

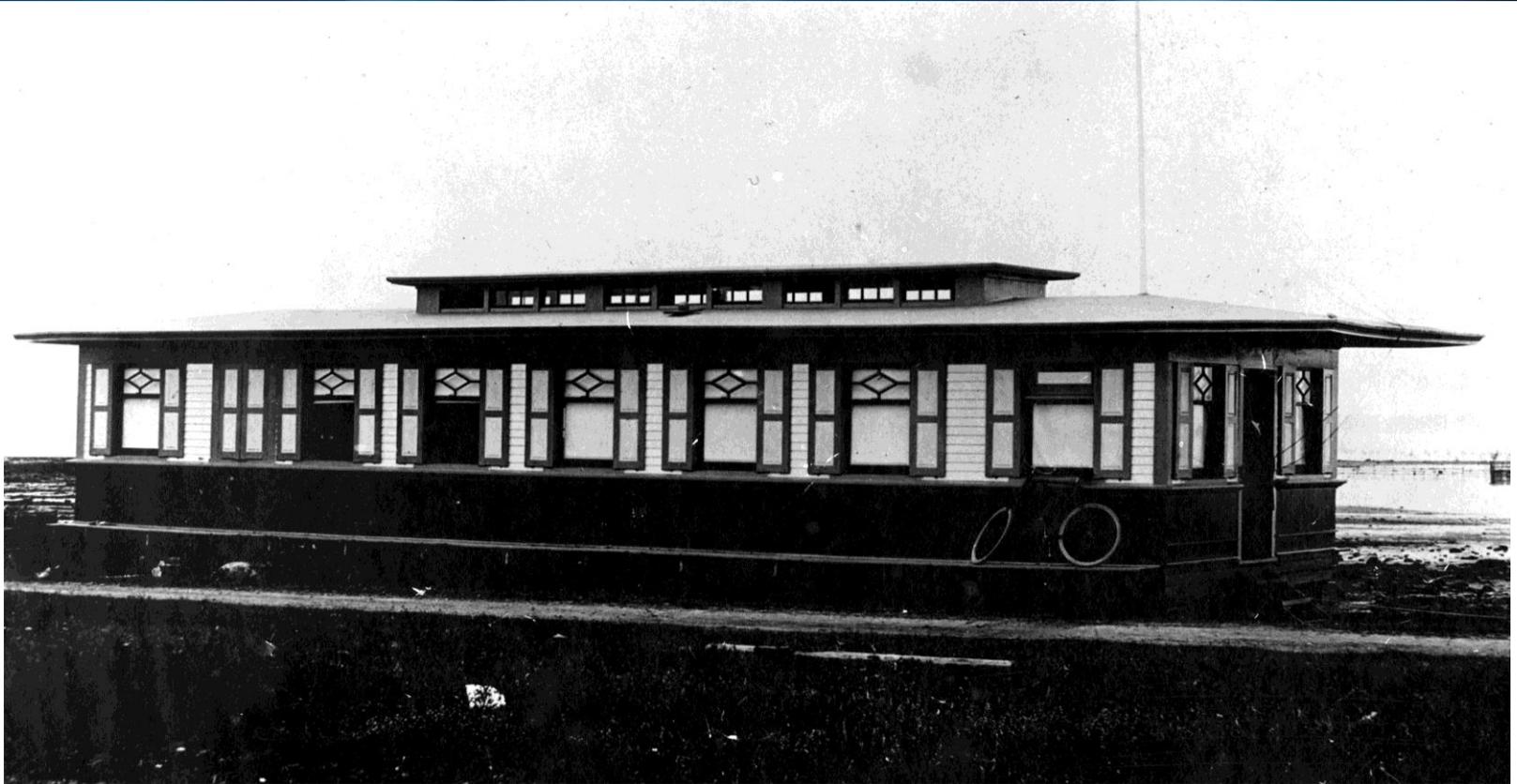


# Some Principles of Eco-toxicology: Its all about the Risk

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**St. Andrews Biological Station (SABS)**



