

ISSN 1170-2001

NEW ZEALAND FRESHWATER FISHERIES MISCELLANEOUS REPORT NO. 91

**BLOAT: PROPOSED INVESTIGATION  
AND REVIEW**

by

**N.C. Boustead**

**Report to: Southern Ocean Seafoods and  
GFW Agri-Products**

**Confidential to clients**

**Job No. 28/91**

**Freshwater Fisheries Centre**

**MAF Fisheries**

**PO Box 8324**

**CHRISTCHURCH**

*Servicing freshwater fisheries and aquaculture*

**MAY  
1991**

## NEW ZEALAND FRESHWATER FISHERIES MISCELLANEOUS REPORTS

This report is one of a series initiated in January 1989, and issued by the Freshwater Fisheries Centre, MAF Fisheries. The series was established to ensure that reports prepared for clients, tribunal hearings, internal use, etc., are collected together and available to future users. They are for limited circulation, and some may be confidential.

ISBN 0-477-08435-4



MAF Fisheries is the fisheries business group of the New Zealand Ministry of Agriculture and Fisheries. The name MAF Fisheries was formalised on 1 November 1989 and replaces MAFFish, which was established on 1 April 1987. It combines the functions of the former Fisheries Research and Fisheries Management Divisions, and the fisheries functions of the former Economics Division of MAF.

Enquiries to:           The Librarian  
                              Freshwater Fisheries Centre  
                              PO Box 8324  
                              Riccarton, Christchurch  
                              New Zealand

**PART 1**

**A PROPOSAL TO INVESTIGATE THE EFFECT  
OF TWO DIFFERENT DIETS ON THE INCIDENCE  
OF BLOAT IN FARMED CHINOOK SALMON**

This proposal was developed following discussions at the Freshwater Fisheries Centre between Nelson Boustead and Martin Unwin (MAF) and Sarah Liddell, Chris Clark and Neil Garnett (NRM) on 20 March 1991. Further details were worked out with Mark Gillard and in consultation with a biometrician, David Baird from MAF, Lincoln.

**Proposed Trial**

Initial trials should be between samples of diets from NRM and Salmon Services (SS). This is because the information on the incidence of bloat in fish fed on SS diet is inconsistent and not adequately determined. Given that bloat is not reported from Stewart Island this would also establish if conditions about the environment or location are significant.

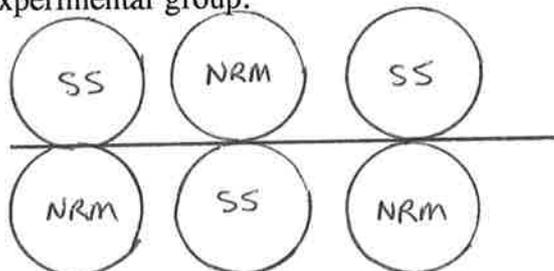
To produce reliable results it is important that replicates of each trial are carried out and that only one parameter should be investigated at a time. This is also to reduce the disruption to commercial activities of the farm and simplify record keeping. It is proposed to use 1990 brood fish for the trial as these will provide the largest number of fish of uniform history. Fish from both Kaituna and Pupu Springs are available but for consistency fish from only one of these sources (Pupu Springs) should be used in the trial. These fish are due to be transferred to sea cages in April and May.

One aspect that was not previously discussed is the possibility that the change in feed from NRM to SS diets could affect the results. To overcome this, the trial could begin immediately on transfer with feeding of the different diets beginning two weeks prior to transfer. This raises the possibility of losses from failure to adapt to seawater confusing the study, but this is preferable to the possibility of variation from the switch to a different diet. If seawater acclimation does prove to be a problem then this can be overcome by extending the duration of the trial and discounting initial losses.

This trial is intended to be concluded before harvesting begins. It will require six pens, three on NRM diet and three on SS diet, each containing about 20 000 fish. Estimated initial losses could be up to 6% in the first month and less in the following months. Of those losses up to half may be from bloat. Those figures are best guesses. There is great variation in seawater survival and the possibility exists that losses could be greater.

The experimental pens will need to be situated on the farm in a layout that provides similar conditions for each experimental group.

e.g.



The inclusion of the other stocks on the farm as part of the experiment was considered and rejected as to do so would mean imposing additional work. It is desirable to concentrate on doing a limited trial rather than spreading effort too thinly which could compromise the work.

If feasible it is proposed that each diet be made in one batch and kept frozen in Nelson before use. The duration of the trial will probably be two or three months but will be influenced by monthly assessment of the results.

