

Program Achievement Report

Food Safety 2010-11



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Executive Summary

The Food Safety Program arises from the Meat Industry Strategic Plan, which identifies the need to ensure market access. The program supports the activities of SAFEMEAT, the primary role of which is to oversee and promote management systems that will deliver safe and hygienic product to the marketplace.

The SAFEMEAT strategy is mirrored in Meat and Livestock Australia's (MLA) objective to enhance product integrity, which has three research-oriented subprograms, which, in this document are collectively called the Food Safety Program. Those three areas of work are:

- Microbiological food safety
- Biotechnology
- Risk-based post mortem inspection

The R&D-oriented component can be divided into two types of activities:

- The use of scientific approaches to understanding food-safety risks
- The development of systems and new technologies to manage identified risks

The Food Safety Program focuses on communicating knowledge about food safety risks in the red meat supply chain, and their control, so that industry, regulators and the marketplace worldwide are aware and satisfied that risks are understood and are being controlled effectively. The communications components ensure that the high level of food safety of Australian meat is acknowledged. Overseas offices, websites with a focus on food safety, and materials for industry/regulator use (brochures, CDs, etc.) are all key communication channels.

The industry's food safety reputation has been strengthened by the publication of the many scientific papers and presentations given to food industry and food safety conferences in Australia and USA. The understanding and acknowledgement of our food safety record by scientists is important for forming public opinion and shaping government policy.

Major outcomes resulting from the food safety program over the past twelve months have been made available to the industry.

Scientific information and advice has helped FSANZ to come to the conclusion that there are no uncontrolled risks in the red meat supply chain. We will continue to support FSANZ as they develop the new meat *Primary Production and Processing Standard*.

A system that allows processors to benchmark their carcass hygiene data against national norms is being trialled with 48 export processors across the country. For the first time, this allows processors to determine (on a monthly basis) how their performance compares to other exporters and whether change to their process is necessary to maintain Australia's levels of safety and quality.

A survey of cattle faeces at the time of slaughter has indicated that the likelihood of finding highly pathogenic strains of *E. coli* in Australian beef is very low, which is good news for the international trade in manufacturing beef to the USA, where these 'non-O157' strains have figured prominently in the news media during 2010.

Considerable advice has been provided to industry, AQIS and customers over the past year on control and testing of *E. coli* O157 to reduce the risk of product rejection in the USA (i.e. US regulatory testing) and maintain confidence.

Research has validated the knowledge of the Australian industry, that with attention to slaughter conditions, hygiene and good cold chain management, both beef and lamb can reach shelf-lives that were previously unimaginable.

A project which investigated the inspection of lymph nodes during post mortem inspection procedures found that a substantial proportion of nodes contained high levels of bacteria, with indications of the presence of food-borne pathogens. Changes in post mortem inspection practices for tuberculosis have been approved by the United States, in part because the changed practices will result in a lower likelihood of meat being contaminated with pathogenic bacteria. The reduced post-mortem inspection will save Australian processors \$5-6m per annum.

1. Reason for Being

The Food Safety Program arises from the Meat Industry Strategic Plan¹, which identifies market access as a strategic theme. Meat and Livestock Australia is required to incorporate MISP strategic themes into its own strategic planning and for the food safety area this requirement is met through the SAFEMEAT food safety program. The MLA program therefore supports the activities of SAFEMEAT, the primary role of which is to oversee and promote management systems that will deliver safe and hygienic product to the marketplace.²

The MISP does not have a section which addresses food safety specifically, which is seen to reflect the absence of market access failures relating to food safety and the maturity of the industry in incorporating food safety issues as a component of everyday business. In addition to the strategic theme of market access, almost all of the strategic themes of the MISP have relevance to the food safety program.

¹ The Red Meat Advisory Council (RMAC) was formed in 1998 as a single industry touch-point for the Federal Government when dealing with cross-sectoral matters. RMAC comprises a membership of five Peak Industry Councils: Cattle Council of Australia, Sheepmeat Council of Australia, Australian Lot Feeders' Association, Australian Livestock Exporters' Council and Australian Meat Industry Council. The Goat Industry Council of Australia also maintains a link, but not as a member. Red-Meat Industry Strategic Plan, 2010-2015
http://www.rmac.com.au/strategic_plan.html

² SAFEMEAT is a partnership between the Australian meat and livestock industry and State and Federal governments. SAFEMEAT's primary role is to oversee and promote sound management systems. SAFEMEAT also initiates R&D projects, particularly in relation to microbiology and food-borne pathogens and examines emerging issues, such as gene technology, that could have an impact on the red meat industry at some point in the future.

