

Integrated Pest Management



40 years of medicine use

Table 1. Compounds used in the control of sea lice in salmon production systems.

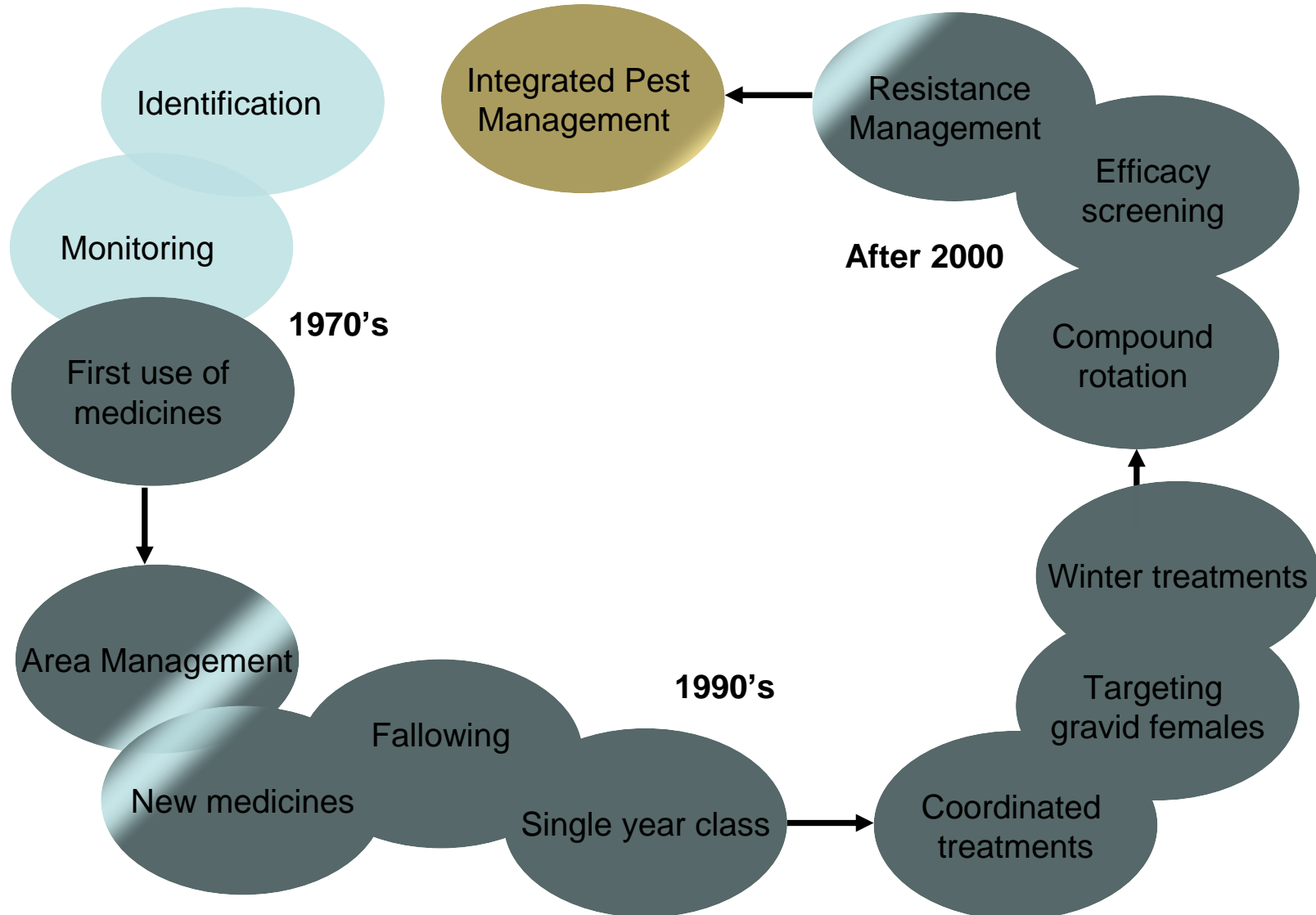
Compound	Product	Reference
Dichlorvos (organophosphate) (bath)	Aquagard [®] (Novartis)	(Rae, 1979)
Azametiphos (organophosphate) (bath)	Salmosan [®] (Novartis)	(Roth <i>et al.</i> , 1992)
Hydrogen peroxide (bath)	Paramove [®] (Solvay Interlox)	(Thomassen, 1993)
Deltamethrin (pyrethroid) (bath)	Alphamax [®] (Pharmaq)	(Høy, 1991)
Cypermethrin (pyrethroid) (bath)	Excis [®] / Betamax [®] (Novartis)	(Hart <i>et al.</i> , 1997)
Ivermectin (in feed)	Ivomec [®] (Merck)	(Johnson & Margolis, 1993)
Emamectin benzoate (in feed)	Slice [®] (Schering Plough)	(Stone <i>et al.</i> , 2000)
Diflubenzuron (in feed)	Lepsidon [®] (EWOS)	(Horsberg & Høy, 1991)
Teflubenzuron (in feed)	Calicide [®] (Skretting)	(Grøntvedt, 1997)

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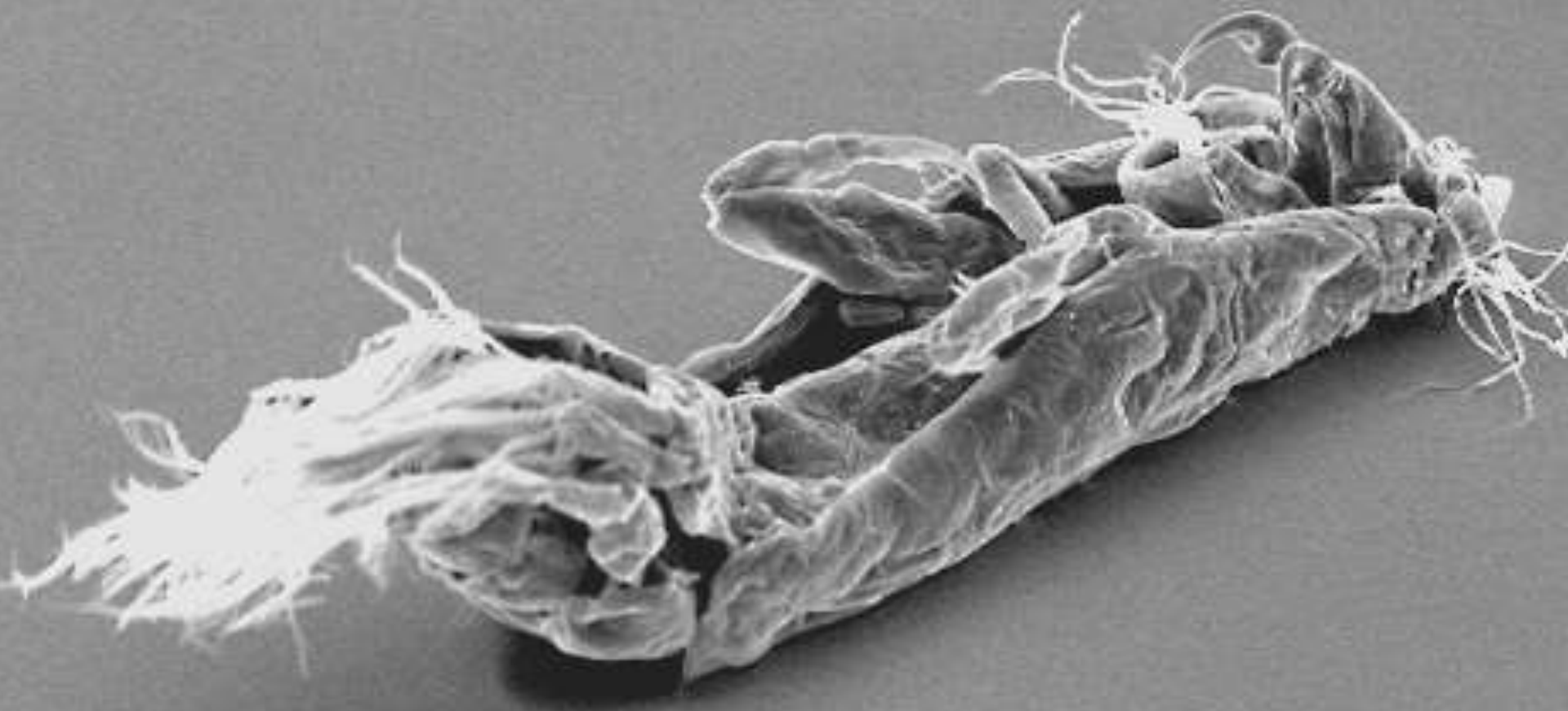
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20 years of management controls



