Atlantic Salmon Health in Australia

Australian Government
Fisheries Research and Development Corporation

Summary of antibiotics and antifouling agents used in farming Australian Salmonids

Introduction

Atlantic salmon and trout (salmonids) farming at sea started in Australia in 1985. Production has increased significantly since then, with most of this growth occurring in the last seven years.

More than 95 per cent of Australia's farmed salmonid production occurs in Tasmania. Between 2002 and 2008, farmed salmonid production rose by almost 70 per cent in volume and 120 per cent in real value to reach a production level of 25,527 tonnes worth $299 million.

Tasmania producers supply most of their salmonids to the domestic market. A key factor contributing to the rapid growth in recent years has been a strong focus on marketing salmon to Australian consumers. Another factor behind the sector's strong growth is the role of research and development, which has helped the sector to drive innovation and best practice in areas such as feeding techniques and disease management.

As with all new primary production activities there remain factors, such as disease pathogens, which take time to develop the best and most efficient strategies to deal with them. This can be seen overseas, where salmon farms have been in operation for a longer time, and there has been a significant reduction in antibiotic use.

Fisheries production in 2007-08, by state - Australia

	NSW	Vic.	Qld	WA	SA	Tas.	NT	C'wlth	Aust
Value	**$'000**	**$'000**	**$'000**	**$'000**	**$'000**	**$'000**	**$'000**	**$'000**	**$'000**
Salmonids	1 400	6 743	0	141	0	290 974	0	0	299 259
Quantity	**t**	**t**	**t**	**t**	**t**	**t**	**t**	**t**	**t**
Salmonids	130	1 134	0	15	0	24 248	0	0	25 527

Australian fisheries statistics 2008

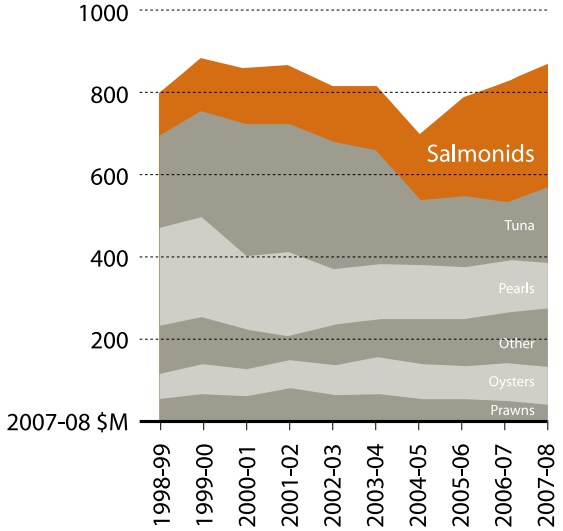
RESEARCH AND DEVELOPMENT FOR BETTER HEALTH

Health of both farmed animals and the environment is one of the most important factors for any primary producer. A healthy environment combined with the well being of stock will ultimately result in increased productivity and decreased cost of production.

Antibiotics and antifoulants are used in aquaculture operations as part of a suite of measures to ensure the health and well-being of farmed stock. Antibiotics are only used in direct response to infectious diseases. Antifoulants are needed to counteract bio-fouling which reduces water flow and oxygen supply in the cages, increasing stress levels and hence disease-susceptibility in the fish.

The management and health of farmed salmonids continues to improve because farmers, veterinarians and scientists have been working together to address the major issues in the industry. This has lead to improved practices, better understanding of disease and the development of new vaccines, and better fish husbandry techniques.

Real gross value of Australian aquaculture production



In order to manage and minimise any impacts associated with these advances and changes to practices, it is important to understand the environmental impacts associated with them.

The Atlantic salmon industry identified a need to review practices and establish environmental risk factors associated with current antibiotic and antifoulant use in Tasmanian aquaculture operations. To this end the industry embarked on a project "*A review of the ecological impacts of selected antibiotics and antifoulants currently used in the Tasmanian salmonid farming industry*".

This study also considered data on sediment residue levels for both antibiotics and antifoulants, which had been collected by the salmon industry in compliance with drug/chemical licensing permit conditions authorities and by the State government in response to concerns regarding antibiotic and antifoulant use.

While developing future research strategies was not a core objective of the project, the review has assisted industry to identify an appropriate plan to research and monitor ongoing impacts.

What the report found

The report outlines the key issues associated with the use of antibiotics and antifoulants in farming salmonids and highlights the current gaps in our knowledge. In conjunction with state and federal environmental agencies the salmonid industry has developed a strategic research agenda to address the priority issues. This will ensure that relevant risks are clearly understood and mitigation/remediation strategies are employed where appropriate.

ANTIBIOTICS

What antibiotics are used and why?