2. Program Overview

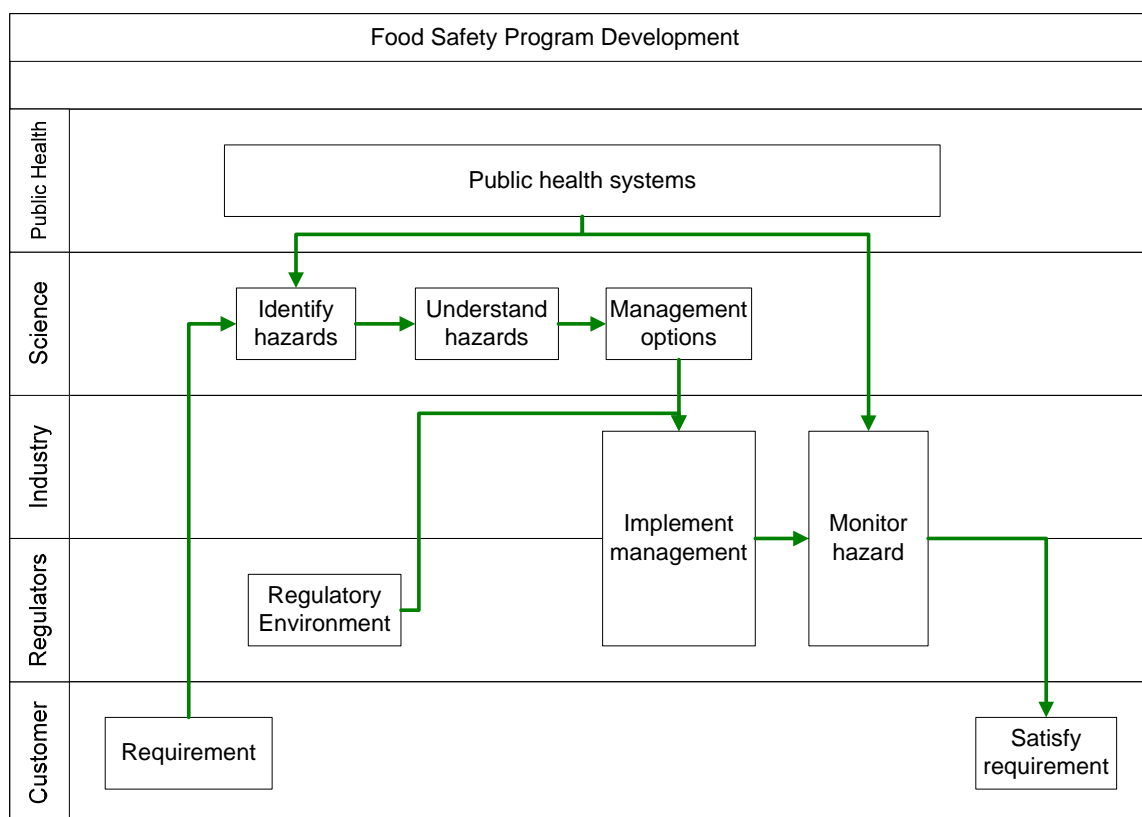
The SAFEMEAT strategy is mirrored in MLA's Objective to Enhance Product Integrity, which has three research-oriented subprograms, which, in this document are collectively called the Food Safety Program. Those three areas of work are:

- Food safety
- Biotechnology
- Risk-based post mortem inspection

The *R&D-oriented component* can be divided into three areas of work:

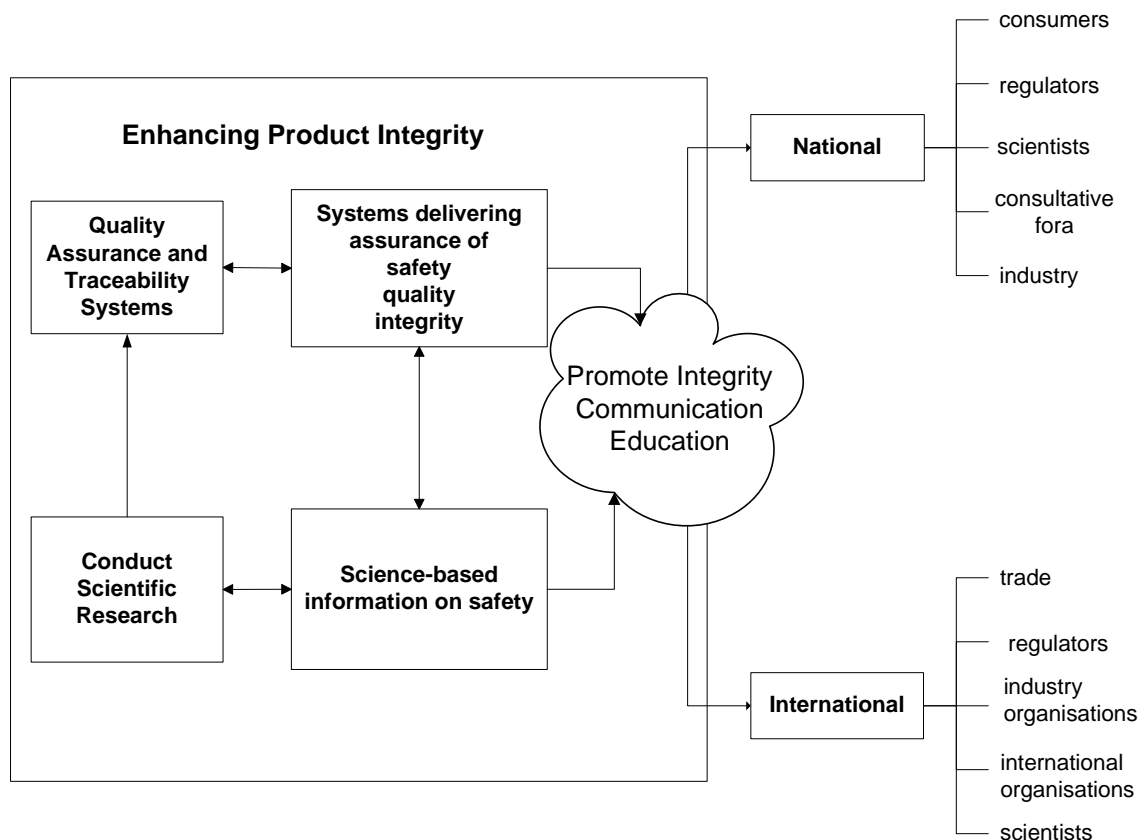
- The use of scientific approaches to understanding food-safety risks
- The development of systems and new technologies to manage those risks.
- The development and dissemination of information relating to risk management

The R&D is conducted within the framework of satisfying the expectations of customers (whether they be countries, companies or consumers). The needs may be expressed by customers, in which case there is usually a short-term need to satisfy the expectation. On the other hand, it is also the role of the program to anticipate future expectations, and to provide the scientific basis for meeting future expectations. The diagram below shows how the components of the science program interact with customers and the major stakeholder groups.



Model for the cooperation of science providers, regulators, public health systems and industry in meeting customer requirements through the work of the food safety program

The Food Safety Program focuses on communicating knowledge about food safety risks in the red meat supply chain, and their control, so that industry, regulators and the marketplace worldwide are aware and satisfied that risks are understood and are being controlled effectively. The communications components ensure that the high level of food safety of Australian meat is acknowledged. Overseas offices, websites with a focus on food safety, and materials for industry/regulator use (brochures, CDs, etc.) are all key communication channels. The work of the program is often transmitted to the target audience through other sub-programs within Meat Safety/Issues Management. The diagram below illustrates the linkages between the MLA components of the objective of Enhancing Product Integrity and its audiences.



How the science projects in the Food Safety Program lead to the development of systems to deliver safety, quality and integrity and are used to influence key stakeholders nationally and internationally.

3. Program Objectives

The overall objective of Enhancing Product Integrity, as expressed in MLA's Strategic Plan³, is to reduce the risk of a food safety incident, ensure that potentially affected product does not pass to consumers and to communicate the superior food safety systems used in Australia. The research-oriented subprograms conduct research and communicate findings to facilitate the adoption of risk-management strategies for the benefit of the Australian industry and consumers.

The activities of the Food Safety Program will thus assist in maintaining market access and demand for Australian meat, through influencing national and international stakeholder groups. The Program will also seek to achieve these objectives in a cost-effective manner. The methodologies used to achieve these outcomes are:

- **Science-based** – producing credible scientific data and information to support its strategies.
- **Risk-based** – concerned with addressing real food safety issues and the protection of public health.
- **Efficient and effective** – are economic for industry to implement

The following table describes the initiatives in the current MLA Annual Operating Plan (AOP)⁴.