Integrated pest management

- No control is 'stand alone'
 - Need to provide a range of additional tools
 - Integrate these alongside medicine use
 - Within the evolving management systems
-
- Understanding of lice biology is a critical factor in effective control
 - Few examples



O'Shea

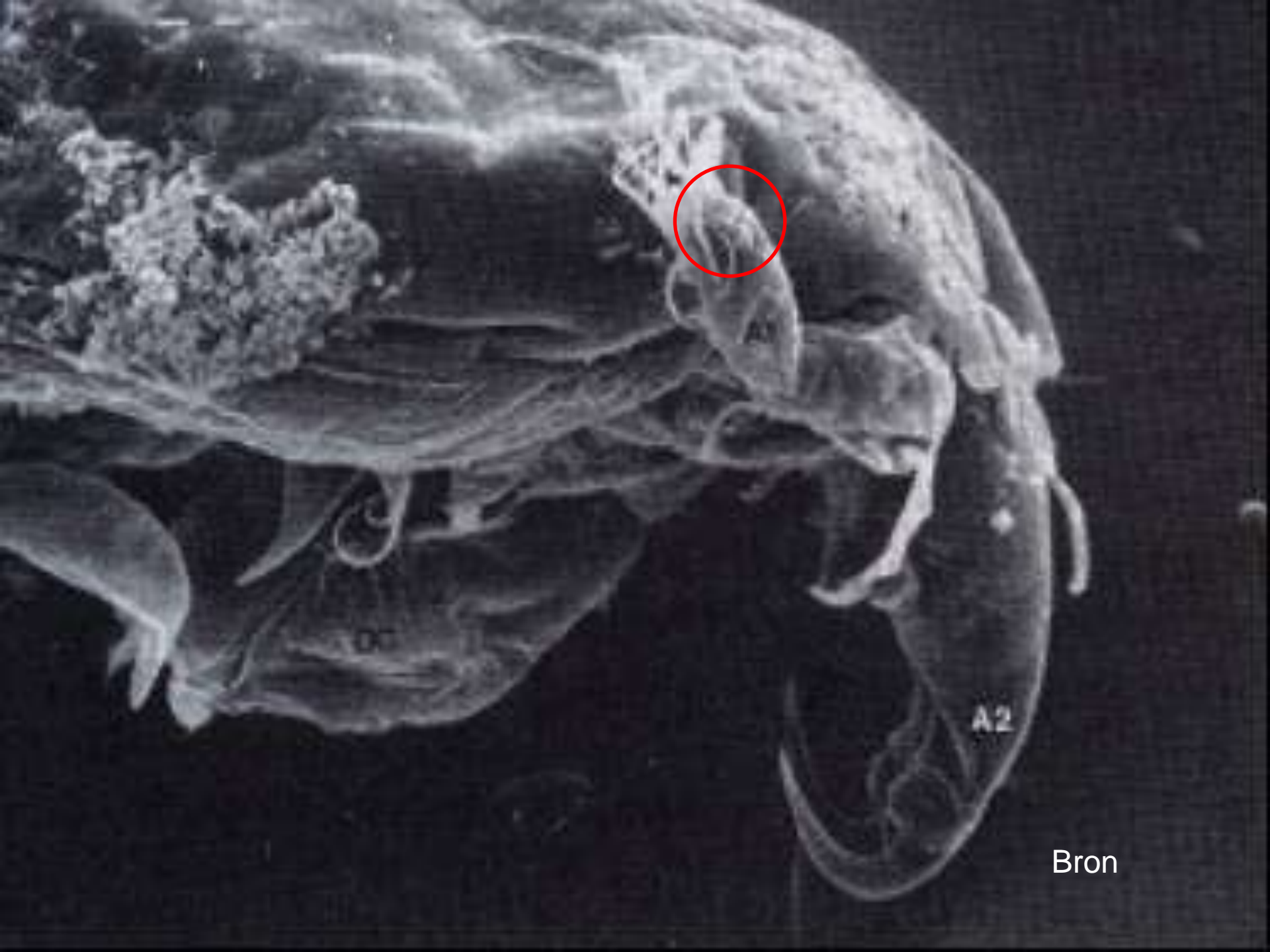




EWOS[®]
Innovation



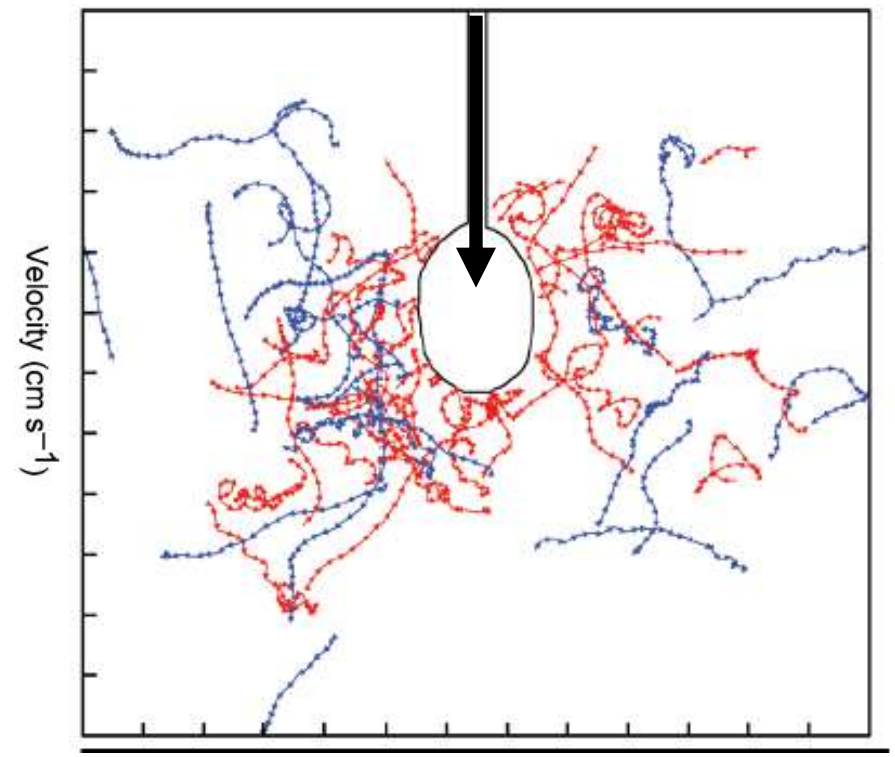
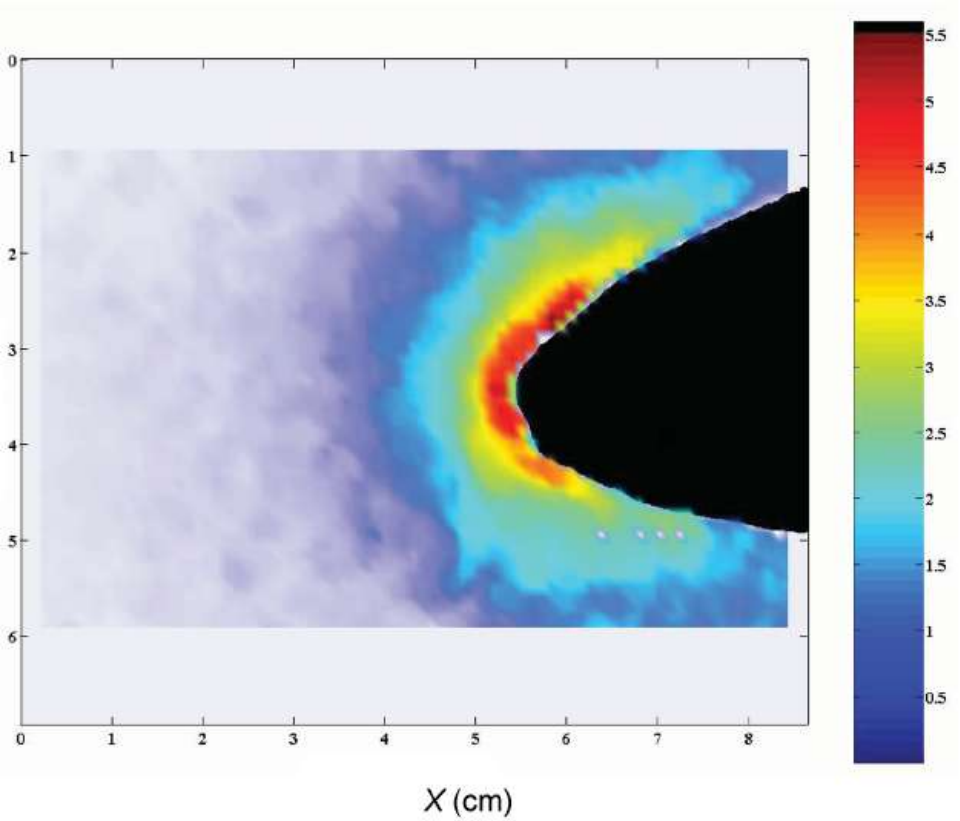
EWOS[®]
Innovation