Antibiotics are used to alleviate suffering when fish health deteriorates due to illness. The choice of antibiotic is dictated by the particular pathogen and/or disease symptoms. In Tasmania, because the causative agents associated with some diseases are not known farmers need to use antibiotics which are effective over a broad spectrum, such as oxytetracycline (OTC).

The objective in any disease management plan is to identify the cause and then develop an appropriate management strategy. The Tasmanian salmonid industry has invested significant resources in developing vaccines for the major health issues that it has faced so far and has had considerable success with this approach. Antibiotic usage in Macquarie Harbour has been reduced to almost zero as a result of a vaccine being developed for the bacteria Vibrio and Aeromonas.

It is important to note that the aquaculture industry in Tasmania differs from the more established salmonid industries in the Northern Hemisphere in two ways.

Atlantic salmon are not endemic to many of the countries in which they are grown, including Tasmania. Therefore they have no natural immunity to local diseases. Therapies, treatment protocols and vaccines have been developed over time by many salmon producing countries to deal with specific diseases. Due to the different conditions in Tasmania, not all of these can be used here. The Australian industry, with the support of FRDC is investing significant time and resources to developing new, more locally appropriate treatment protocols and medicines such as vaccines.

Consequently, when comparing the disease management status of the local industry it is more realistic to compare it to that of the Northern Hemisphere in the mid-late eighties, when the industry in countries like Norway and Scotland were first dealing with new health challenges. At that time their antibiotic usage was higher than it is now.

Annual antibiotic usage (kg) for selected antibiotics and salmonid production ('000 tonnes)

	Norway		Scotland	Chile	Tasmania				
	1987	2005	2005	2005	2004	2005	2006	2007	2008
Annual Salmonid Production ('000 Tonnes)	46	586	129	374	14.6	18.4	22.4	24.0	26.1
Amoxycillin								550	
Chlortetracycline						12	39		
Fenbendazole			1						
Florfenicol		202	10					2	1
Flumequine		28							
Oxolinic acid		977			142				
Oxytetracycline		8	1,654		790	845	4,453	8,665	3,831
Trimethoprim					64	21	44	78	165
Tylosin									10
Total Antibiotics Used (kg)	5000	1,215	1,654	133,800	996	878	4,536	9,295	4,007
Antibiotics (kg)/ tonne production	0.92	0.0021	0.0128	0.3577	0.0680	0.0477	0.2023	0.3873	0.1531

Data for Norway (data from FAO), Scotland (production data from FRS, antibiotic data from SEPA) and Tasmania (2003-8) (data from Tas DPIW). Data for Chile 2005 is only available as total antibiotic usage (Bravo, 2005 and FAO).

Another reason that the levels appear particularly high is that the main antibiotic prescribed for use in treatment of salmon in Tasmania is oxytetracycline (OTC). OTC is generally prescribed at a higher dosage rate than many other antibiotics and therefore total amounts administered will be higher for the same level of response (efficacy).

How are antibiotics given to fish?

If treatment is needed, farmed fish receive the antibiotic via a medicated feed. Individual fish only ingest a small proportion of the total amount administered to the population. The remainder breaks down in the environment – see over *What happens to antibiotics in the environment?*

Are there antibiotic residues in salmon sold for human consumption?

All antibiotics are administered according to strict protocols that require specified withholding periods before the animals can be supplied for human consumption. The amount of residue present in the flesh of each fish following treatment decreases and breaks down over time. This correlates to the strict and conservative rules set by the Australian Pesticides and Veterinary Medicines Authority (APVMA) on withholding periods. The withholding period is the amount of time that must elapse before a fish can be harvested. To ensure compliance, fish that have been treated are tested prior to being harvested and are only harvested if they are within the levels of the FSANZ MRL standard.

How are chemical residues in food regulated?

The safety and performance of all chemicals that are used in food producing crops and animals are assessed by the APVMA to ensure that the health and safety of people is protected. As part of that assessment the APVMA also recommends a Maximum Residue Limit (MRL) for each chemical and a withholding period that must be observed before the product can be harvested. No product is registered unless these levels are safe for people. Food Standards Australia New Zealand (FSANZ) considers the MRL in its legislation and monitoring program.

Who monitors residues?

FSANZ and other government agencies in Australia and New Zealand monitor the food supply to ensure that it is safe, and that foods comply with standards for microbiological contaminants, pesticide residue limits and chemical contamination. FSANZ has a Bi-National Surveillance and Enforcement Strategy which allows food/health agencies in Australia and New Zealand to discuss and share information about monitoring and surveillance of the food chain in Australia and New Zealand. FSANZ acts as the central point for collection of food surveillance data from public health units in Australia and New Zealand. This data includes the results of general compliance testing, and specially targeted surveys conducted in the various jurisdictions.

What happens to antibiotics in the environment?