## Canada's First Marine Biological Station 1899



## New SABS Facilities (2011-2012) Including 24,000 ft<sup>2</sup> Wet Lab





# Outline

**Basics**

**Sources of Pollutants**

**Aquaculture**

**Other “culture”**

**Industry**

**Municipal wastes**

**Oil & Gas**

**Questions**



# Some basics

**Everything is toxic; The Dose makes the Poison.**

**Hazards are Determined; Risks are Assessed.**

**We will never prove there is no effect**



**A non-target organism is the environmental equivalent of an innocent bystander. These organisms are not the target of the treatment but can reasonably be expected to be exposed to the chemical during or after treatment.**



**LC50: The concentration of a chemical that, when in the environment of a test organism, is estimated to be fatal to 50% of those organisms under the stated conditions.**

- An LC50 must include a time which indicates how long the organism has to be exposed.
- Also nice to have an idea of “confidence” in the estimate.



## **Hazards are determined**

- ❖ **Loaded gun**
- ❖ **Nuclear power plant**

## **Risks are assessed**

- ❖ **Will I be shot here or today?**
- ❖ **Do I really need an iodine pill?**



## Hazards:

- **Is it lethal?**
- **If it doesn't kill are there Sub-lethal effects?**
  - **Growth**
  - **Reproduction**
  - **Biochemistry**



• **Species** – Is it there? Is it sensitive?

• **Chemical** – Is it there? What concentration? Is it toxic?

• **Time** – Are the animal and chemical together at the same time? For how long?



## **Risk (probability of exposure)**

- **The key question is: how much, or what concentration, do non-target organisms really “see” and for how long?**
  - **How long is it in water?**
  - **Is the sensitive organism there?**
  - **If its bound to sediment is it available to other organisms?**



# UNITS

What is a part per million/billion/trillion?

**Count to 30**

Shot glasses and swimming pools???

