



PREVENTION IS BETTER THAN CURE!

A pre-emptive dietary approach to improving larval rearing



Carly Daniels



EUROPEAN UNION
European Social Fund



The Worshipful Company of Fishmongers



University of Plymouth



GREAT WESTERN
RESEARCH



Introduction

Cure - Chemotherapeutics

Prevention - improving the health of an organism to improve success in culture

- External and dietary use of biotic supplements (Pre and Pro)
 - Improved food conversion = Increased growth rates
 - Reduction in disease susceptibility = Increased survival



Relevance To Aquaria

- Develop technology suitable for use throughout culture
- Produce sustainable sourced organisms
- Increase survival
- Reduce production cost





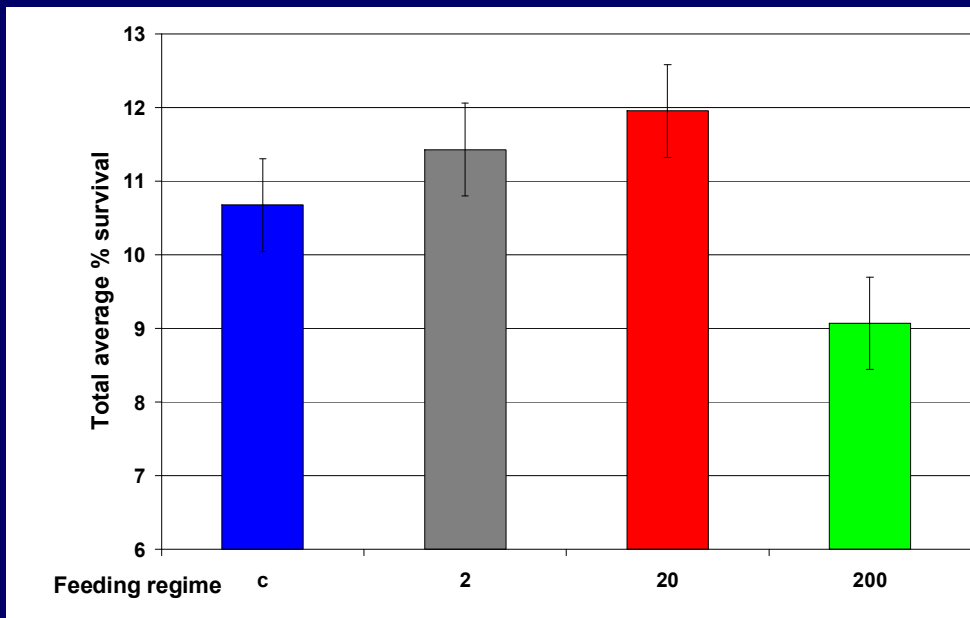
Aims

- Examine the dietary use of biotic supplements in crustacean culture
 - Uptake into diet
 - Effects on growth and survival
 - Gut structure
- **Pre-Biotics** - Non-living plant extracts (often yeast) that reduce pathogenic bacteria by removal from the gut
- **Pro-Biotics** - living bacteria that benefit the gut fauna by out competing the pathogenic bacteria



Previous research

Pre-biotic dietary inclusion in larval lobsters



Significant positive effects on survival at larval stages with short term effects into juvenile stages of growth

Figure 1. Effect of differing concentrations (0, 2, 20 AND 200 ppt in relation to artemia enrichment) of dietary pre-biotic on the survival of European lobster larvae