Strategy	Initiatives within the food safety R&D program
Enhance the uptake of quality assurance systems by all sectors of the red meat supply chain	<ul style="list-style-type: none"> • Contribute to the development and implementation of new food safety systems
Conduct scientific research to ensure the food safety systems available in Australia are at the leading edge of international knowledge and practice	<ul style="list-style-type: none"> • Maintenance of safety and integrity aspects of product • Develop new techniques for delivering safe and wholesome product • Monitor developments/develop initiatives in biotechnology • Develop risk-based post mortem inspection systems for animal health surveillance, and assessment of product safety and suitability.
Promote the integrity of Australian red meat products to our international and domestic customers while minimising food safety related incidents	<ul style="list-style-type: none"> • Respond to market expectations for scientific information on the safety of red meat products

³ <http://www.mla.com.au/About-the-red-meat-industry/About-MLA/Company-overview/Corporate-documents>

⁴ <http://www.mla.com.au/About-the-red-meat-industry/About-MLA/Company-overview/Corporate-documents>

4. Key Performance Indicators

Achievement against KPIs in the MLA Annual Operating Plan (AOP) and the KPIs agreed with SAFEMEAT. Further information is given in the following sections.

	KPI	Progress to date	Further information
AOP KPIs	Maintain current level of microbiological performance as demonstrated through the ESAM database.	Continuing	Interrogation of the ESAM database has revealed higher Total Viable Counts (TVCs) and <i>E. coli</i> prevalence during 2010-11, compared with those determined over the period 2008-10. The object of the present study is to adduce possible reasons for this increase. See case study on page 27 for more detail.
	All potential market disruptions for red meat products avoided due to integrity of Australia's food safety systems	Achieved	No markets have been closed in the past year due to integrity concerns with Australian red meat products. However, representations have been made through the trade and/or official channels over rejections or concerns about product in several markets [USA, Japan, Korea, UAE] due to integrity concerns. Such incidents could easily spread to Australian product, in general, if it were not for confidence in our systems. The mid-term report from the microbiological baseline of Australian meat is confirming high processing standards, improvements in some areas in response to MLA projects, and suggesting areas for future work.
Program KPIs	Contributions are made to the development of the FSANZ Primary Production Processing Standards (PPPS) for meat	Achieved	FSANZ have made few requests in the past year and only small contributions have been made to the collation of data to support the regulatory impact analysis for the meat PPPS.
	Retail sector is encouraged to adopt practices to improve safety	Satisfactory progress	A document is being prepared, in conjunction with a retail butcher committee, to provide guidance on hygiene and HACCP in retail butchery. It is planned to involve trainers and regulators before the guidelines are finalised. The Guide is anticipated to become the industry standard as well as being accepted by authorities as a basis for acceptable practice, control and possibly, audit.

	KPI	Progress to date	Further information
	Data analysis tools are accepted through the processing sector for carcase hygiene data	Achieved	Favourable responses to the carcase hygiene reporting system have been obtained from processor QA Managers. We have also completed training sessions with QA Managers. We are now beginning to use these reports to assess wider industry problems.
	Predictive tools are implemented by smallgoods manufacturers and regulators that improve the safety of processed meats, and reduce the number of recalls of products for Listeria	Satisfactory progress	An industry workshop has been held and a publication has been produced explaining the safer formulation of smallgoods. Negotiations still need to occur with FSANZ and state regulators about how this approach can be implemented efficiently.
	New data are collected on pathogens and indicators through the supply chain	Satisfactory progress	The fourth national microbiological baseline study has been initiated and the first sampling window and been completed. A second sampling will occur in Winter/Spring. The information gathered is used to evaluate and update the benchmark for national meat hygiene and safety. The mid-term report from the microbiological baseline of Australian meat is confirming high processing standards, improvements in some areas in response to MLA projects, and suggesting areas for future work.
	Risks to public health and market access for red meat products are minimised through adoption of efficient, risk-based approaches to management	Satisfactory progress	Publications have appeared or are in press on low prevalence of pathogenic E. coli in Australian beef (including the non-O157 STECs) and on low level of contamination even when it is detected. Work continues to develop a better understanding on the relationship between testing and risk management. Discussions have been held with US industry on approaches to testing.
	Risk of project rejection (due to contamination of ground beef components) is efficiently managed by processors/exporters.	Achieved	The food safety program continues to maintain a watching brief and consultation with stakeholders. Further work may be required to defend Australia's position. Discussions with the E. coli panel continue.
	Shelf-life models and information package is developed to assist	Satisfactory progress	Practical tools which will allow manufacturers to assess their product are being developed and the way in which these models can be used by