A2

Bron

Detect and Attack



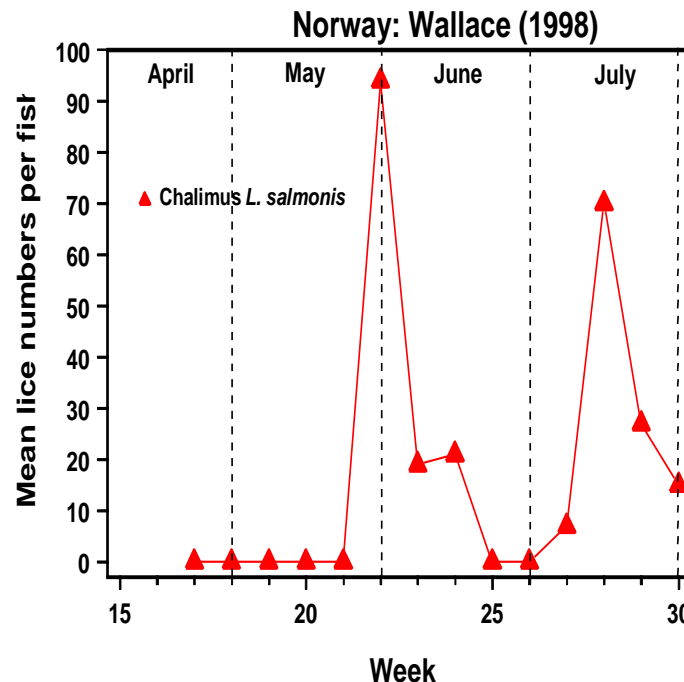
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Feed management

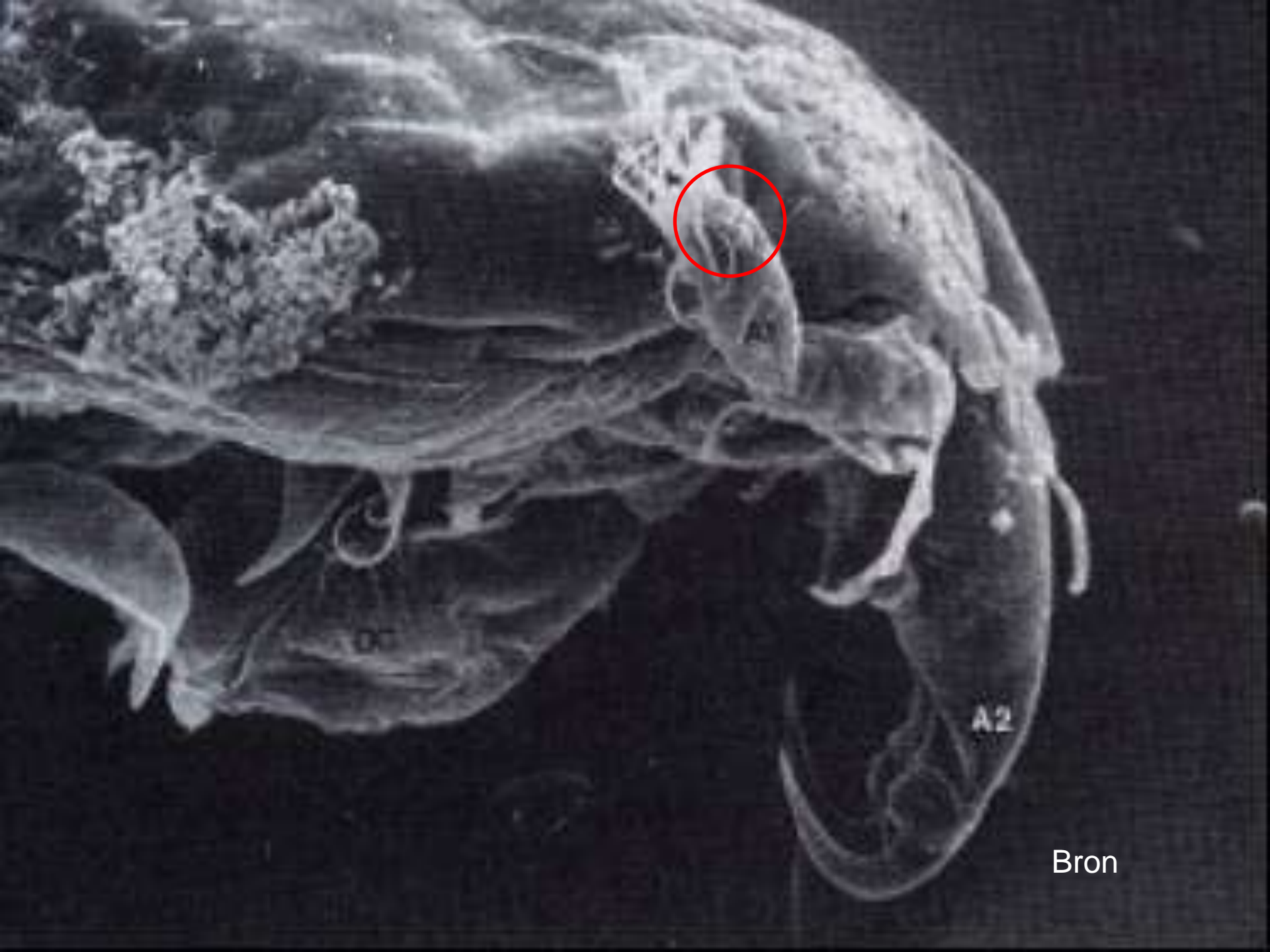
- Keep fish well satiated and at depth
- Avoid surface feeding activity
- Target for periods of increased lice settlement (spring)