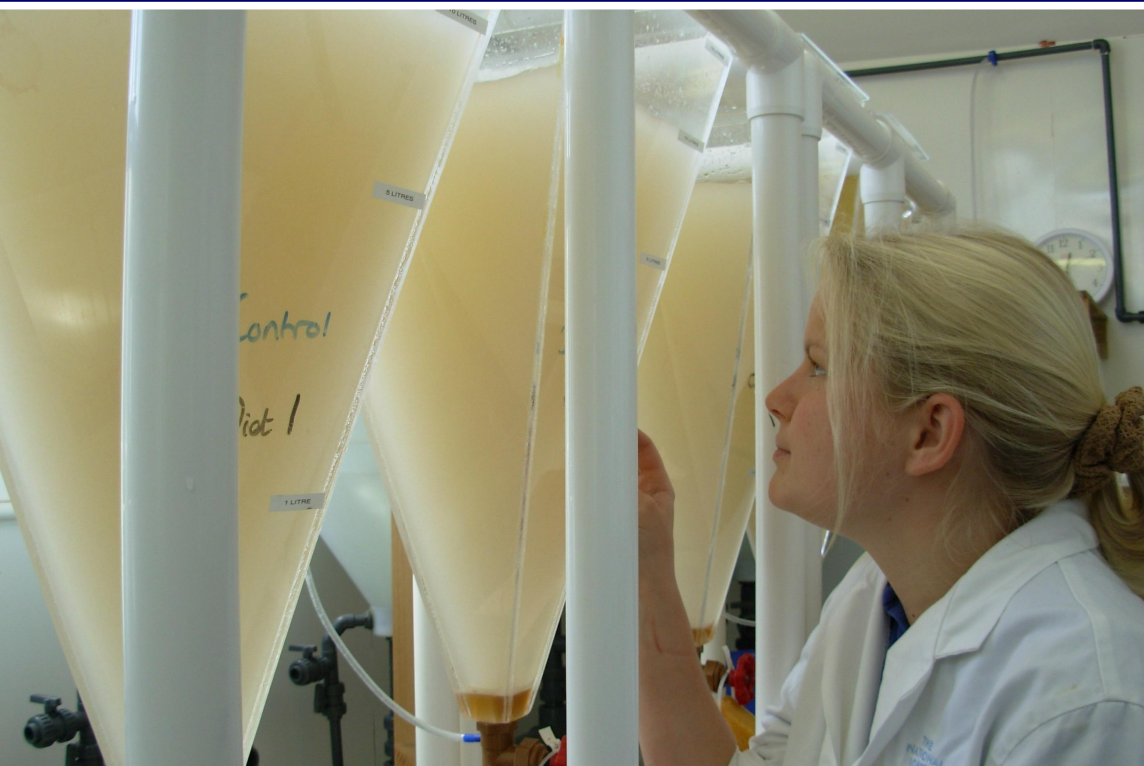
Uptake into live feed and larvae

- Fluorescence labelling of pre-biotic
 - Concanavalin A FITC Labelled
- Pre-Biotic movement into and through live feeds
 - Whole *Artemia*
 - Fluorescence microscopy
- Pre-Biotic in gut of lobsters larvae
 - Gut sections
 - Laser Scanning Confocal microscopy



Diet Preparation

Bio-encapsulation into live food - Selco™ enriched *Artemia*



Three diets
Control - (*Pre-biotic*)
Diet 1 - (*Pro-biotic*)
Diet 2 - (*Pre and pro-biotic*)

One hatching vessel
Three enriching vessels



Larval Rearing

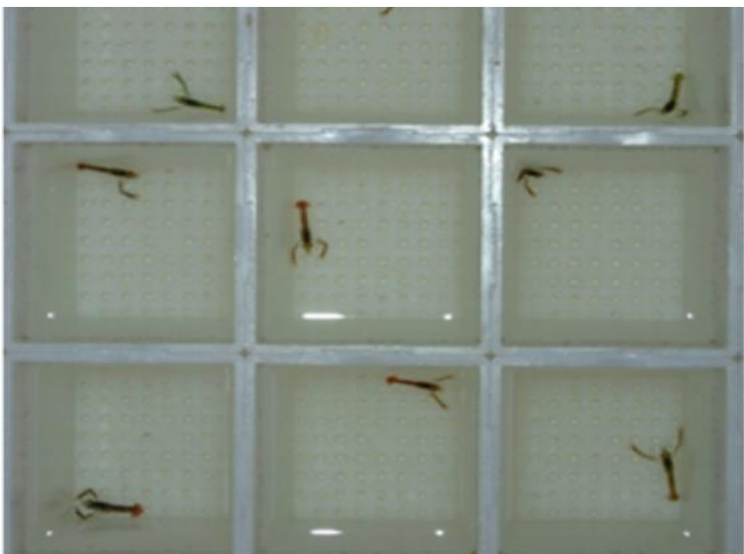
- Re-circulating system
- 12 90L conical kreisel vessels
- 6 Repeats
- 2500 Larvae per cone
- Mixed Brood stock origin
- Rearing for 21 days