	KPI	Progress to date	Further information
	supply chain manage shelf-life issues.		industry and regulators are being trialled. A user panel has been established to guide development. A publication is in preparation.
	Shelf-life is managed through processor and supply chain interventions.	Satisfactory progress	Discussion with supply chains (particularly into the Middle East and Japan) and customers/ governments continue to find better ways of managing shelf-life and restrictive microbiological criteria for product.
	Low risk of Australian sheep for C. difficile is communicated	Slow progress	Further work is being conducted on the prevalence and concentration of Clostridium difficile in Australian sheep flocks, along with assessing the risk of food borne transmission. Once this work is complete a scientific publication will be generated.
	Risk assessment approach for animal diseases as they relate to food safety is deployed in animal health agencies	Achieved	A 'Risk Assessment Framework for animal diseases' as they relate to food safety has been developed. The framework has been submitted to SAFEMEAT for adoption as a contingency tool to guide scientific discussions feeding into the SAFEMEAT Incident Control Plan.
	Scientific developments in meat food safety are monitored and assessed for significance to the Australian industry	Achieved	We continue to scan industry and scientific literature for significant items and meet with a group of scientists to assess the research program and our preparedness to deal with future issues.
	Contribute to the animal health electronic information capture (AHA) working group	Achieved	We have continued liaison with Animal Health Australia on the links between post mortem inspection and animal health data.
	Establish effective and efficient approaches to risk-based post-mortem inspection	Satisfactory progress	An investigation of cancer condemnations has commenced. Further work on Cysticercus bovis and diagnostics is underway. Consultation with scientists, processors and AQIS is developing a more rounded program of work.
	SAFEMEAT is kept informed of developments in biotechnology	Achieved	Gene Technology E-bulletins continue to be produced and periodic assessment of the status of cloning is also made.

	KPI	Progress to date	Further information
	Red Meat industry position on antimicrobial resistance is communicated	Slow progress	A review publication has been planned and discussions are underway to draft the review.

5. Activities and outputs

The table below indicates, for each target group, the kinds of activities and the nature of the activities conducted, either directly by the MLA staff working on the Food Safety R&D Program, or by the scientists who work most closely with the program.

Communication, education and promotion of food safety and integrity

Arena	Group	Activity	Nature of interaction
NATIONAL	Consumers	Website information	MLA's consumer website , www.themainmeal.com.au , is used as a way of communicating specific meat safety messaged to consumers. The Q&A section is updated in response to consumer concerns.
		Food safety brochures	Thousands of copies distributed each year, particularly to child care centres, schools, hospitals and community care organizations.
		HGP Brochure	The HGP brochure is used to explain HGP usage to consumers.
	Regulators	FSANZ PPPS Meat risk assessment	Contribution of information and the opportunity to review FSANZ risk assessment outside the confines of the public consultation process
		National Association of Testing Authorities, Biological Testing Accreditation Advisory Committee	Providing advice to NATA on the accreditation of laboratories, which includes laboratories conducting microbiological tests for AQSI programs and meat export.
	Scientists	Australian Association for Food Protection	A professional association, where the position of the Australian industry as technically competent is communicated.
		National Measurement Institute	An advisory committee provides access to the international metrological community,
		Invited guest lecturer in postgraduate veterinary courses	Opportunity to communicate that the Australian meat industry is a responsible corporate citizen, that it is technologically advanced and provides opportunities for careers.
		Food Safety Centre	Stay abreast of international developments and an opportunity to develop informed spokespeople
		Australian Society for Microbiology	A professional association, where the position of the Australian industry as technically competent is communicated.
		Australian Institute of Food Science and Technology	A professional association, where the position of the Australian industry as technically competent is communicated.
	Consultative	SAFEMEAT	An opportunity to regularly update all red meat industry sector

