

# **Research Travel Grant Report: “R” Basic and, Design and Analysis of Experiments Workshop**

as part of research activities related to PhD project  
**Atlantic Salmon Gastrointestinal Health and  
Productivity (2011/701)**

*Kamarul Zaman Zarkasi*



AUSTRALIAN  
SEAFOOD  
COOPERATIVE  
RESEARCH CENTRE

**2012/751**



***This project was conducted by University of Tasmania***

**Copyright, 2012:** The Seafood CRC Company Ltd, the Fisheries Research and Development Corporation and the University of Tasmania

This work is copyright. Except as permitted under the Copyright Act 1968 (Cth), no part of this publication may be reproduced by any process, electronic or otherwise, without the specific written permission of the copyright owners. Neither may information be stored electronically in any form whatsoever without such permission.

*The Australian Seafood CRC is established and supported under the Australian Government's Cooperative Research Centres Program. Other investors in the CRC are the Fisheries Research and Development Corporation, Seafood CRC company members, and supporting participants.*

Office Mark Oliphant Building, Laffer Drive, Bedford Park SA 5042  
Postal Box 26, Mark Oliphant Building, Laffer Drive, Bedford Park SA 5042  
Tollfree 1300 732 213 Phone 08 8201 7650 Facsimile 08 8201 7659  
Website [www.seafoodcrc.com](http://www.seafoodcrc.com) ABN 51 126 074 048

#### **Important Notice**

Although the Australian Seafood CRC has taken all reasonable care in preparing this report, neither the Seafood CRC nor its officers accept any liability from the interpretation or use of the information set out in this document. Information contained in this document is subject to change without notice.



**Australian Government**  
**Fisheries Research and  
Development Corporation**



An Australian Government Initiative



ISBN: 978-1-925983-07-4

## **NON-TECHNICAL SUMMARY**

**PROJECT NO: 2012/751**

**“R” Basic and, Design and Analysis of Experiments Workshop**

**PRINCIPAL INVESTIGATOR:** Kamarul Zaman Zarkasi

**ADDRESS:**

Tasmanian Institute of Agriculture  
University of Tasmania  
Private Bag 54, Hobart  
Tasmania 7001

**(PROJECT) OBJECTIVES OF RESEARCH TRAVEL GRANT/ INDUSTRY BURSARY**

1. To improve skills and knowledge for experimental design and analysis of research data.
2. Advance overall technical skills in biostatistics.
3. To better understand and improve skills using R-based statistical packages for analysing research data.
4. To improve outcomes of the overall PhD project.

**OUTCOMES ACHIEVED TO DATE : Successful completion of the “R” Basic and Design and Analysis of Experiments Workshop**

**(PROJECT) OUTPUTS DEVELOPED AS RESULT OF TRAVEL GRANT/ INDUSTRY BURSARY:**

- Development of skills using R-based statistical applications
- Development of skills associated with advanced experimental design and analysis
- Implementation of skills in current research milestone activities including analysis of salmon farm operational data, microbial community data, diet modification data

## **ABOUT THE PROJECT/ACTIVITY**

### **BACKGROUND AND NEED:**

The research travel grant included attending a training course that consists of an introduction to the statistical software environment “R”, reading and handling data, graphic analysis and data output analysis, writing simple R-based functions, developing flow control structures, and use of ANOVA and split level designs. The training was conducted as an interactive face-to-face workshop at the Centre of Applied Statistics, the University of Western Australia, Perth (27 November 2012 until 30 November 2012).

My PhD project “***Salmon Gastrointestinal Health and Productivity***” requires biostatistical analysis, which includes handling a wide variety of data comprising environmental information (water temperature and dissolved oxygen), farm production criteria (salmon growth specific rates, feed usage efficiency), dietary information (energy content, oil content, prebiotic and probiotic amendments) and microbial community parameters (population load, taxonomic structure, diversity). Combined, this multivariate data can be hard to relate without use of more powerful statistical models and is complicated by the fact we know very little about salmon gastrointestinal microbiology and links to salmon growth and responses to environmental conditions.

Furthermore, research design training will be important in aiding in the development of research within milestones 3 and 4 of the PhD project, which seeks to find means to manipulate gastrointestinal microbial communities of salmon via diet modifications. The end goal of the PhD is to influence or to improve productivity under summer water temperature conditions, which lie outside salmon optimal physiological performance levels. The development of an efficient and logical experimental structure, including consideration of split-level design and other strategies, could lead to improved and accurate experimental outcomes.

Therefore, the research travel grant improved my skills and knowledge for experimental design, analysis of my research data and also advanced overall my technical skills in biostatistics. Currently, I’m using R-based statistical packages to analyse my research data source, thus these activities really improved my skills and knowledge about R-based statistical software. I’m choosing R because it’s a free and extremely powerful language and software environment for statistical computing, data analysis and graphics. It has become the tool of choice for many statisticians. Understanding of R is extremely valuable for my professional development, improves my skill for data analysis, and potentially improves the outcomes of the PhD project.