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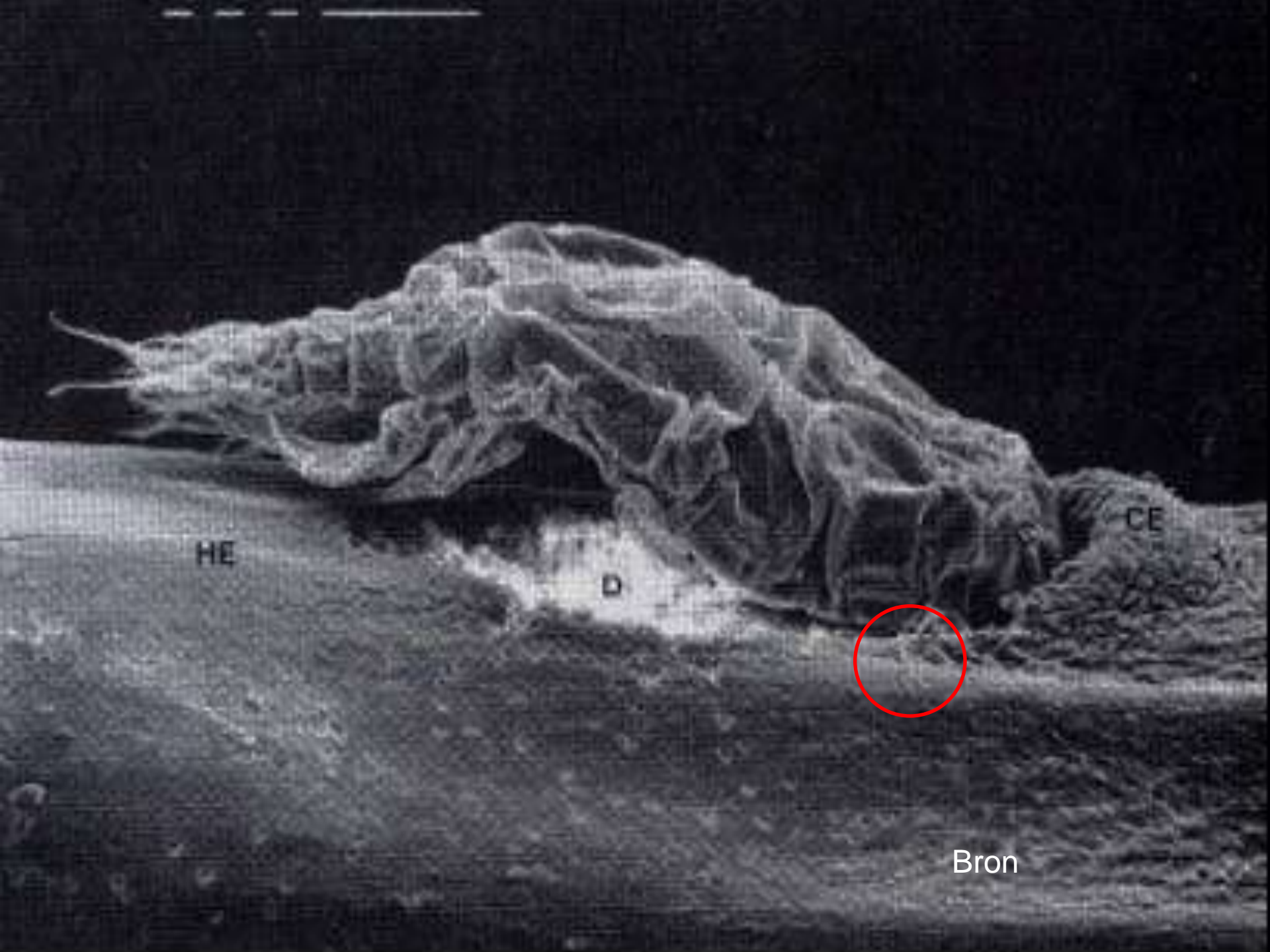


Wallace



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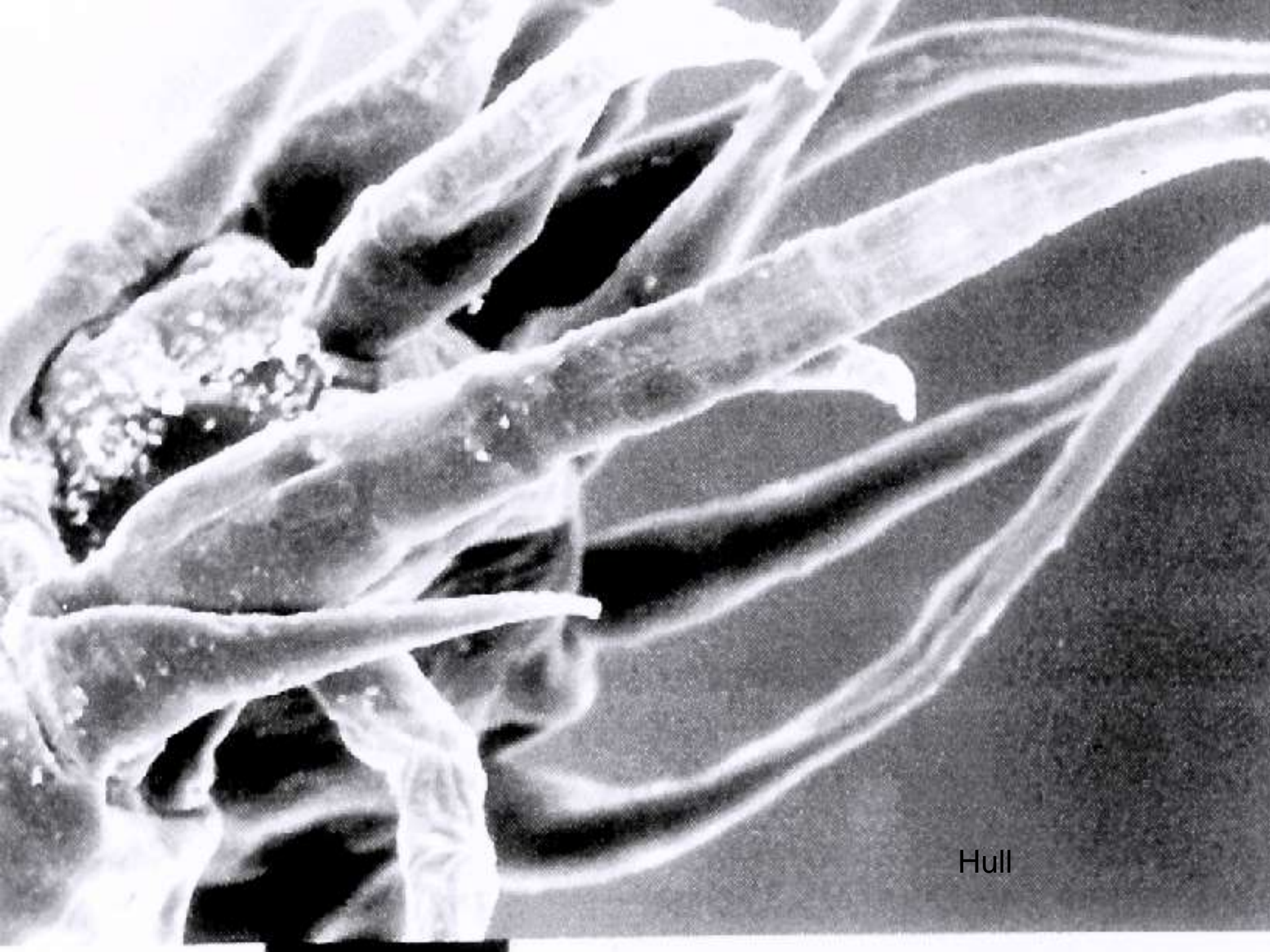
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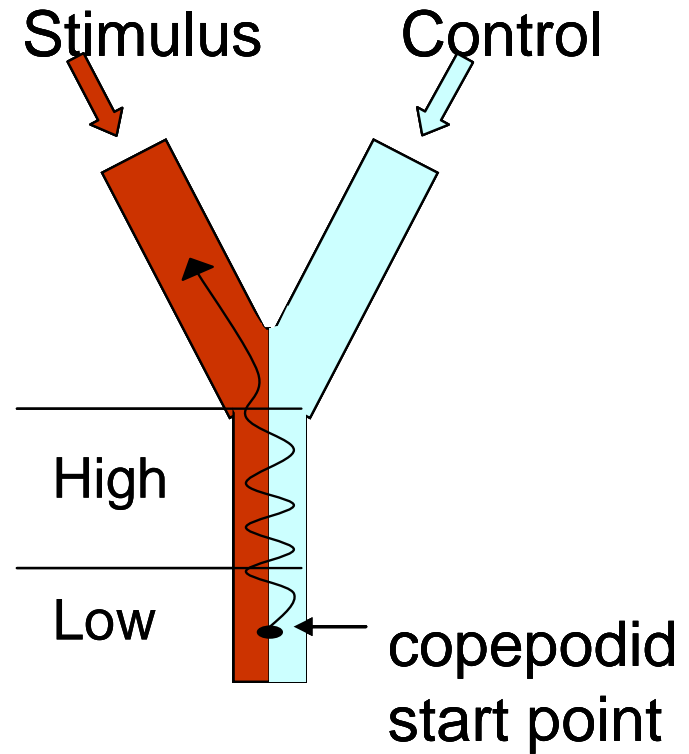
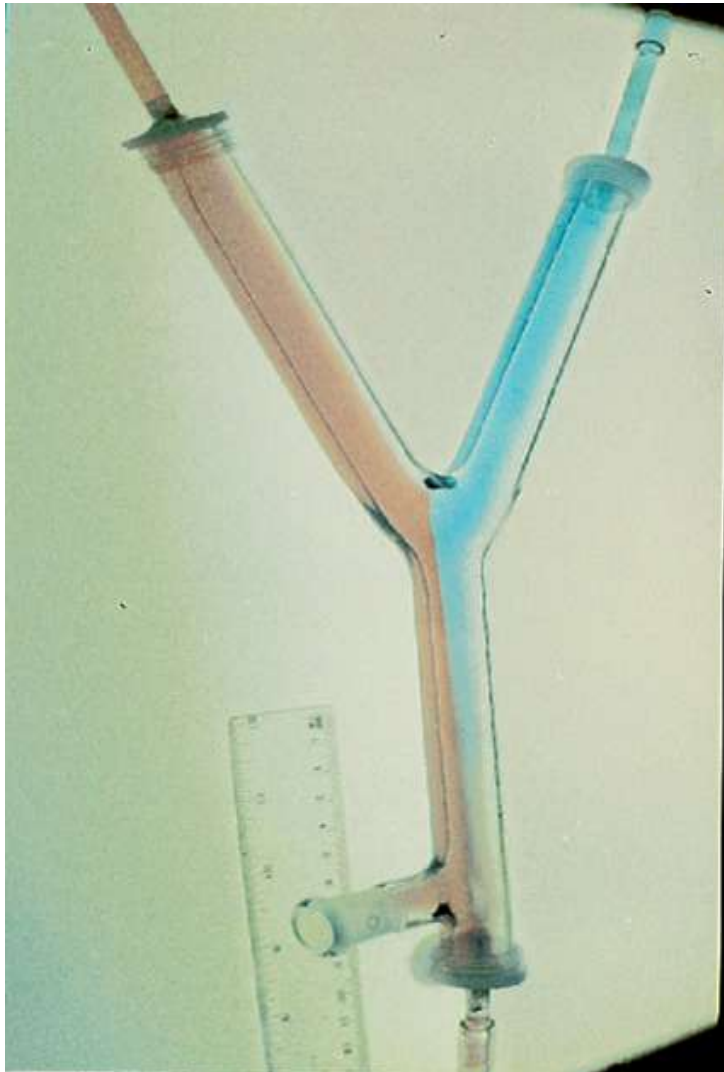


