Lessons Learned and Furture Approaches in Antimicrobial use in Aquaculture – Experiences with *Streptococci* in Southern Africa

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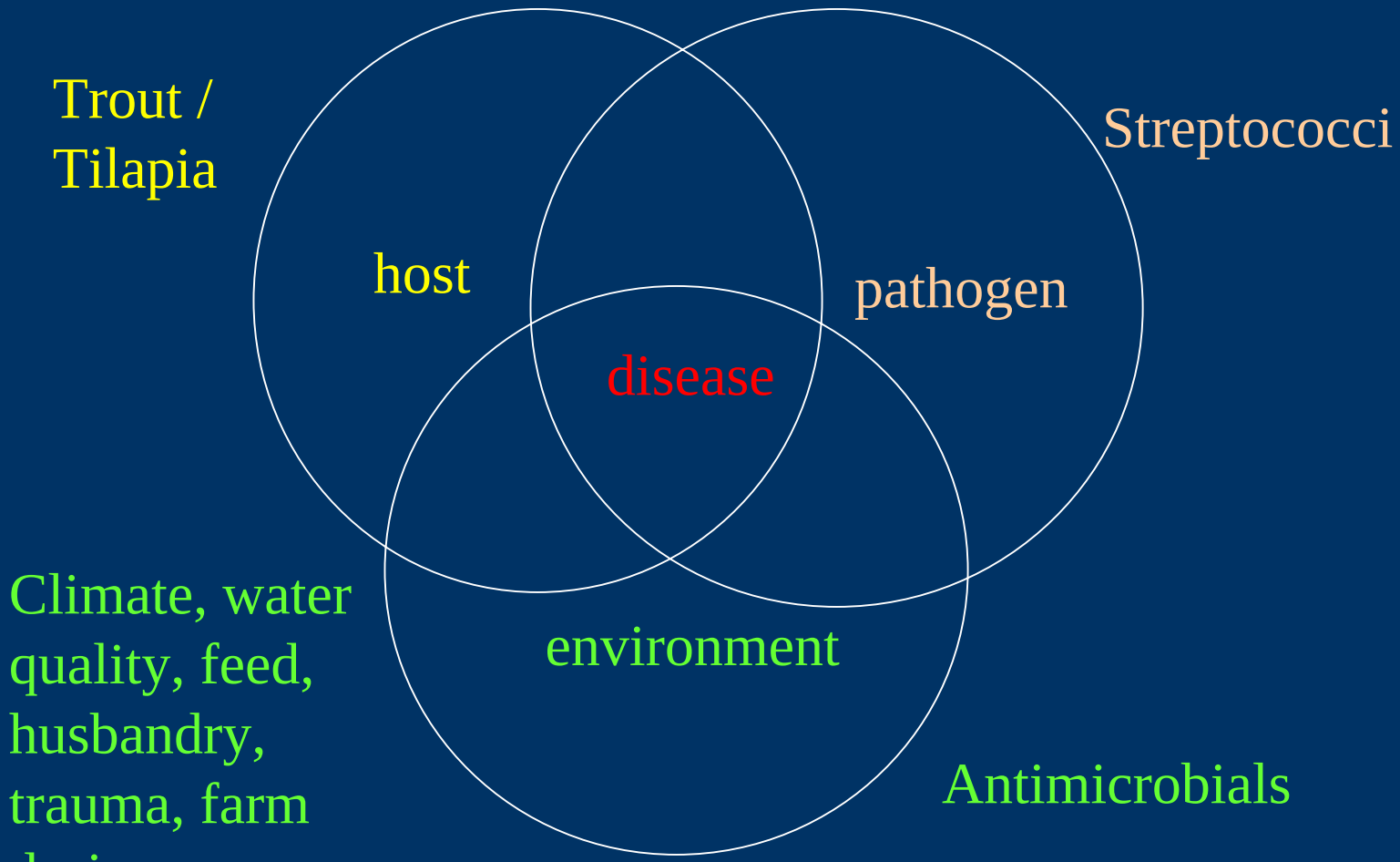