This depends on the antibiotic used. At present the main antibiotic used in caged salmon farming is oxytetracycline (OTC). Farmed salmon are fed carefully based on water temperatures and life-stage. Underwater cameras are used to continuously monitor feed uptake, and subsequently very little feed is lost to the environment. It is highly soluble and consequently any that is not assimilated by the fish will be excreted and disperse rapidly through the water column or settle in underlying sediments along with faecal material.

As part of the APVMA minor—use permit for OTC, if more than 500 kilograms is used at any one time, industry is required to undertake sampling and monitor residue levels in the area where the antibiotics were administered.

Are antibiotics administered for purposes other than treatment of disease (i.e. growth enhancement)?

No. In salmonid aquaculture antibiotics can only be administered under veterinary prescription and this must be accompanied by a clearly defined diagnosis and treatment recommendation.

ANTIFOULANTS

What the report found

Antifoulants are used by the Tasmanian salmonid aquaculture industry. The primary antifoulants used by the Tasmanian salmonid industry are copper and zinc based. The antifoulant organotin tributylin (TBT) has never been used in Australia on aquaculture cages and is banned internationally as a marine antifoulant. The industry continues to monitor and assess alternative antifoulant products and technologies as they become available, but to date, copper based paints remain the most effective products.

Why are antifoulants needed?

As with antibiotics the main need for antifoulants is to ensure the health and well being of the farmed stock. Fouling material (i.e. algae and epifauna such as sponges, sea squirts and similar colonising animals) reduces water movement through the nets. Good water flow is essential to ensure a continuous supply of clean, oxygenated water for the fish and to remove dissolved waste products. If water flow is reduced for any reason then the oxygen levels within the cage can be reduced causing significant stress to the fish and in severe cases, mortalities.

As with antibiotic usage the production conditions in Tasmania are different than those overseas. Water temperatures are generally higher here than in salmonid farming areas in the Northern Hemisphere. As a result, bio-fouling species in Australia tend to grow faster, particularly in summer, and therefore nets need to be replaced or treated more frequently. In addition, the amount of fish grown in each cage in Tasmania is less therefore more nets need to be treated and used.

What measures are being used to minimise impact?

As a result of these unique conditions and in order to minimise impacts on the environment, the industry has developed specialised handling techniques including shore based net washing and coating facilities to minimise losses to the environment in net cleaning and deployment. Furthermore there has been a transition in recent times to lower strength antifouling products.

How much antifoulants were used?

Total copper oxide antifouling use for Tasmania. Figures for Tasmania 2005-2008 based on volume of paint applied per annum, sourced from industry reports.

Year	KG Copper Oxide used	Production (t)	Kg Copper oxide /tonne fish produced
2005	61,439	18,403	3.34
2006	33,923	22,417	1.51
2007	42,958	23,982	1.79
2008	42,674	26,172	1.63

Estimates of total copper (I) oxide used in Tasmania for 2008 are based on mass balance calculations conducted by industry (Cameron Dalgleish, pers. comm.). For the purposes of this table it is assumed copper oxide = copper (I) oxide, or Cu_2O. Annual production values (t) from FRS, 2007 and Tasmania from DPIW.

What are the potential effects of antifoulants on human health?

None. There is no evidence of health impacts in humans as a result of eating farmed fish and the use of antifoulants on the farm. Independent testing of levels in fish both within and around the cages and of shellfish in the vicinity of the farmed cages indicated that copper concentrations were well within levels set by APVMA and FSANZ. In addition as part of export and quality control conditions all farmed fish are routinely tested for the presence of any contaminant.

How much antifoulant residue was left in the environment?

The project did not specifically quantify the amount of antifoulants left in the environment. Some initial tests from industry indicate that approximately 57% of the active ingredient (copper) is retained on the net of the), 22% is lost during net washing on land and 21% ends up in the marine environment. Of the 21% in the marine environment it is estimated that half disperses in the water column and the rest becomes stored in the sediment. Further research is being done to verify these findings.

What are the potential effects of antifoulants on the environment?

The main concern with the use of antifoulants is copper accumulation in the local sediments and associated effects on non-target organisms and benthic processes. Copper does not break down in the environment and therefore the only way it can be removed is by dispersal, either through physical processes, or by uptake and export in animals and plants.

The industry holds an APVMA permit to conduct research into the use of antifoulants and to monitor copper levels in the environment. Industry recognises that more work needs to be done to understand the impacts on sediment processes. As part of the meetings undertaken for this project, a plan was developed and industry have committed to undertake targeted activities to address key risk areas and knowledge gaps identified in the report.

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More information on antibiotics and antifoulants is available in the full report “A review of the ecological impacts of selected antibiotics and antifoulants currently used in the Tasmanian salmonid farming industry” - project number 2007/246 on the FRDC website.

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