Hull



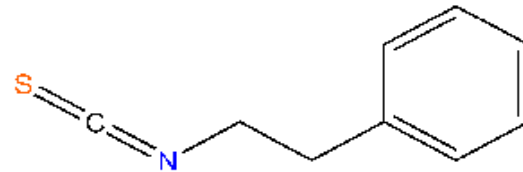
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Anti attachment



L. salmonis programme UK

C. rogercresseyi programme Chile *

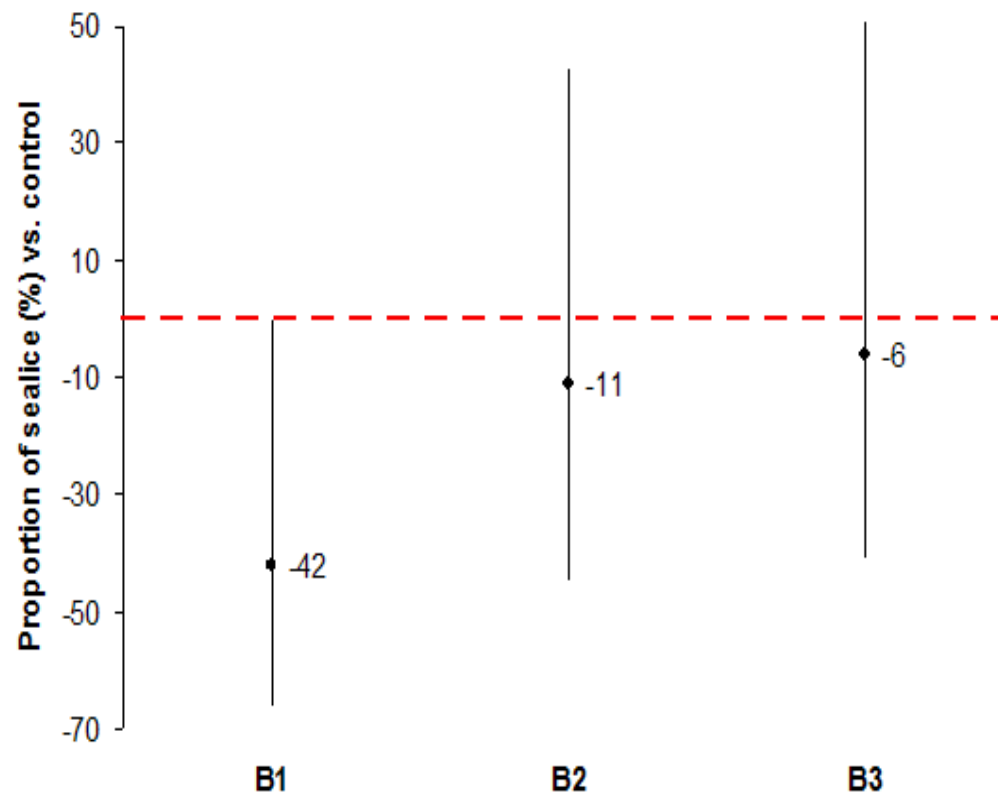


Anti attachment

- Masking compounds effective at reducing salmon 'attractiveness'
- 90% reduction in host location behaviour
- *Caligus* and *Lepeophtheirus* both affected
- Library of products being established to avoid habituation

- In feed studies successful for *Caligus*
- Further work needed for *Lepeophtheirus*