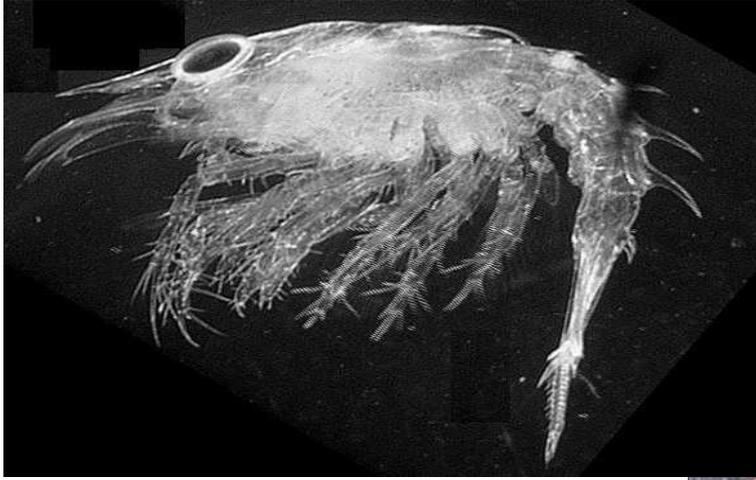
**Whose shot?**



# Salmon Aquaculture



**Pesticides are designed to kill something.**



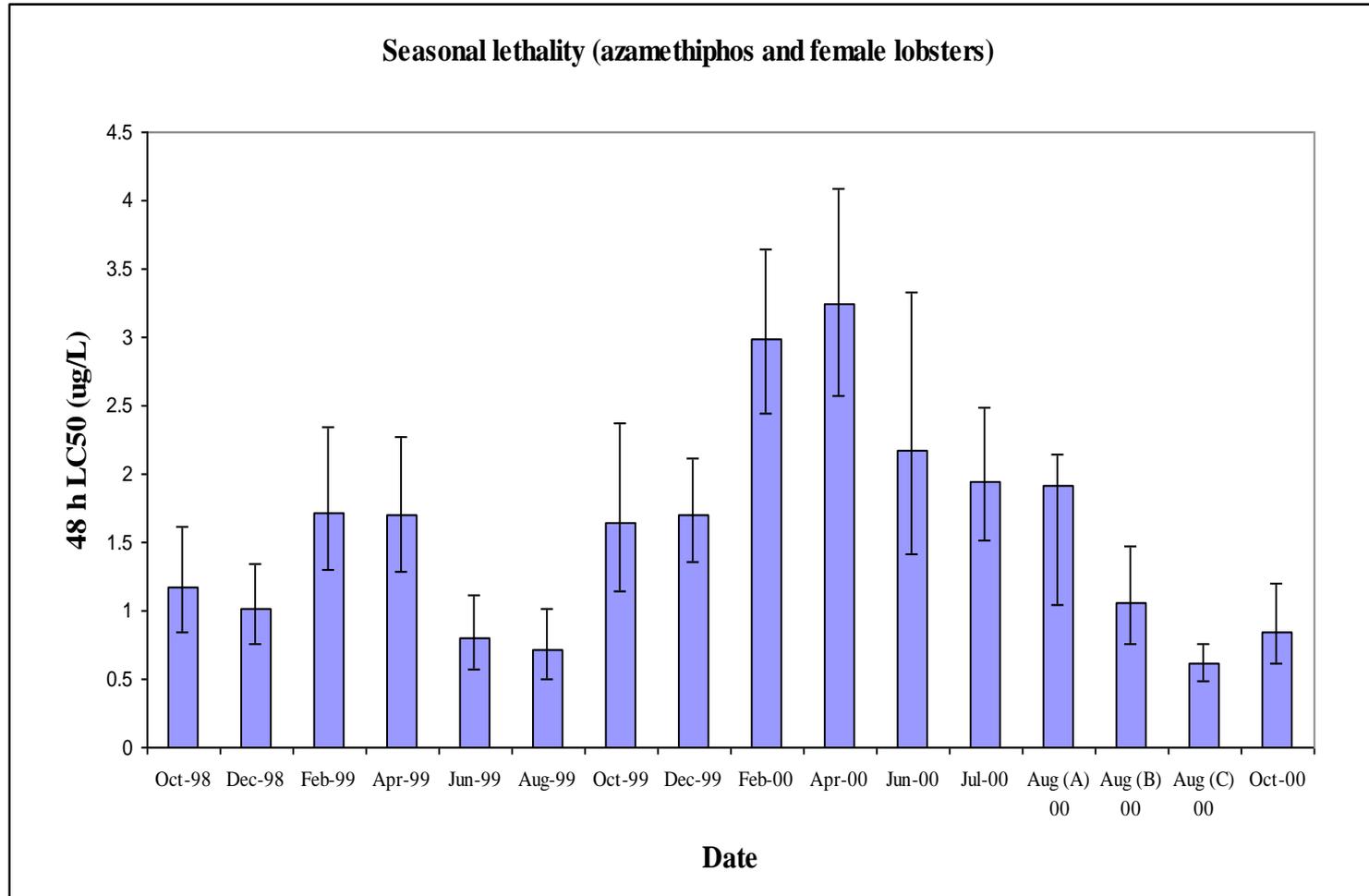
# American Lobster





## Percent mortality of adult lobsters after repeated short-term exposures to Salmosan® (azamethiphos).

Conc. (µg/L)	Exposure (min.)	% Mortality after Exposure #								
		<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>	<u>8</u>	<u>9</u>
0.51	15	0	0	0	0	0	0	0	0	0
0.51	30	0	0	0	0	0	0	0	0	0
0.51	60	0	0	0	0	0	0	0	0	0
0.51	120	0	0	0	0	0	0	0	0	0
1.03	15	0	0	0	0	0	0	0	0	0
1.03	30	0	0	0	0	0	0	0	0	0
1.03	60	0	0	0	0	0	0	0	0	0
1.03	120	0	0	0	0	0	0	0	0	0
11	15	0	0	0	0	0	0	0	0	0
11	30	0	0	0	0	0	0	10	10	20
23.8	15	0	0	0	0	0	0	0	0	60
23.8	30	0	0	40	60	60	60	60	60	80