Juvenile Rearing

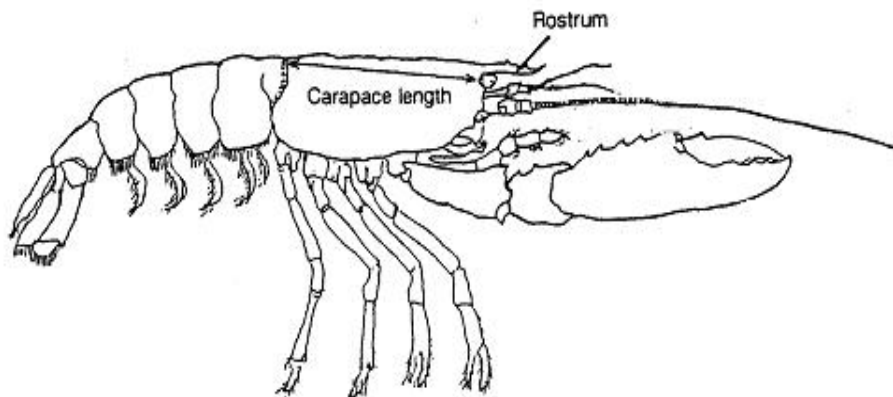
- Re-circulation system
- 2 125L raceways, 2 pellet diets
- 730 juvenile lobsters
- Stage V, VIII and X
- Orkney pots
- Fed once every two days with 1-2 pellets over 40 days





Measuring Growth

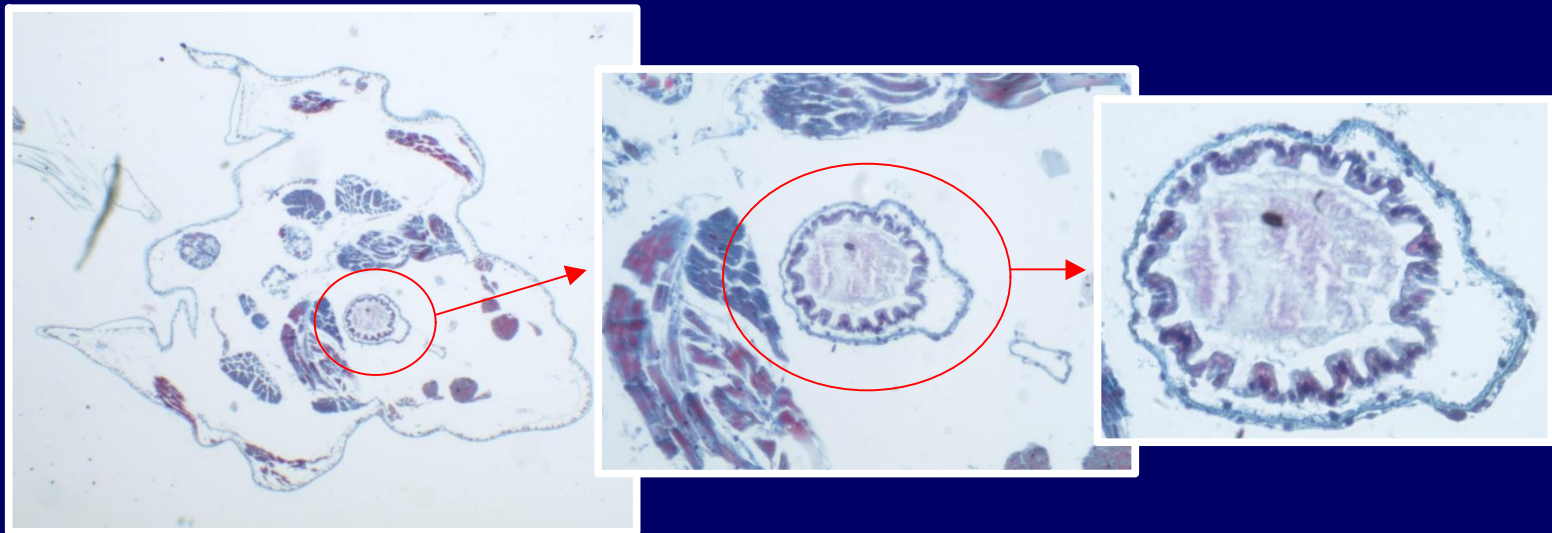
- Carapace length as a measure of growth
- Image J software
- Samples taken at stage I, II, III, IV of larval growth and at 10 day intervals of juvenile growth