### **RESULTS**

Two short courses were conducted that I attended: The *Introduction to R* and the *Design and Analysis of Experiments*. Within the *Introduction to R* course, basic R commands, R help pages, the reading of data, data manipulation, summarising data, basic statistical analysis and basic plotting commands was covered. The *Design and Analysis of Experiments* course covered the use of ANOVA and split level designs and also application of one-way ANOVA, block designs, balanced factorial designs,

unbalanced factorial designs, fixed and random effects, nested designs, split plot designs and simple repeated measures and associated analysis method. My knowledge about R and biostatistics has been dramatically improved.

The information and knowledge gained during the courses should lead to better integration of data generated in my PhD research. This includes environmental, farm operational, diet related and microbiological data using multivariate statistical approaches implemented in the R software environment and better research design for implementation of milestones 3 (diet manipulation and effect on gastrointestinal microbial communities of Atlantic salmon) and 4 (sea cage field testing of modified diets on a salmon population) which rely on using kn. These experiments will heavily rely on data generated from laboratory or farm-level surveys to allow effective manipulation of salmon gastrointestinal communities in a way to be potentially beneficial to production efforts.

## **INDUSTRY IMPACT**

### **PROJECT OUTCOMES (THAT INITIATED CHANGE IN INDUSTRY)**

Skills and knowledge gained from this workshop will make it easier to translate multivariate data in a form that can be more readily communicated and understood by the industry partners (Tassal Group, Skretting Australia). Such extension activities typically take the form of what are largely scientifically oriented meetings in which data is displayed and interpreted extensively by experts. The end goal is to provide clear messages to the industry partners who then take note of possible new directions in salmon mariculture or at the very least be armed with in depth knowledge of underlying phenomena that occur during mariculture that could be useful as future problems arise. The outcomes can also be extended to aid in comparison of data generated in other aquaculture related projects being funded by the Seafood CRC including the project being led by Prof. Mohammed Katouli at the University of the Sunshine Coast.

### **SUMMARY OF CHANGE IN INDUSTRY**

We do not expect there to be an immediate impact to industry as a result of this training. The focus is to improve interpretations of experiments within the PhD research program and thus generate reliable outcomes of the highest possible quality.

### **WHAT FUTURE AND ONGOING CHANGES ARE EXPECTED?**

The focus will be to use what is learnt during the statistics course in developing and implementing new experiments where I will use a model system to determine how modified feeds affect microbial communities under conditions mimicking those that lead to summer-related suboptimal feeding problems ("Summer Gut Syndrome") as well as modified diets to try to alleviate or suppress such effects. This requires

empirical experimentation and careful analysis of data. Diet development and model testing will be done in consultation with the feed company partner Skretting and CSIRO colleagues as part of annual discussions of the data. The outcomes arising from such data could be important in predicting future feed-related issues in terms of microbially –mediated gastrointestinal health.

### **WHAT BARRIERS ARE THERE FOR CHANGES TO OCCUR?**

The main barrier is the actual industry need for diet modifications in the first place. Husbandry methodologies improved salmon farming since feeding-related troubles in prior to 2010 thus interest in summer-related feeding issues have declined in the past few years, however it is expected that foreknowledge of the impact of different diets on fish health (from a microbiological view point) will be potentially valuable for the industry in terms of maintaining productivity and them being able to react to change. Such change could be climate-related or in the case of feed ingredient price changes sufficient enough to generate concerns related to profitability.

### **IF NOT ALREADY HAPPENING, WHEN WILL THE CHANGES OCCUR?**

Again the training was focused on experiment interpretation and thus industry change is not a short term expected outcome but practice may may result in the longer term from the overall findings developed through the PhD research.

### **WHAT IS THE LIKELIHOOD THAT THESE CHANGES WILL OCCUR?**

As mentioned previously there is a good likelihood industry, especially the feed industry will find the data useful in general and thus having the best approaches to make this information clear and as useful as possible is obviously advantageous.

### **WHAT BARRIERS ARE THERE TO ADOPTION OF THESE CHANGES AND WHAT ACTION COULD BE TAKEN TO OVERCOME THESE?**

As indicated in the question related to barriers against success, adoption depends on needs, interest, and economic imperatives within the industry. For example if climate change wand warming of surface waters continues to occur, drastic changes to management of the salmon industry will be needed. Another issue is the price of fish meal and oil, which may be increasingly become expensive depending on global demand and environmental pressure on the sources. With the research we can hopefully provide information that will be useful in such situations. The training will make it possible to develop recommendations in a clear cut manner supported by statistical based conclusions not just qualitative opinions.

## **COMMUNICATION OF PROJECT/EXTENSION ACTIVITIES**

Given the report is on training for scientific purposes, extension related activities are not relevant here but extension activities carried out will be covered in the second PhD milestone report due March 2013.

## **ACKNOWLEDGEMENTS**

We are grateful to the Australian Seafood CRC and in particular Dr Graham Mair for approving and supporting this research travel grant. Thanks are also extended to the Tasmanian Institute of Agriculture which also supported this training program.