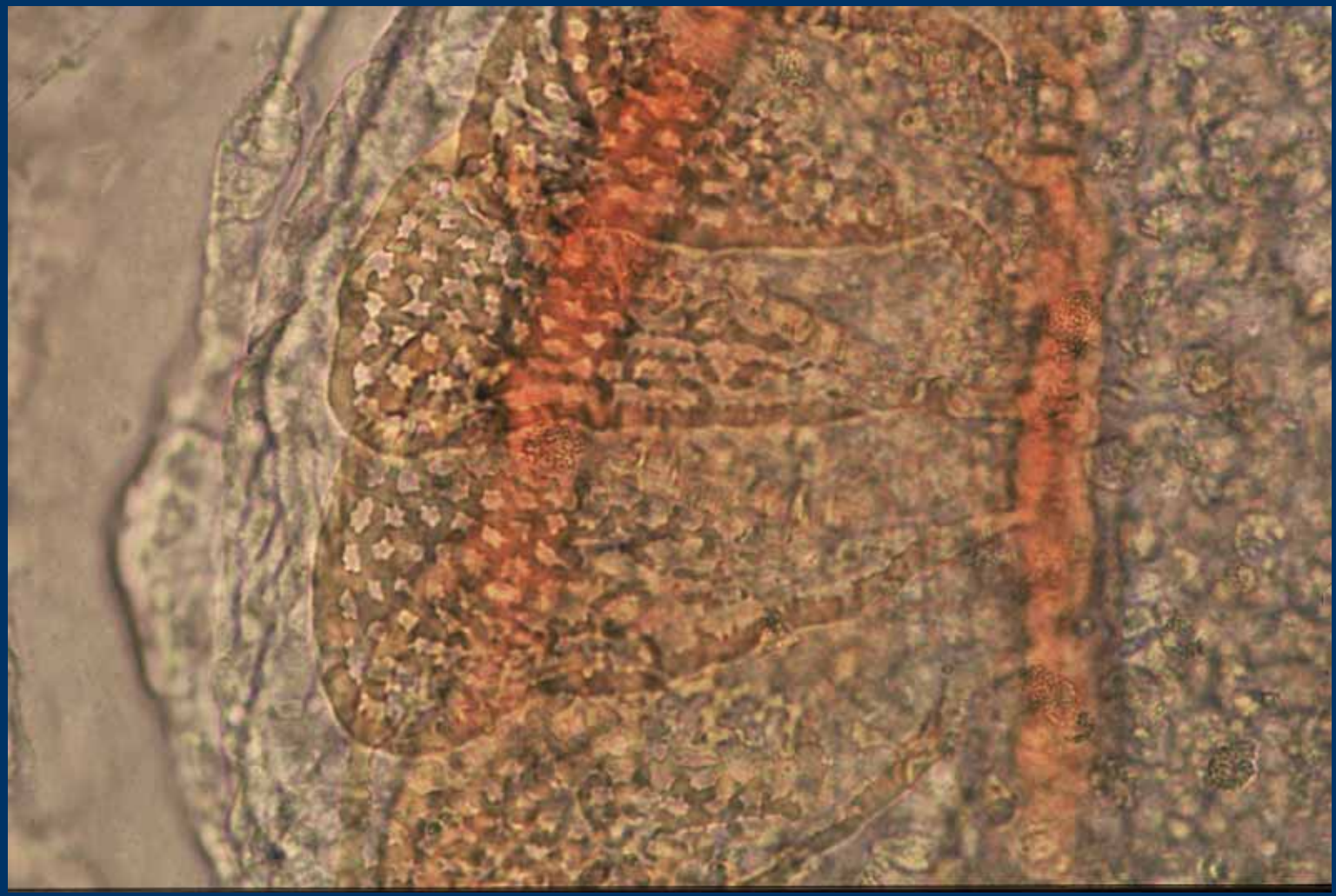
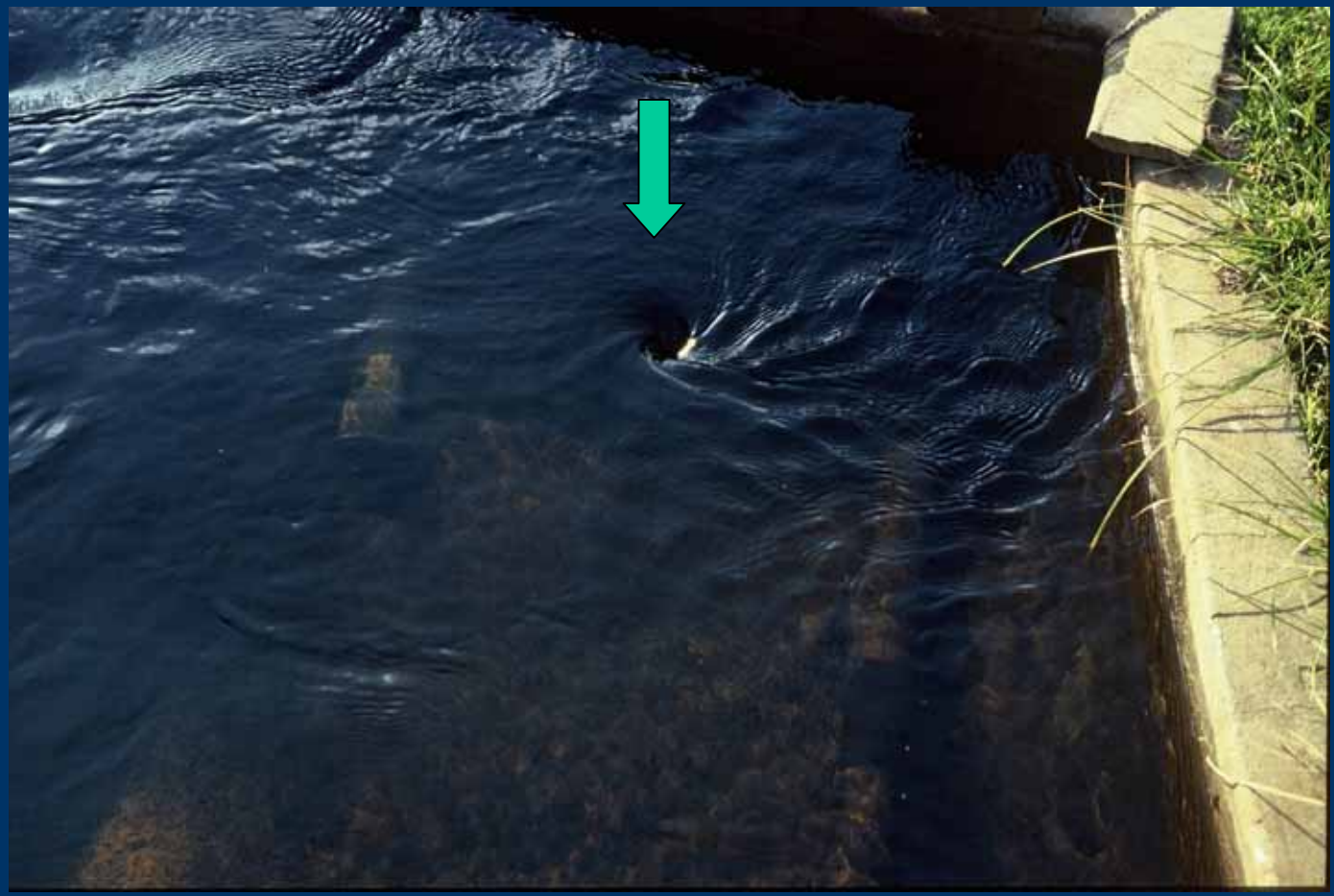
Multifactorial causes of fish disease