Gut structure

- Wax blocked
- Transverse sections through tail - Hind gut
- Light Microscopy





Uptake Into Live Feed

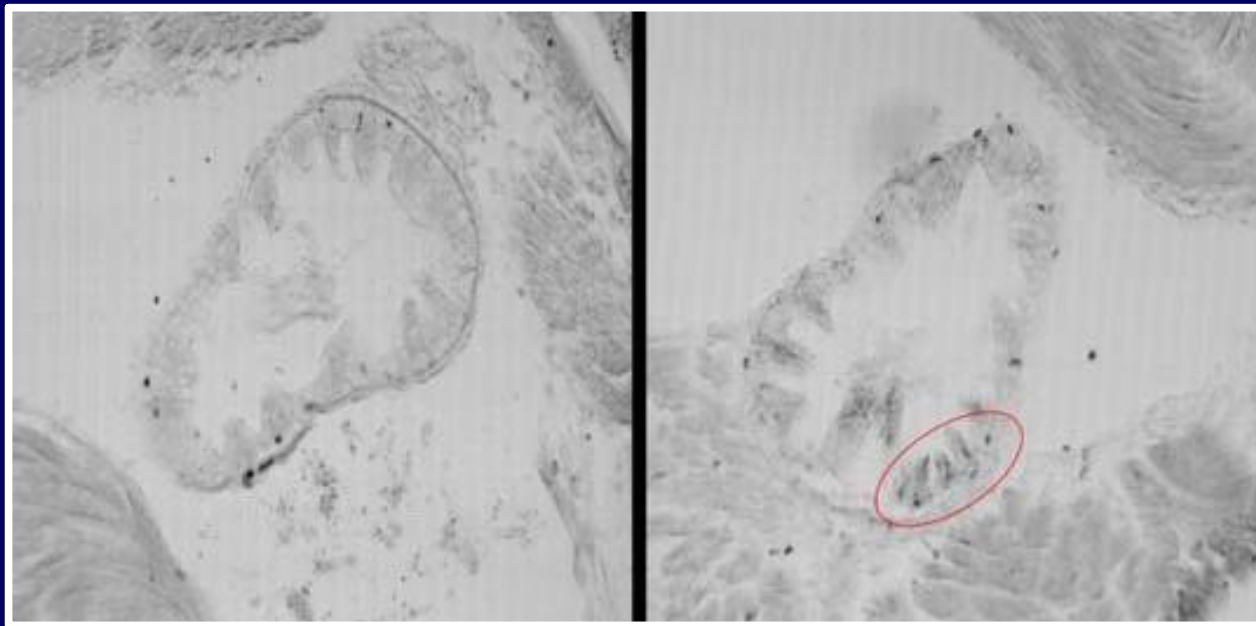
Fluorescent particles highlighted indicate Pre-Biotic particle transit in gut



Uptake Into Larvae

- Fluorescence gut section
- Darker sections in the epithelial folds indicate fluorescently labelled pre-biotics