Accurate record keeping and monitoring of feeding will be essential. Records required will be as follows:

All mortalities by number cage and date which will have to be recorded as -

- Bloat
- Runts
- Red lesions
- Jacks
- Too necrotic to tell

Average sizes of fish in each cage will need to be determined at the beginning and end of the experiment. Ideally 100 fish should be weighed for each group. Each fish should be weighed individually to provide information on the range of weights.

Some system of classification of bloat observed by divers will need to be developed. For example:

- None seen
- Few mild
- Few severe
- Many severe/mild

Feeding records of amounts fed to each cage and all changes of pellet size must be recorded.

Salinity and temperature at 5 m depth with some checks on oxygen. Any stratification of salinity, temperature or oxygen will need to be determined. Weather, particularly storms, wind, rainfall and sunshine must be recorded.

Names of staff must be recorded beside the data they collect. If possible try to reduce the number of different people doing the same tasks. It is normal for some bias to occur when different staff do the same task. By identifying which staff make which observations any bias can be removed in subsequent analysis.

Most of this information is already recorded, so little extra work should be involved. A summary of data required is appended. The data from the experiment will be supplied to MAF Fisheries for analysis and preparation of a report to the clients.

### Schedule and costs

The development of this proposal, and the review of existing information on bloat have been funded by MAF Fisheries and by NRM and Southern Ocean Seafood. As agreed previously these costs to NRM and SOS will not exceed \$500 each.

MAF's fees for overseeing the trial, analysis and preparation of a report are estimated as follows:

- |    |  |               |
|----|--|---------------|
| 1. | Visit to Bulwer as part of setting up the trial. | Up to \$2,000 |
| 2. | Consultation and preparation of the report.      | Up to \$1,500 |

I understand these costs will be met half by NRM and half by SOS. Should additional tests, analysis, or additional visits be required these would be at additional cost. Diet analyses are likely to be required as part of the assessment of results. These analyses would be arranged and costs met by SOS and NRM. Similarly, supply of the different feeds is to be the responsibility of NRM and SOS.

If required, a formal quotation can be prepared when details on the trial are agreed.

NRM and SOS will need to consider the confidentiality of the report. Given the potentially sensitive nature of the results MAF Fisheries can make the report confidential for a specified number of years. However this is unlikely to stop the results becoming known via the grapevine!

On completion of this trial it may be possible to apply to FoRST for funding of more comprehensive trials if required in 1992. Such a funding application can include costs of additional labour for the trials and materials used, including fish. Such funding is not guaranteed.

### POSTSCRIPT

Consultations on the experimental design have been carried out with David Baird, a biometrician from MAF, Lincoln. He advised that an expansion of the experiment to eight cages and inclusion of Kaituna fish in four of those cages would be advantageous. This change could increase the validity of results obtained if similar results are obtained in fish from two sources, compared to one. If possible this should be incorporated into the experiment.

**APPENDIX****DATA REQUIRED****1 For each cage**

Cage number  
 Cage volume  
 Mesh size  
 Position on farm  
 Date stocked  
 Origin of stock  
 Transfer details  
 Number of fish  
 Average weight at start  
 Average weight at end  
 Feed manufacturer  
 Freshwater feeding period on test feed

**2 Chronological records for each cage**

Cage number  
 Date  
 Food fed - kg  
 Food size  
 Food changes  
 Any unusual behaviour  
 Morts:           person counting  
                   net pull or dive  
                   numbers        bloated  
   runts  
   lesions  
   jacks  
   necrotic  
   apparently normal  
 Dives   diver  
           bloat observations  
           other comments

**3 Weather records**

Sun   sunny/cloudy/overcast/rain  
 Sea   flat calm/light chop/rough  
       direction  
 Wind  
 Water temperature at depth  
 Oxygen  
 Salinity

**PART 2****A REVIEW OF INFORMATION CONCERNING  
BLOAT IN SEAWATER REARED SALMONIDS**

Bloat is a condition found in some species of salmonids reared in seawater. The stomach of affected fish becomes massively distended and is filled with sea water and food remains.

Published information on the condition is scant. A computer literature search of Aquatic Science and Fisheries abstracts from 1978 to 1989 found no published information on bloat. Since then two publications describing bloat have appeared. Hicks (1989) briefly describes and illustrates the condition as it occurs in chinook salmon in Canada. Staurnes *et al.* (1990) describes bloat in detail as it occurs in rainbow trout in Norway. Both these publications have been supplied. Staurnes has advised that they have not done any other work on bloat since that report.