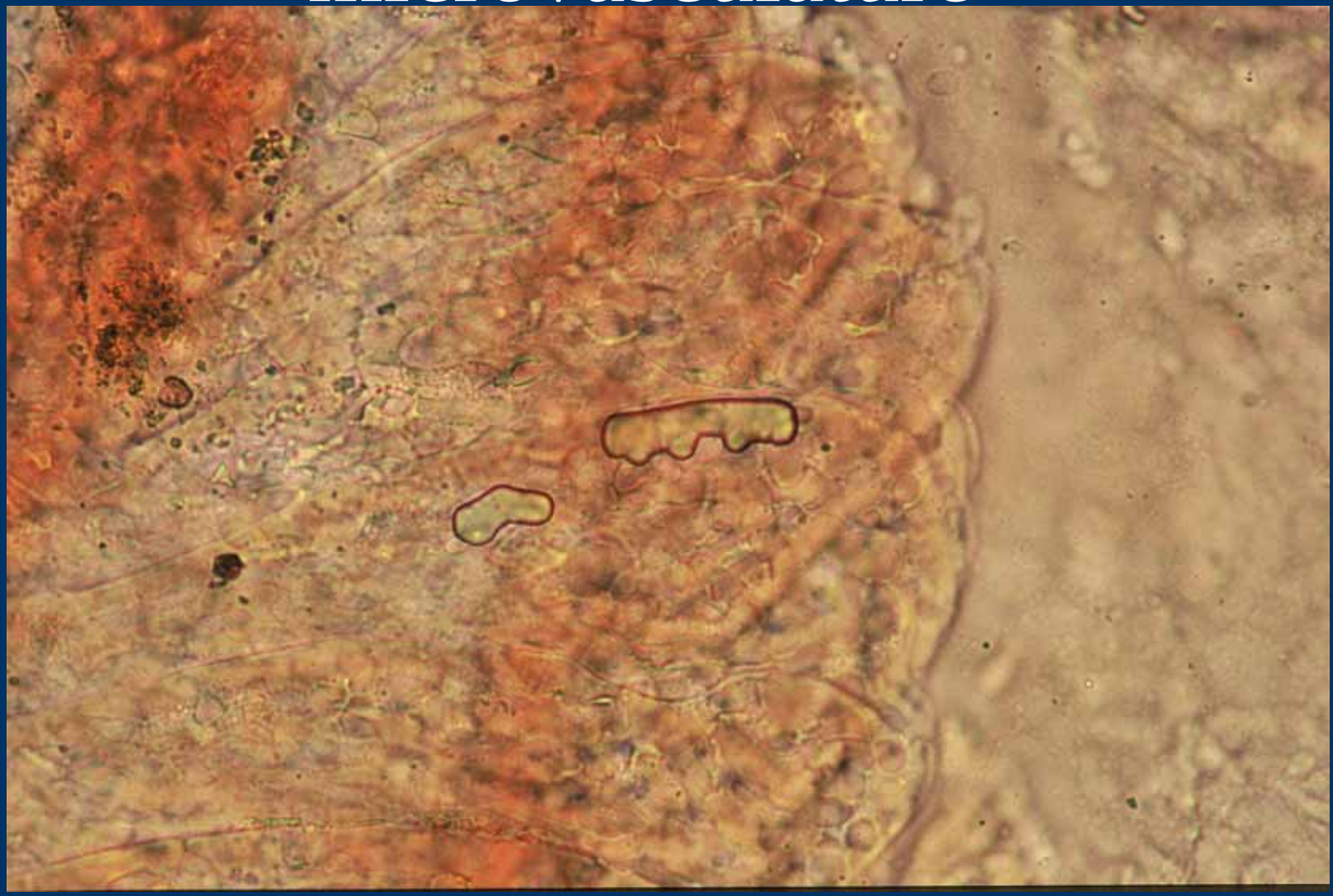
Healthy gill microvasculature



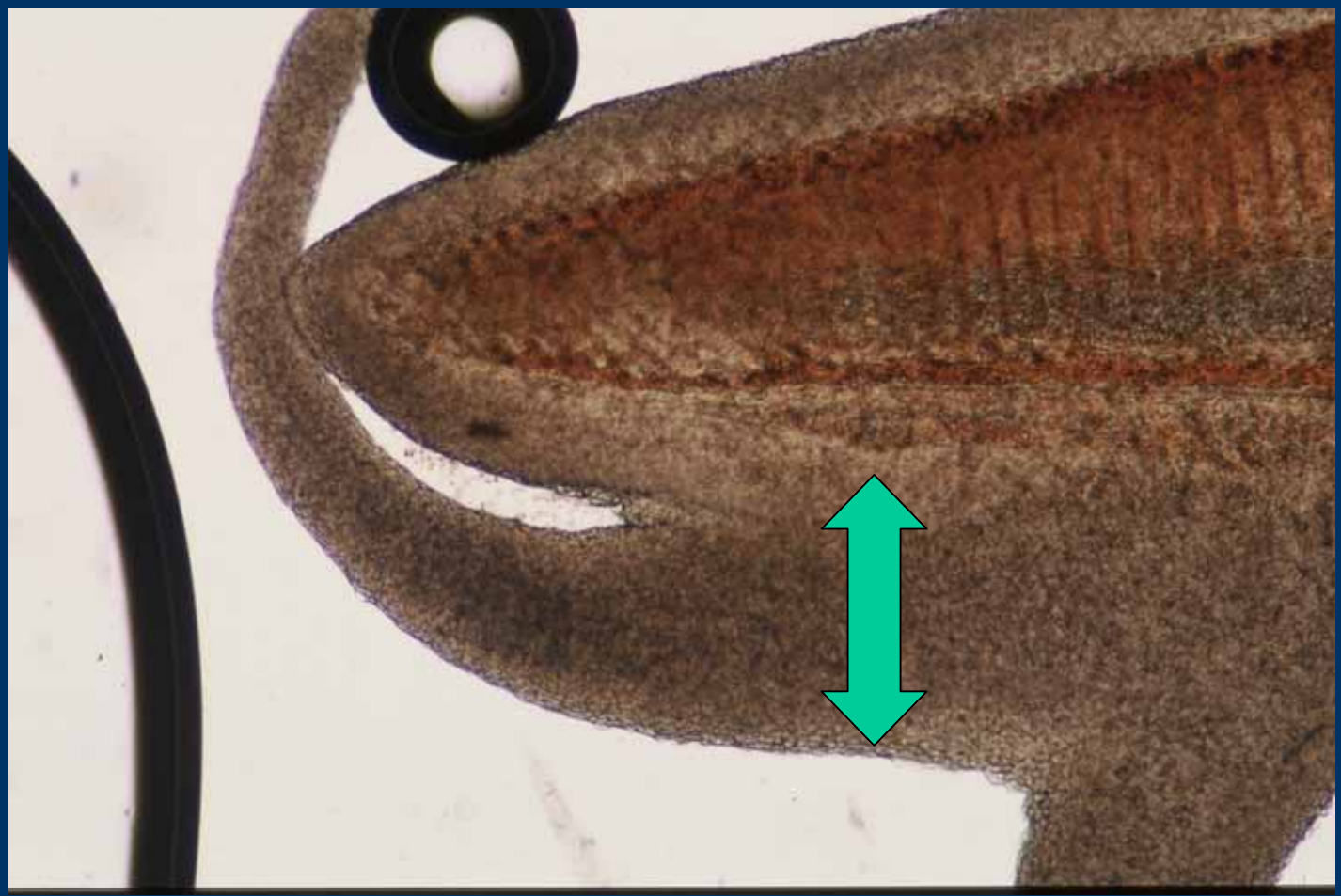
Vortex formation feeding into a pipe – one of many causes of gas supersaturation



Gas emboli in gill – obstruct gill microvasculature



High pH - inability to excrete ammonia - autointoxication – hyperplasia of gill epithelium - increased oxygen diffusion pathway – fish unable to extract sufficient oxygen from water



Intensive fish farming

- Large amount of organic waste favours growth of environmental bacteria
- High population density creates a suitable host population for opportunistic bacteria from the environment
- Sub-optimal environmental conditions provide a weakened host - selection pressure benefits more virulent opportunistic bacteria
- Repeated antibiotic use - selection pressure favours antibiotic resistant bacteria

Disease management

- Identify risk factors
- Limit losses – short term gain by using antimicrobials
- Optimize production
- Optimize husbandry
- Consumer concerns – antimicrobial residues
- Environmental concerns – development of antimicrobial resistance

With injudicious repeated use of antimicrobials

- Antimicrobial sensitivity declines in the pool of bacteria associated with the farmed environment
- Increasingly virulent strains of bacteria emerge
- Virulent fish-associated bacteria are moved with transport of live fish and threaten other producers