<b>Treatment</b>	<b>N</b>	<b>% Mortality</b>	<b>% Survivors to Spawn</b>
<b><u>1997 Fall</u></b>			
Control	24	0	96
10 µg/l x 4	24	13	90
0.06 µg/l x 14 d	24	8	100
<b><u>1998 Spring</u></b>			
Control	21	0	95
5 µg/l x 4	24	8	90
10 µg/l x 4	23	43	46*
<b><u>1999 Spring</u></b>			
Control	24	0	100
10 µg/l x 3	48	48	84
<b><u>2001 Spring</u></b>			
Control	10	0	100
10 µg/l x 4	10	100	
5 µg/l x 4	10	10	67
2.5 µg/l x 4	10	0	100
1.25 µg/l x 4	10	0	90

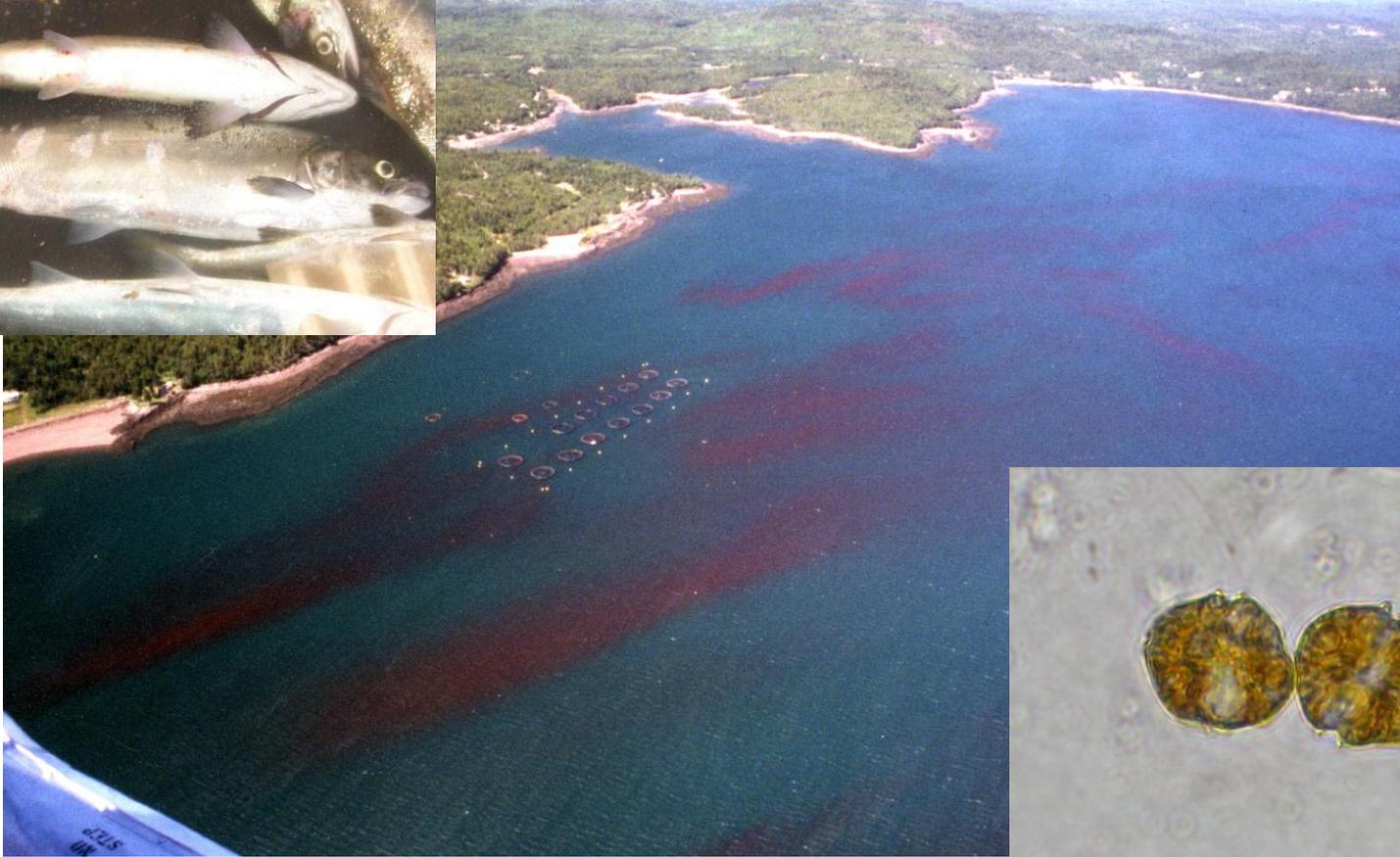


## Sublethal effects of emamectin benzoate





## A. *Fundyense* Red Tide





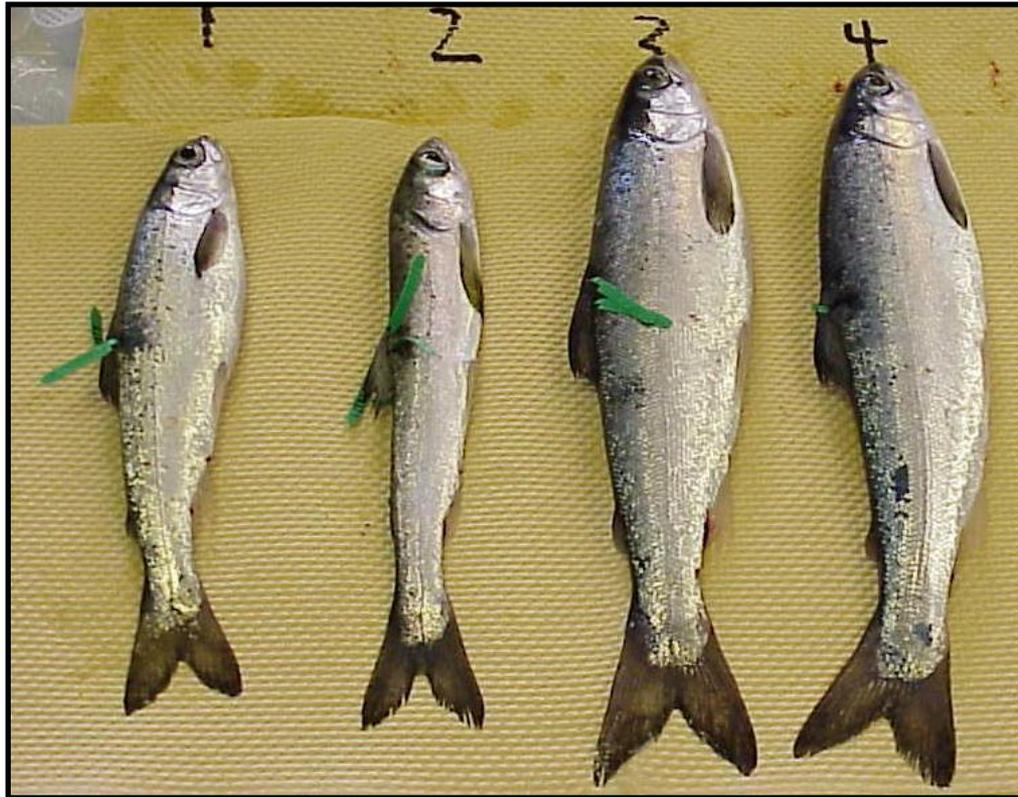
# Endocrine Disrupting Substances (Gender Benders)





# Sewage Treatment/Industrial Effluents/Pesticides







## Pharmaceuticals in the Environment





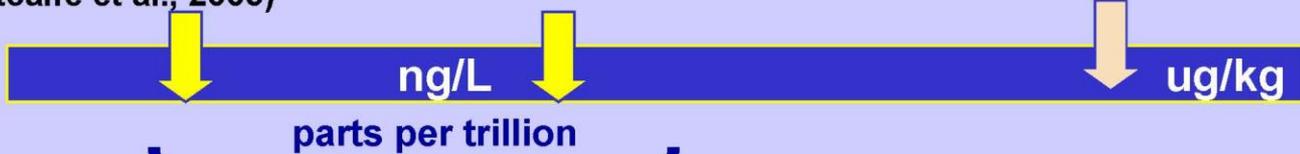
Feminization of fish  
in lab at < 1 ng/L  
(Metcalfe et al., 2005)