Observations and investigations of bloat in New Zealand have revealed some information about the condition. Bloat has occurred in salmon of all ages in seawater. MAF does not have good data on mortality rates due to bloat. However, the condition does not quickly lead to death as affected fish can be seen in cages without high losses. In some cases where there has been other significant problems of collapsed net or failure to adapt to seawater mortalities have increased dramatically and many of the morts were bloated. In the case of the collapsed net a variety of feed analyses were carried out but these did not reveal any problems. Fat, moisture, protein, carbohydrate, many vitamins and the fatty acid profile were examined. In other cases examination of 59 "normal" summer morts found nine of these were bloat. In another case 10 % of post transfer losses were bloat. A further case found a difference in two or three month post transfer losses of 2.1% in fish fed NRM feed and 0.6% in fish fed predominantly Salmon Services feed. However overall losses in the two groups were 8 and 6.6 % respectively. This result may also have been influenced in that the fish fed NRM diet appear to have been given proportionately more feed. It is the opinion of the farm manager concerned that this difference is a reflection of the proportion of fat in the respective diets, there being fewer problems with bloat from diets with less oil.

A different condition is known from some sea cage reared fish where off flavours are apparent in a small number of individual fish. The relationship of this problem and bloat is not clear, although some farmers associate one with the other.

Your own data, supplied to MAF Fisheries, found a higher incidence of bloat in salmon fed diets with local fish meal compared to salmon fed with fish meal from Chile.

The cause of bloat is not known. There are numerous suggestions that the cause is related to feed and feeding practice but there is little published information to support this. Bacterial, virological and histopathological examinations of bloated chinook salmon from New Zealand and in overseas investigations, have not revealed any evidence that the condition is caused by an infectious disease.

Correspondence with American and Canadian Fish pathologists has provided some other ideas and observations. This information is speculative and not supported with evidence or data thus should not necessarily be taken as correct.

Meyers, Alaska Department of Fish and Game, has seen bloat in chum salmon. These were fed a semi-moist diet (biodiet). Meyers associates the problem with overfeeding with a high caloric content feed and advised starvation and reduced feeding prevents bloat in additional fish. Hicks (1989) also suggests decreasing the feeding rate appears to alleviate most of the problem.

Stan Hammer from Fox Island Sea Pens, Washington also observed bloat in chinook salmon and attributed it to fish being fed too much feed too fast. He advised that losses spike dramatically and immediately after increases in the feed ration. The problem was eliminated by stretching out the feeding period and elimination of sudden feed increases.

In contrast, Craig Kent, now with the Department of Fisheries and Oceans at Nanaimo, advised in 1990 that he was aware of bloat occurring in fish that were on reduced rations. Kent is part of a very highly regarded group of scientists working on salmon diseases for the Canadian Federal Government and his field includes diseases of sea cage farmed fish. I contacted him again to find out if there had been any further advances in knowledge concerning bloat. His reply, received 8 May 1991 was as follows:

*"We frequently observed bloat in seawater reared coho, chinook and Atlantic salmon, but we do not have an active research project on the disease. To my knowledge nobody has conducted any well controlled studies on the problem"*

Lee Harrell of the United States National Marine Fisheries Service at Manchester observed bloat following transfer of 8 g chinook salmon to seawater. The bloat affected 35% of fish about four months after introduction to seawater. Other fish of the same group had extended freshwater rearing and then were transferred to seawater at 35 g. These did not suffer from bloat. Harrell thus associated the condition to osmoregulatory dysfunction. He also advised that he had seen bloat on dry, semi-moist and moist pellets (9, 16, and 30% water).

Inositol deficiency was proposed as a cause of bloat by some workers. In the undated review by Poston, inositol deficiency is recorded as causing a slow rate of gastric emptying as well as other signs. Reported levels of inositol in New Zealand salmon diets should be adequate although results of any analyses of diets for inositol are not known.

## References

- Hicks, B. 1989. British Columbia Salmonid Disease Handbook. Province of British Columbia Ministry of Agriculture and Fisheries.
- Poston, H. A. Vitamin requirements of finfishes: a review. Roche Information Service Animal Nutrition Department.
- Stuarnes, M., Andorsdottir, G. and Sundby, A. 1990. Distended, water filled stomach in sea-farmed rainbow trout. *Aquaculture*, 90. 333-343.