Gram positive, cocci shaped, non-haemolytic bacteria

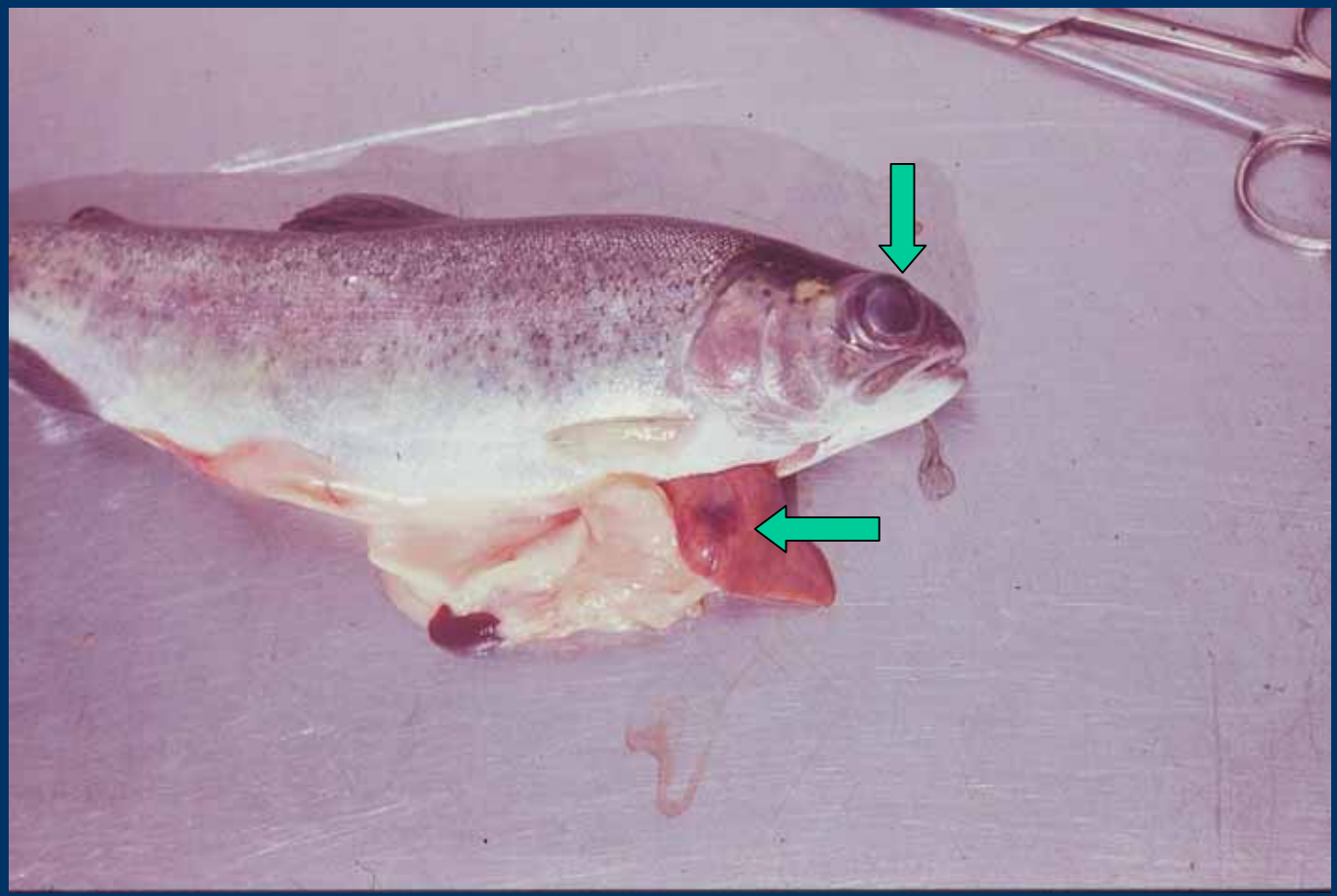
- *Lactococcus garviae / Enterococcus seriolicida*
- *Streptococcus iniae*
- *Streptococcus parauberis*
- *Carnobacterium piscium*
- *Streptococcus* D
- Other *Streptococcus* species

Streptococcal infection of trout

- Disease peculiar to South Africa
- First described from rainbow trout in 1974
- Important septicaemic summer disease
- Primarily an environmental disease related to stress factors
- Treatment with oxytetracycline resulted in suppression of disease but not in cure
- Emergence of resistance to oxytetracycline

Bacterial septicaemia

Streptococcus infection



Streptococcus septicaemia in trout – precipitating environmental factors

- Low water flow and high water temperature
- High daytime water pH due to algal photosynthesis
- Ammonia build up in water and gills
- Low DO
- High dissolved gas pressure
- Build up of infective dose

During the early years of intensive trout farming in South Africa

- Bacterial isolates showed good sensitivity to a number of readily available antibiotics
- Antibiotics were repeatedly used during the summer months to control outbreaks of streptococcal disease
- Antibiotic use at best controlled losses from streptococcal infection but seldom achieved a sustainable cure
- **Oxytetracycline** was mainly used for cost and availability reasons.

