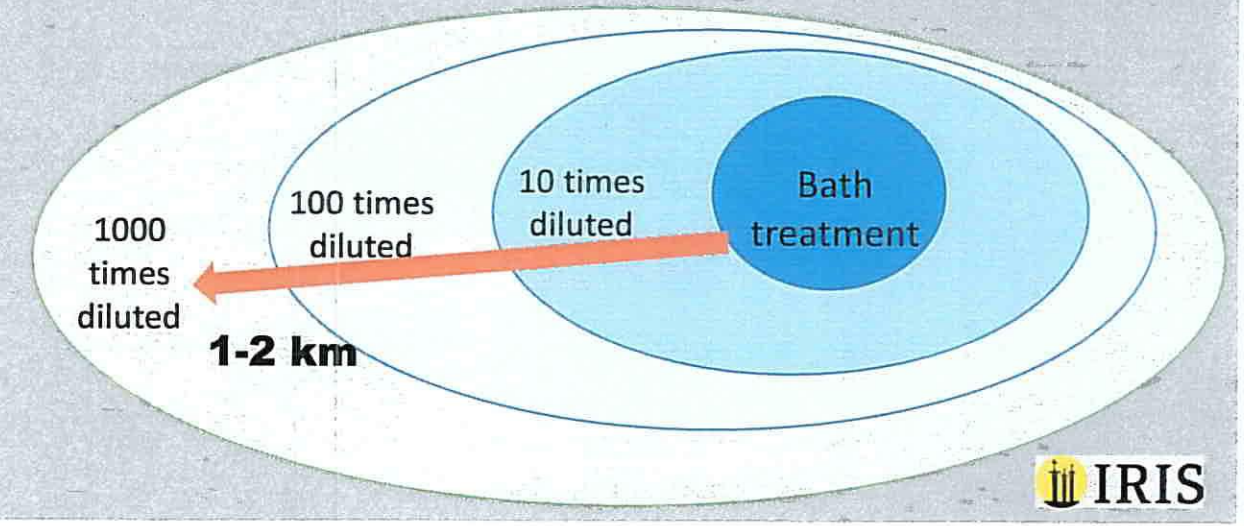
- Maybe not?

Page et al. (2014), Fisheries and Oceans Canada:

Within **a couple of hours** after release, bath chemicals may be advected up to **1-2 kilometers**, and the concentration is estimated to be **100 – 1000 times diluted**

Samuelsen et al. 2015, IMR:

Particles of medicine feed and feces from fish eating medicine can be transported **more than 1 km away** from the farm



IRIS

Please think about

What is acceptable?

Aquaculture is important for Norway

In 2017 we had ca. 3400 cages at 550 locations

*..... **x 5** in the future?*

= Sustainable?

- ✓ How important is it to protect the coastal marine ecosystem? Are shrimp & co "expendable"?
- ✓ How important is it to protect wild Atlantic salmon from lice (and escaped farmed salmon)?
- ✓ Should farmed salmon be protected from lice in closed cages to stop the use of chemical treatment?

Thank you all for listening!

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4. The **Solvay** project (PL: Renée K. Bechmann)

Thank you to the project participants:

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2) NIVA

3) University of Leicester

4) Université du Québec à Rimouski

5) DEBtox Research

6) Burridge Consulting Inc

IRIS

WORLD EXPERT AND FORMER GOVERNMENT ADVISOR WARNS MINISTER OF THE IMPACTS OF SEA LICE ON IRELAND'S WILD SALMON

Cites incorrect information in the media

The Chair of the World Register of Marine Species, President of the International Association of Biological Oceanography, and Marine and Freshwater Editor of the journal Biological Conservation has written to Minister Simon Coveney warning him of recent incorrect information in the media about whether sea lice from salmon farms can cause problems on wild fish.

In his letter, he explained that while he does 'not normally get involved in such debates' he 'was surprised at some of the recent incorrect information in the media about whether sea lice from salmon farms can cause problems on wild fish' and felt it important 'that I provide you with best scientific information'.

Professor Mark Costello received his degrees from NUI Cork and Galway and has lectured on marine biology in Ireland and Canada. He is currently Associate Professor in Marine Ecology at the University of Auckland. He has published research on this issue since the early 1990's, and was a Technical Consultant to the Irish Aquaculture Licence Appeals Board.

In his letter he points out that salmon lice emanating from farms 'have proven difficult to control on farms, especially large farms' and have been 'linked to mass fatal parasite infestations on wild salmon and trout in Ireland, Scotland, Norway and Canada'. He writes while an average of five adult lice per fish generally triggers treatment on farms, 'If there are a million fish on the farm with 1 egg-bearing louse each, the farm may release 500 million lice larvae'. He continued: 'A key consequence of this is that on large farms, it is possible to keep the number of lice below what is harmful to the farm fish but they may still be producing a lot of lice larvae.'