Reproductive failure in  
fish in a lake at 5-6 ng/L  
(Kidd et al, 2007)



Human daily dose  
>20 ug, 0.3 ug/kg



EE2 concs in Canadian  
municipal wastewater  
0.2 to 14 ng/L



Environment  
Canada

Environnement  
Canada

Assessing the risks  
to fish exposed  
to ethinylestradiol  
(EE2)



# Oil and Gas Production and Transport





## Oil Spills





# Produced Water





# Atlantic Cod

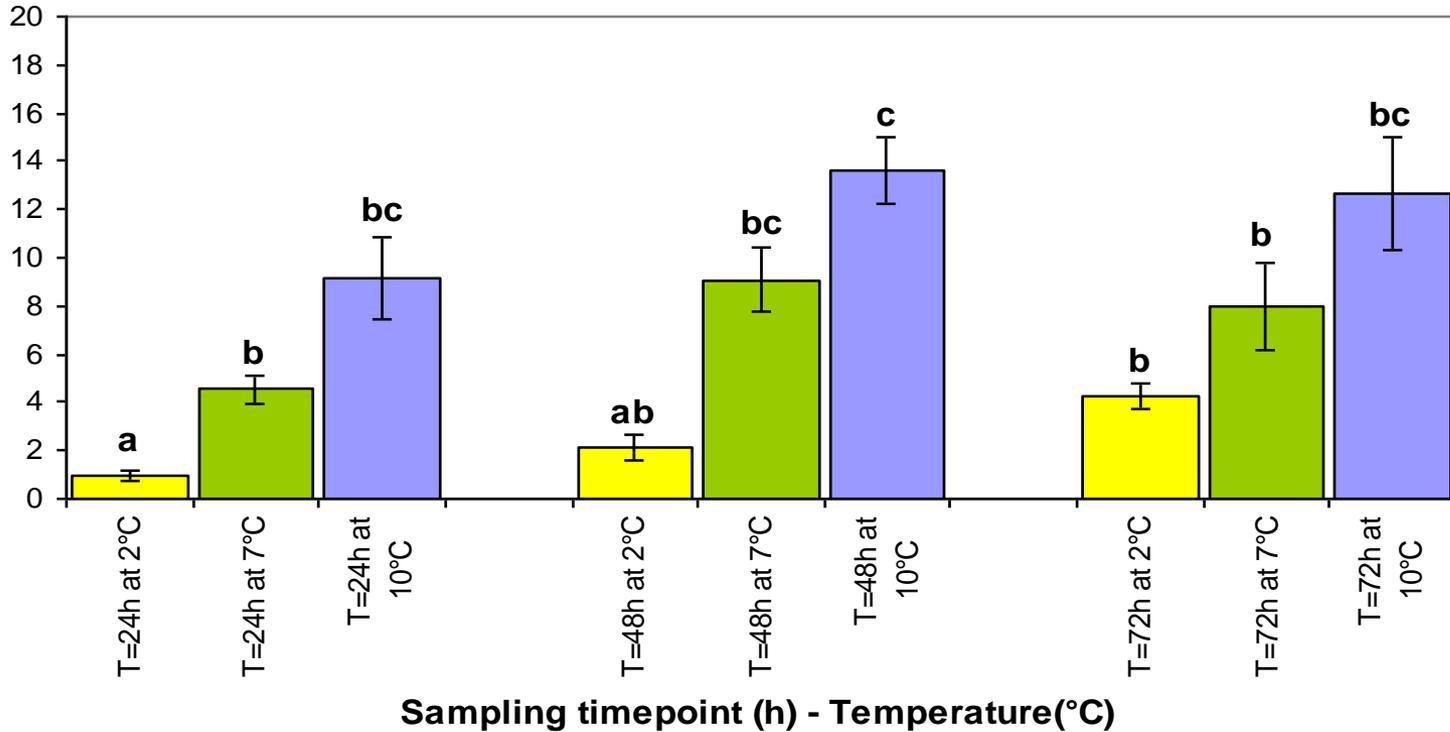






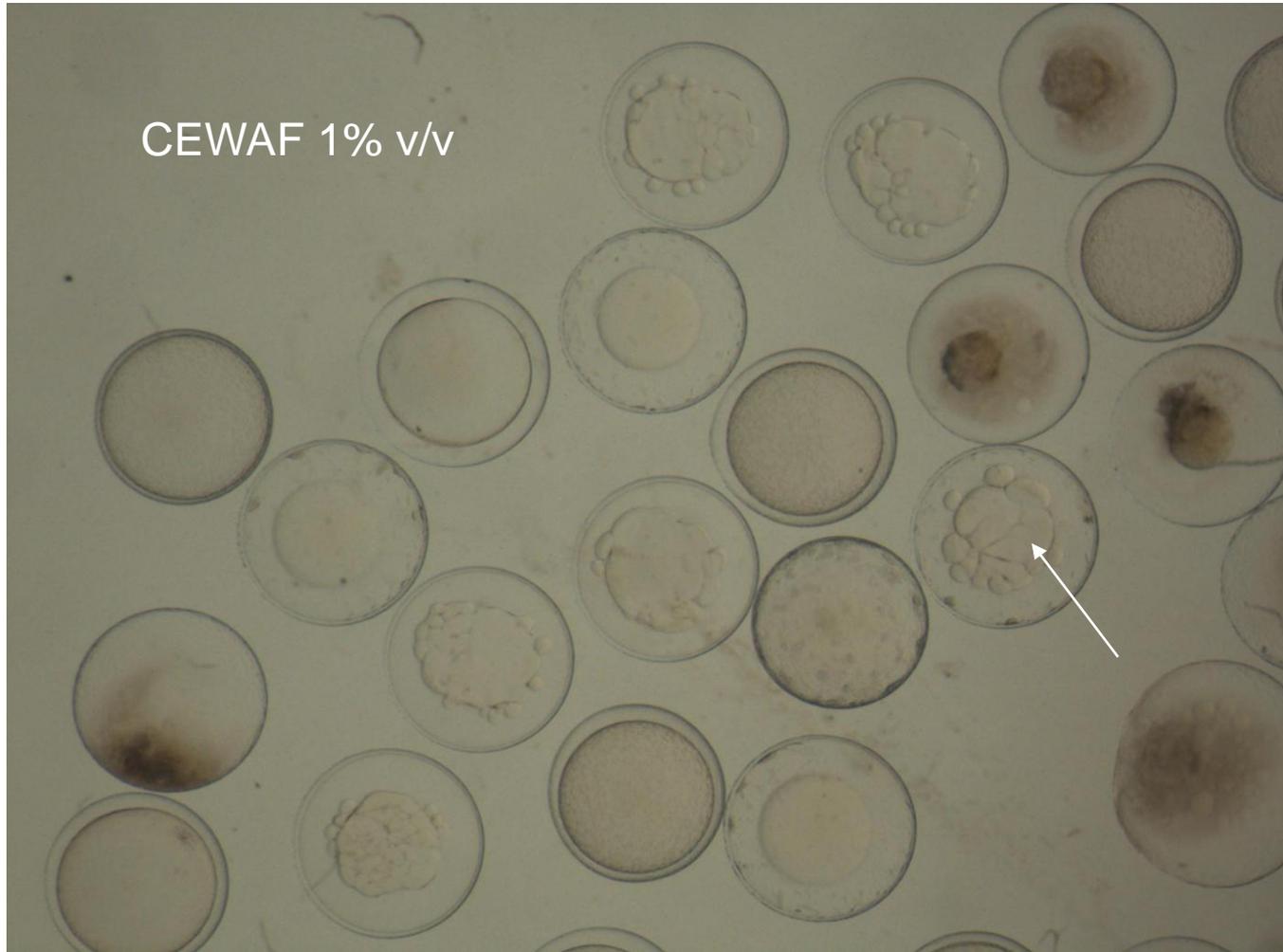


### Exposure of Cod to 1.0% CEWAF





## Effects on eggs





# Absence of Evidence is not Evidence of Absence

**Sir Martin Rees (Astronomer)**



Questions?