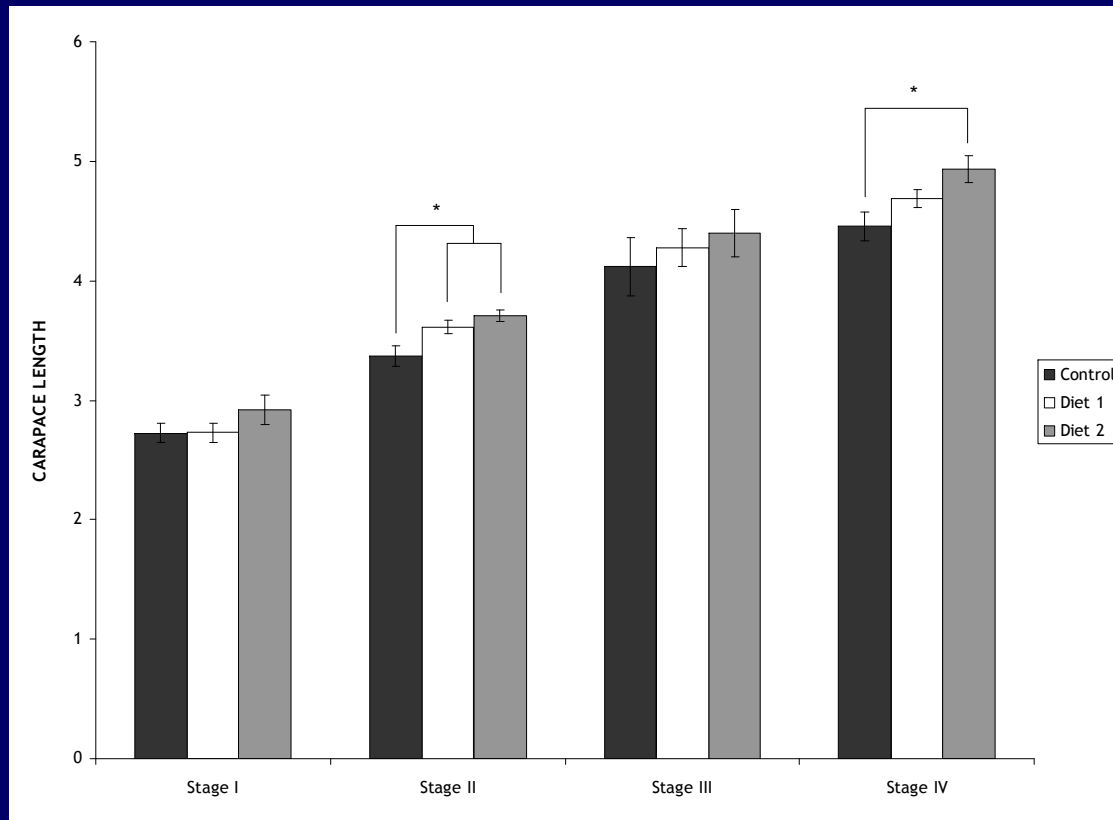
Control



Pre-biotic



Larval Growth

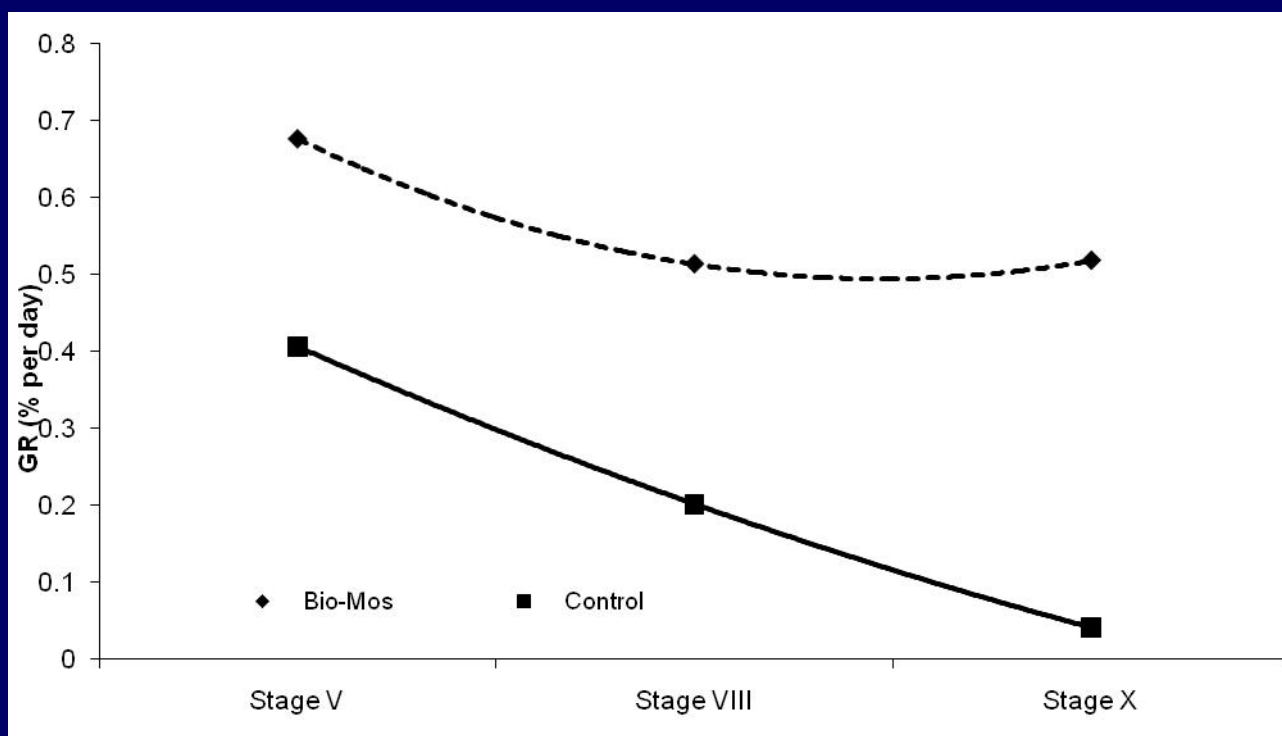


Significantly greater growth with the simultaneous use of pre and pro-Biotics

Figure 2. shows the carapace length of larval lobsters fed on different diets over four stages of larval growth. Diet 1; *Artemia* enriched with pro-biotics, Diet 2; *Artemia* enriched with pre and probiotics.