More recently

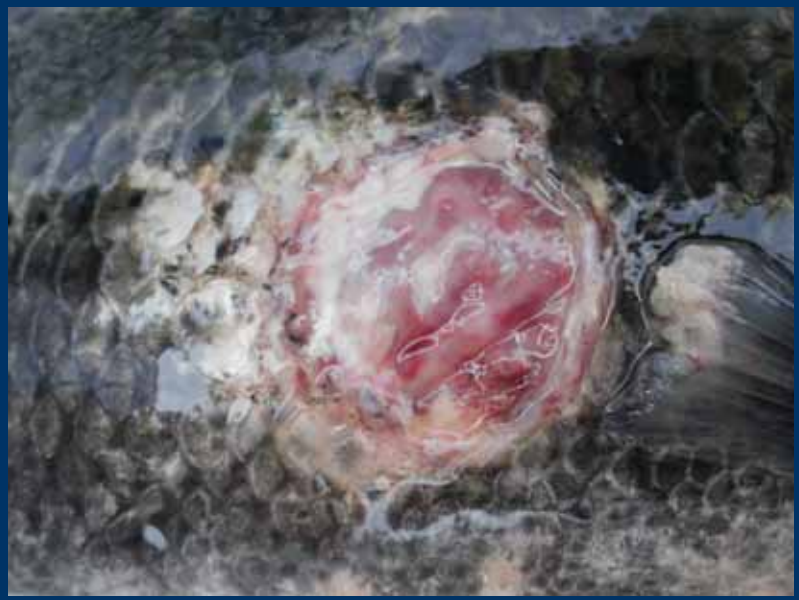
- Oxytetracycline found to be nolonger efficacious
- Most isolates still sensitive to amoxycillin.
- Fish reponded well to amoxycillin with better cure rates than those achieved with oxytetracycline
- Already some *Streptococcus* isolates identified showing resistance to amoxycillin
- Erythromycin used elsewhere in the world but not in South Africa. Florfenicoal not available in South Africa
- Use of autogenous vaccines against *Streptococci* becoming more accepted with generally good results

Streptococcus infection in Nile tilapia in Southern Africa

- *Streptococcus iniae*
- *Lactococcus garviae*
- *Streptococcus parauberis*

Stocking density – trauma - cage size

Typical lesions seen with *Streptococcus* infection in tilapia



Inbalanced feeds – ascorbic acid and omega 3 fatty acids

Dissolved oxygen levels
Stocking density
Feeding practices

Lax enforcement of legislative controls will promote the injudicous use of antimicrobials to the detriment of

- the consumer
- the environment
- sustainable aquaculture

Sourcing of antimicrobials

- According to antimicrobial sensitivity of isolates from disease outbreak
- Antimicrobial registered for use in aquatic animals for human consumption – none in South Africa
- Off-label use on veterinary prescription
- The script may be from the aquatic veterinarian involved with the disease outbreak or from a generalist veterinarian supplying bulk scripts
- Availability and cost of the drug influences choice.
- Often raw active drug intended for manufacture of human and veterinary drugs is sourced

Use of antimicrobials in South Africa - legal / illegal

- Most antimicrobials are supplied by an aquatic veterinarian or under veterinary prescription for the first time
- The responsible veterinarian looses control of antimicrobial use when:
  - Farmers look for cheaper suppliers – often directly from wholesalers or importers or from other sectors of the livestock industry.
  - Antimicrobials supplied without script or on blanket script from a veterinarian not involved with fish.

Who decides when to treat? Farmer or veterinarian

- Aquatic veterinarian may supply antibiotic to see fish through a crisis while underlying causes are addressed
- Farmer may be unwilling or unable to make recommended changes and rather sources further antibiotic without veterinarians knowledge to safe guard his investment
- Repeated injudicious use by the farmer leads to selection of antimicrobial resistant strains predominating on the farm

Do antimicrobials have a place in modern aquaculture?

Intensive farming creates environments conducive to emergence of bacterial pathogens

Future of antibiotic use

- If used judiciously, antibiotics will continue to play a crucial role in seeing fish through times of unanticipated environmental conditions
- Antibiotics should not be used to bridge nutritional and husbandry shortcomings that can be solved in more appropriate ways
- Where possible vaccination should be used to control bacterial disease

Farmers can curtail emergence of bacterial pathogens by:

1. Identifying and understanding underlying causes
2. Following good bio-security practices

but NOT by reliance on antibiotics