Anti attachment

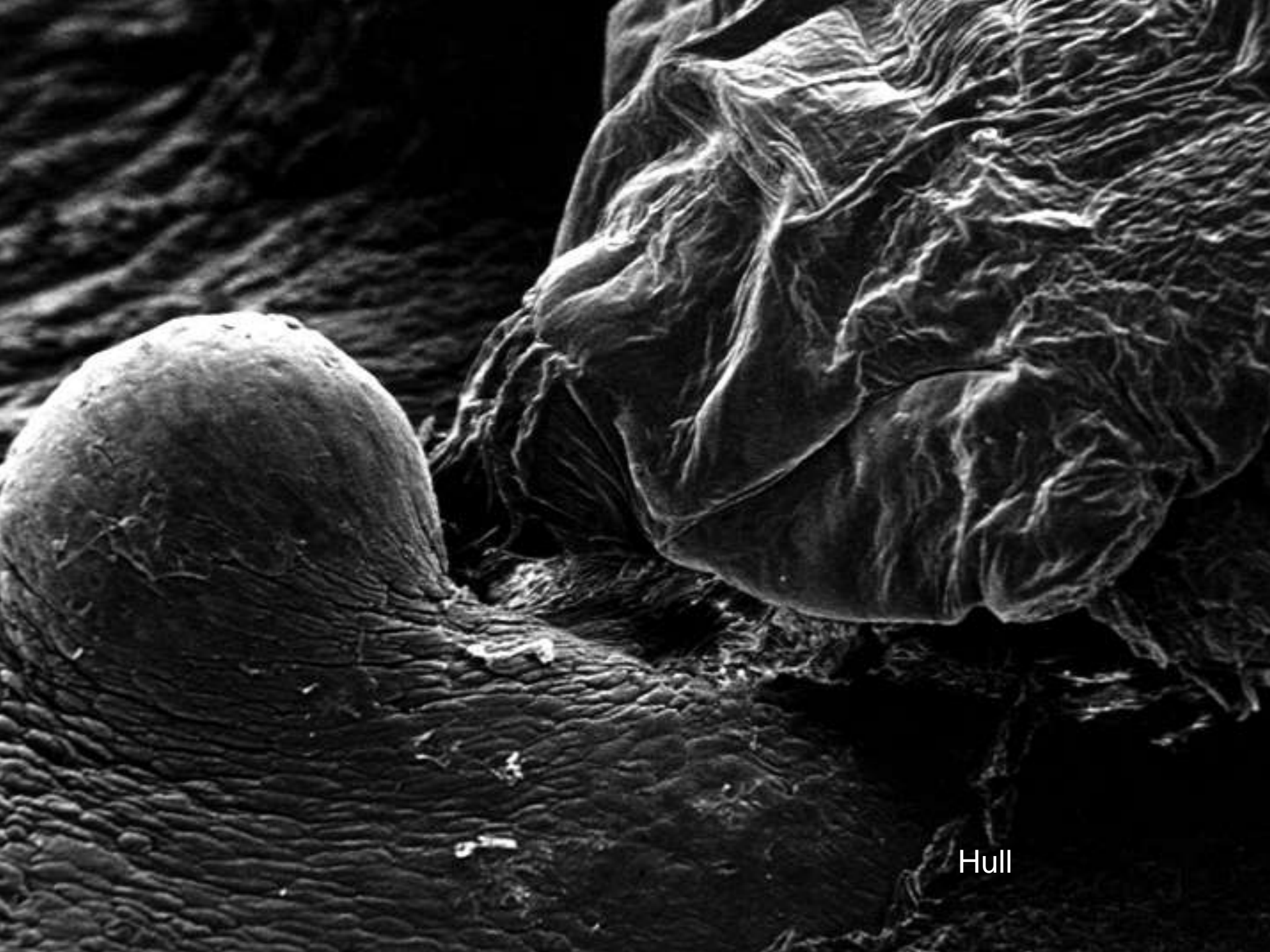




Wadsworth



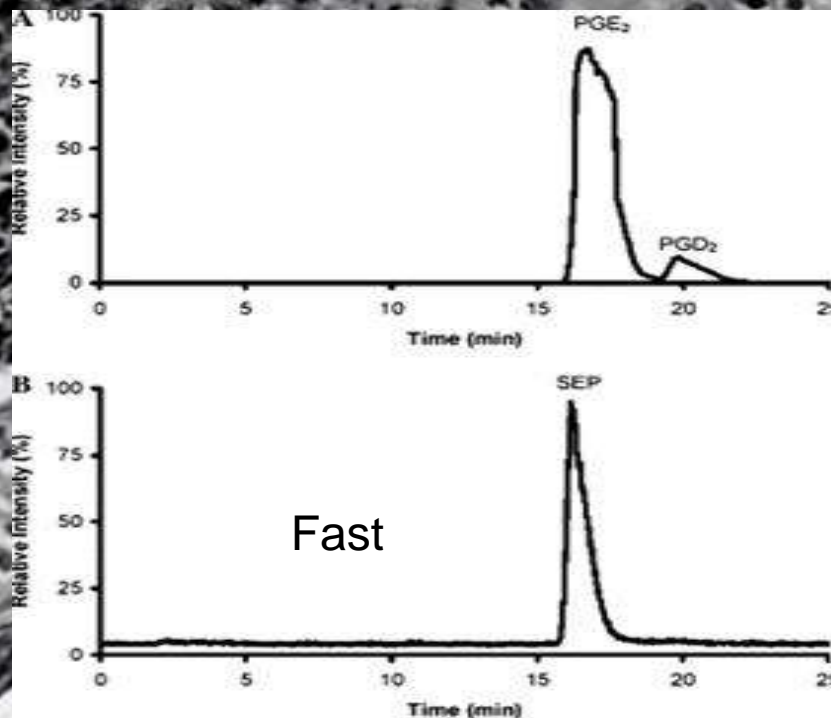
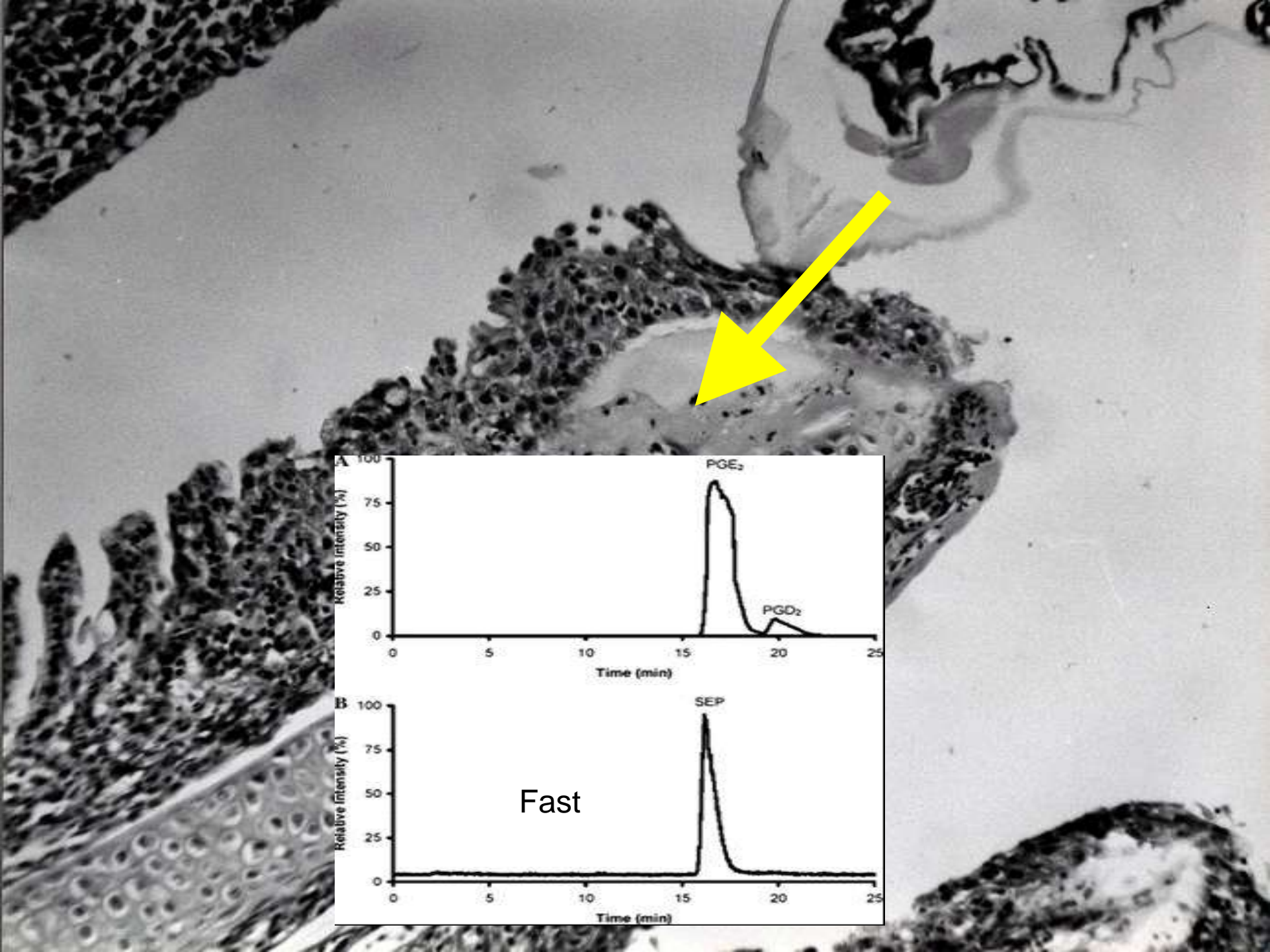
Hull