Juvenile Growth

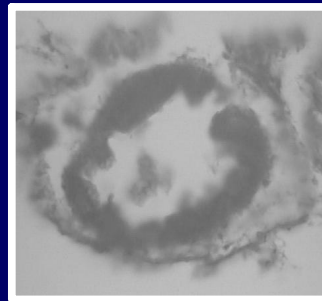


Percentage growth rate between 1.5 time and 12.5 times higher with pre-Biotic

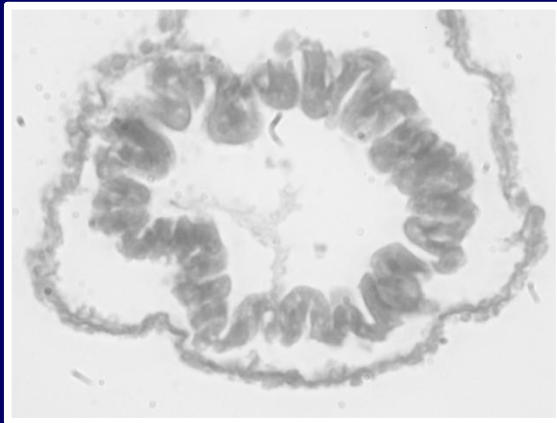
Figure 3. Effects of dietary presence of pre-biotic on the GR response of clawed European lobsters fed diets with and without the addition of pro-biotic for 40 days.



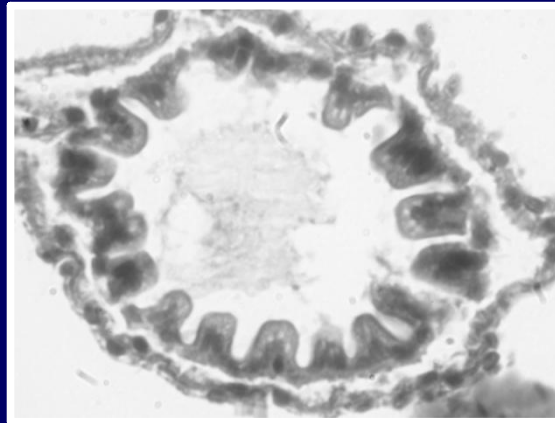
Gut Sections - Physical Structure



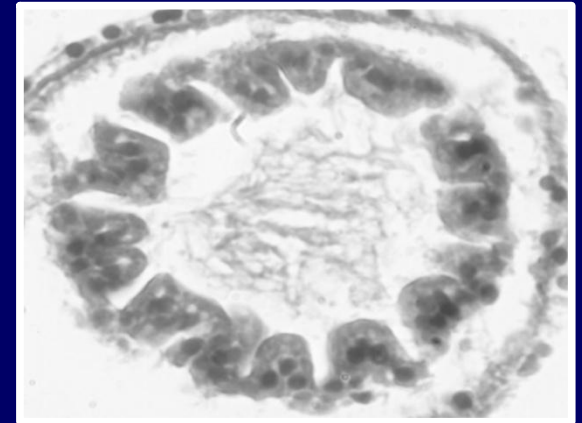
Control



Pre-Biotic



Pro-Biotic



Pre and Pro-Biotics



Conclusions

- Pre and Pro-Biotics have shown improved growth, survival and gut structure in larval and juvenile culture
- Improved gut structure = improved food conversion
- Improved survival = Increased outputs
- Improved growth = Larger individuals
- Transferable to other culture species and situations



Further PhD research

- Challenge trials
- Juvenile diet formulation
 - Specific pellet
- Specific Pro-Biotic
 - Natural
 - Bacterial plating
 - Testing



" A PROJECT TO ASSIST MOTHER NATURE TO RESPOND TO MODERN PRESSURES "



Thank You