At the infective stage the sea lice actively searches for a host. It swims towards the surface during the day. Surface waters tend to blow towards the shore due to the day-time onshore winds. Thus the copepodites [sea lice] are moved towards the seashore and into estuaries so they congregate in the path of salmonids migrating to sea.'

He continues: 'Studies in Ireland, Scotland, Norway, and Canada involving computer models and field data on infestations indicate that lice from farms may infest wild fish up to a distance of 30 km (i.e. there was no effect detected beyond 30 km). Similarly one may expect farms within 30 km of each other to be cross-infecting.'

'Like any use of the environment for farming', he concludes 'there can be environmental impacts. It appears that sea lice are the most significant impact of salmon farms generally by virtue of their impact on wild salmonids.'

Friends of the Irish Environment point out that the Bord Iscna Mara, The Marine Institute, and BIM have all argued that the sea lice are no longer an issue and that the current treatment protocols will prove adequate. Director Tony Lowes said 'It is quite clear from Professor Costello's letter that even with infection levels far less than the treatment levels required in Ireland open pen net salmon farming must no longer be permitted within 30 kilometres of our salmon rivers.'

How sea lice from salmon farms can spread to wild fish

These epizootics are unusual in being mass infestations of the earliest life-stages of salmon lice (called the 'chalimus') on salmonids migrating from rivers to the sea. This means the fish were all infected at the same time as they entered the sea. They have only been reported in locations with salmon farms. When high numbers of lice occur naturally on wild fish, they usually have chalimus, immature pre-adult and adult lice. Other species of lice on salmonid farms in Chile are infesting wild fish there. These problems have not occurred in countries with low salmon farm production. Could the repeated epizootics in different years in the same places and in different places with salmon farms all be coincidences? Correlations do not prove cause; so what is the mechanism as to how lice from farms infest wild fish?

Sea lice, especially the larger of the two common species called *Lepeophtheirus salmonis* or salmon louse, have proven difficult to control on farms, especially large farms because it is difficult to treat all fish simultaneously against the parasite, and where several farms occur in the same area due to cross-infection. The salmon louse has developed resistance to the most effective pesticides (variously called drugs, medicines, chemicals) and not all of them can be applied in all situations. The chalimus imbeds itself into the fish and grazes on the skin and mucus. Being small, a few cause little harm, but small fish have been found with tens to a hundred and more each. Once the chalimus moult into an adult stage their impact is much greater. The adults swim over the fish skin and graze it, sometimes grazing through the skin and muscle to expose the bone. All lice will irritate fish and perhaps alter their behaviour, but heavy infestations result in bleeding, may cause secondary infections, and lead to fish death. An average of five adult lice per fish generally triggers treatment on farms because such levels indicate stress to the fish and that some fish may have pathogenic levels.

Each female louse can produce several batches of eggs, each containing hundreds (up to 1,000) of eggs, over her life-time. The more hosts, the more lice. If there are a million fish on the farm with 1 egg-bearing louse each, the farm may release 500 million lice larvae. So the number of fish on the farm as well as the average number of lice is key to the problem. In this example, even if there is only 1 in 10 fish with an egg bearing louse; that is potentially 50 million lice larvae. A key consequence of this is that on large farms, it is possible to keep the number of lice below what is harmful to the farm fish but they may still be producing a lot of lice larvae.

The larvae (called nauplii) do not feed and swim in the plankton until they moult into the infective stage called a copepodite. The copepodite antennae are like grappling hooks and it actively searches for a host. It swims towards the surface during the day. Surface waters tend to blow towards the shore due to the day-time onshore winds. Thus the copepodites are moved towards the seashore and into estuaries so they congregate in the path of salmonids migrating to sea. If there is freshwater on the surface they will not swim into it but may get moved up the estuary in a mid-depth counter-current common in estuaries. Hydrographic models of water currents have been verified with field data on copepodite distribution. Studies in Ireland, Scotland, Norway, and Canada involving computer models and field data on infestations indicate that lice from farms may infest wild fish up to a distance of 30 km (i.e. there was no effect detected beyond 30 km). Similarly one may expect farms within 30 km of each other to be cross-infecting.

Of course, not all salmon farms get problems with sea lice, and should they occur there are several ways to deal with them. The most effective method is to remove all fish from the farm and leave it fallow for some weeks. Shortening the period the salmon are on the farm will limit the build of lice. Fallowing will also break the cycles of other diseases that may occur on the farm and allow the seabed to recover from waste deposition. If there is no farm acting as a source of lice then it may be many months before re-infestation occurs from the few wild fish that may occur in the area. Like any use of the environment for farming there can be environmental impacts. It appears that sea lice are the most significant impact of salmon farms generally by virtue of their impact on wild salmonids.

I hope you find this information helpful in your decisions. I will be in Ireland next week and contactable at 087 239 339 0 if you wish to discuss further.

I have recently been contacted by Mr Tony Lowes of Friends of the Irish Environment for information about sea lice so I will send him this same information as well.

Please confirm receipt of this email.

Yours sincerely

Mark Costello