Hull



Wadsworth

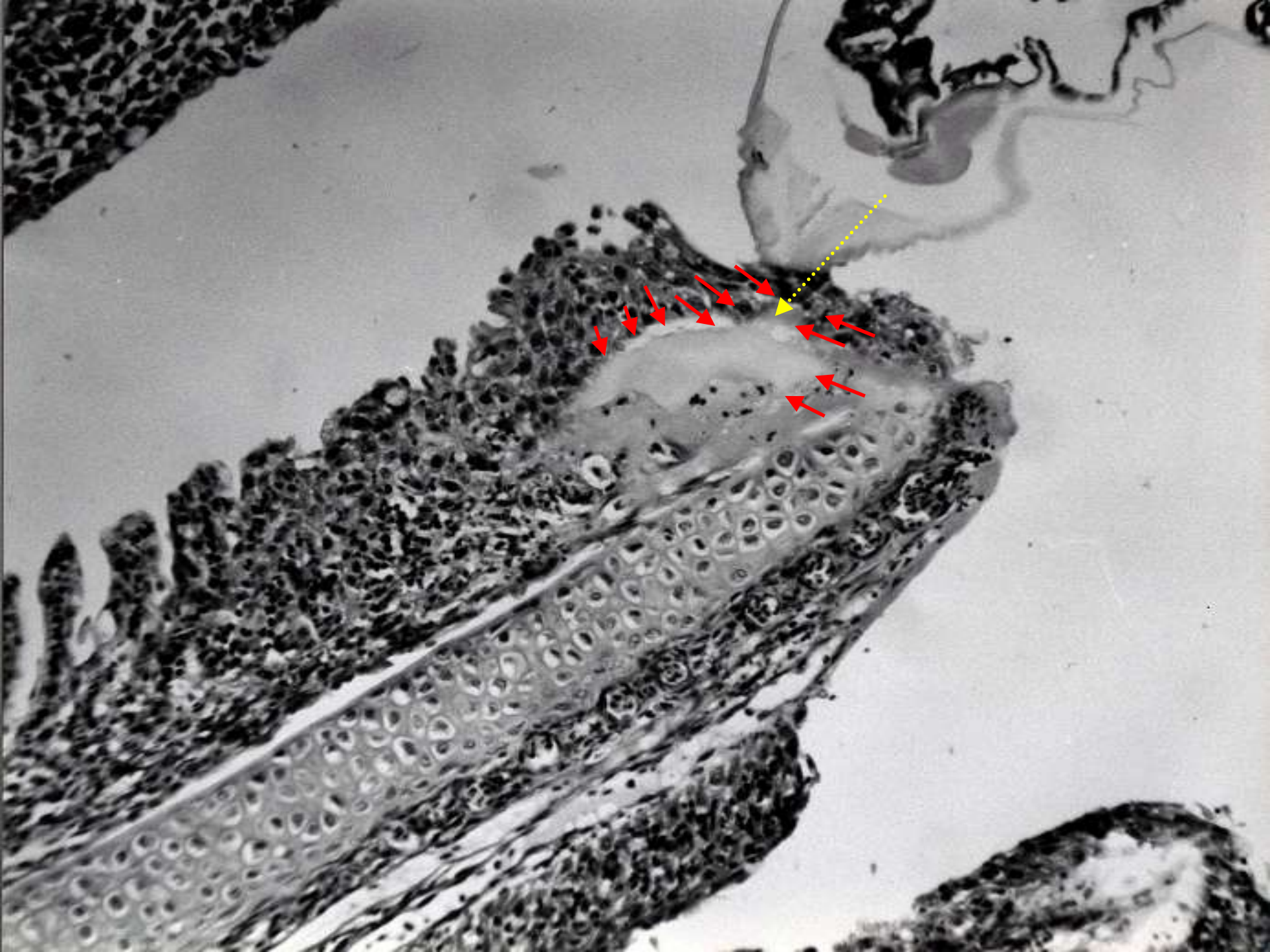


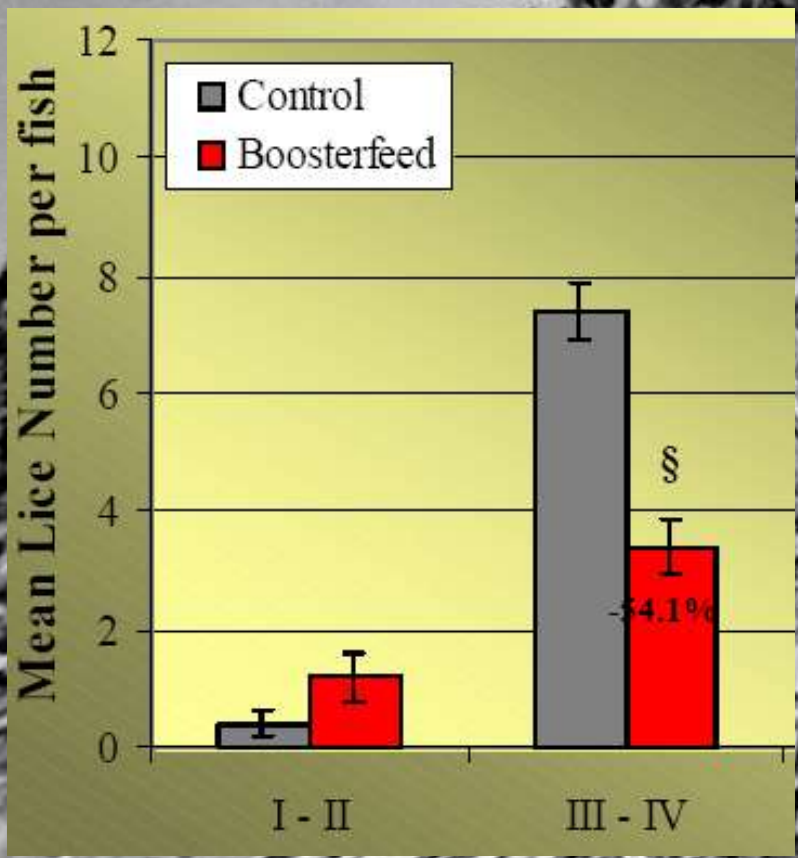
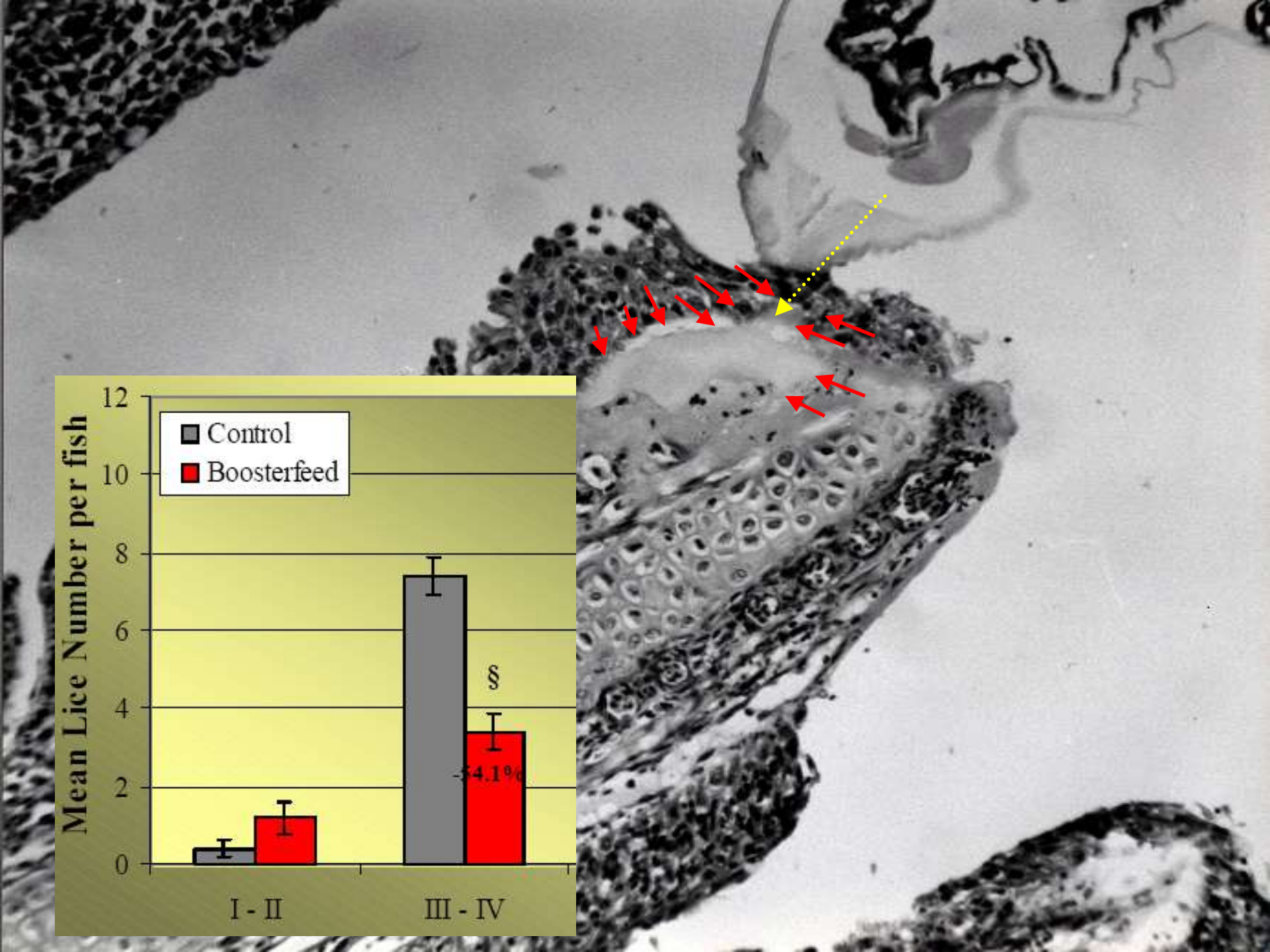
Immune suppression

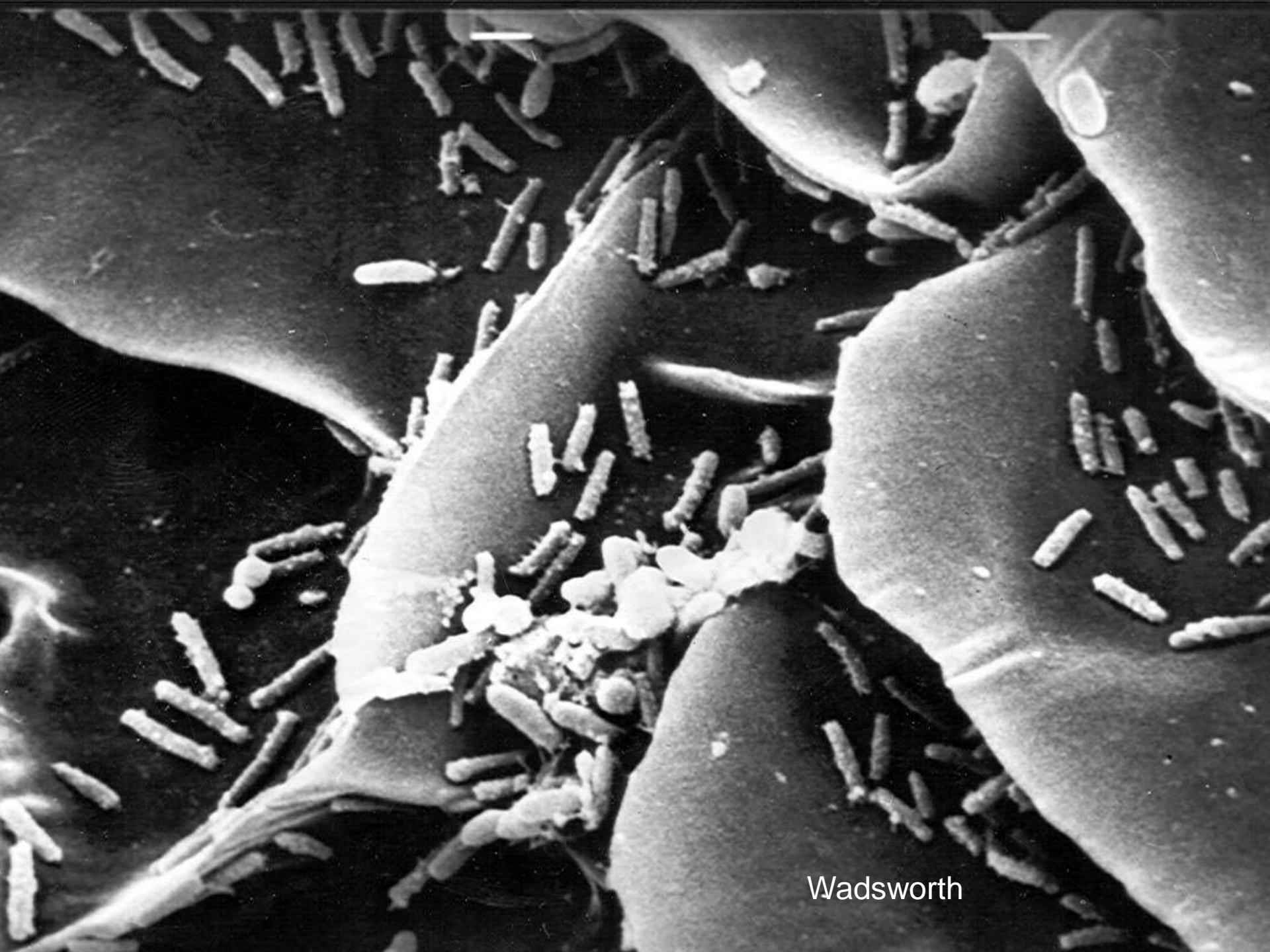
- Prostaglandin PGE₂
- Range of proteases
- Phosphatases
- Macrophage inhibitors

These have an immune suppressive effect on a range of factors

- Reduced respiratory burst
- Lower macrophage activity
- Increased apoptosis
- Necrosis
- Decreased numbers of mucosal cells
- Down-regulation of immune genes IL-1, 6, 8 β , TNF α and MHC-1







Wadsworth

Integration and synergy

New tools increase performance of other controls

- Increase efficacy of medicines
- Lower infection pressure: reduce requirement for treatment
- Prolong positive effects of fallowing and management practices
- Good synergy with wrasse

- Immune controls increasingly important
- Synergy when combined with anti attachment strategies