			participants on the progress of the program.
NATIONAL	Consultative (continued)	Export Meat Industry Advisory Committee	Provides an opportunity to gain agreement between export processors and AQIS on the application of MLA research to the industry. Sometimes responsive projects are developed
		Food Chain Assurance Advisory Group	This group is run by DAFF as part of Critical Infrastructure Protection and food defence/security. It is an opportunity to measure existing systems against emerging threats.
	Industry	MINTRAC- QA Network, speaker	About 12 presentations were given in the past year to industry QA Managers in all states on shelf-life research and on relating risk to microbiological specifications. Also an opportunity to learn about industry needs.
		MINTRAC QA MI Conference	This popular conference for industry QA Managers and trainers was an opportunity to share R&D relating to E. coli test methods, particularly new methods likely to be introduced to the industry in the near future..
		MLA publications	Contribution to articles in MLA's magazine, feedback, on role of the program in managing technical trade issues.
		Meat Industry Services	Meat Industry Services, operated by CSIRO, has published a Meat Technology Update on controlling contamination of beef carcasses during dressing.
		Enquiry services	MLA provides an enquiry service for processors, exporters, customers, regulators etc. who require technical information on the safety of meat.
		E. coli panel	MLA runs an E. coli expert panel to interact with stakeholders on this important issue. MLA also provides advice to AQIS and AMIC in dealing with their own interests in this area.
		Listeria panel	MLA runs a Listeria expert panel that is an interaction between stakeholders seeking to trial and implement new approaches to Listeria control in our regulatory environment. A major publication came from this panel process and a workshop was held to brief stakeholders on new approaches to controlling Listeria.
		Standards Australia, member of committees	Australian Standards for food safety systems, analysis of food, microbiological methods.

INTERNATIONAL	Trade	Working relationship with American Meat Institute, National Cattlemens Beef Association, National Meat Association	The Beef Industry Food Safety Council held an invitation only meeting to discuss test methods for non-O157 E. coli and MLA was invited to attend and make a presentation. This was a good opportunity to have input into policy development.
		Enquiry services	Enquiries are often directed through MLA regional offices to provide information, or technical support, on trade enquiries
	Regulators	Australia's position at Codex Alimentarius	Reviewing the development of Codex documents, which are a basis for international trade, to ensure that they reflect Australia's approach to meat safety. Particular attention is being paid to documents on microbiological criteria for foods and to guides on control of parasites in the supply chain.
		Opportunity to input into Australia's position at OIE	Reviewing the development of documents to ensure that they do not impinge negatively on Australia's meat safety approach.
National food control systems		Opportunities, through MLA regional offices, to make technical representations to assist in policy development relating to Australian meat products.	
INTERNATIONAL	Regulators (continued)		
	Industry organizations	International Standards Organisation- SO standards and working groups	Opportunity to comment on the development of International Standards, including participation on working groups, and obtaining advance notice of standards being developed.
	International organizations	International Association for Food Protection (IAFP), member	A professional association, where the position of the Australian industry as technically competent is communicated.
		International Commission on Microbiological Specifications for Foods	Scientists close to MLA are members of this group which is the leading international scientific food safety influencer.
		Consultants to FAO/WHO	A number of scientists close to MLA work as consultants for the FAO/WHO food safety program.
		FAO/WHO Joint Expert Meetings on Risk Assessment (JEMRA)	Several scientists close to MLA are on the roster of experts for JEMRA.
	Scientists	Reviewer for International Journal of Food Microbiology	The IJFM is one of the leading food safety journals internationally, and MLA staff are frequently asked to peer review papers prior to publication.

		Editorial Board, Food Protection Trends	MLA staff have been invited to be members of this IAFP journal. It provides international recognition for the Australian industry.
		Invited speaker, international conferences	MLA staff and scientists working closely with MLA are frequently invited to be keynote and major speakers at international conferences (see details below)
		Publications and conferences	See details below

Communication to scientists and technologists, both nationally and internationally holds a critical place in the strategy of the food safety program. There is a demand within government for risk-based and science-based transparent regulation with demonstrated cost-benefit. Communication through the scientific literature in peer-reviewed publications makes this information available to governments over a long period of time. It also influences scientific/technological thinking about meat safety and risk management.

Below is a list of publications and presentations that either are a direct result of food safety R&D program funding, or contain results or benefit relating to the food safety program from personnel funded indirectly.

Abstracts

- Ward, M.P., Jane Heller. *E.coli* colonization and shedding in cattle. *Australian College of Veterinary Scientists Science Week*, 30 June – 2 July, 2011

Scientific/Technical Publications.

Risk Assessment and Risk Management

- Sumner, J., Jenson, I., Kiermeier, A. (2011). Verification of hygiene in Australian manufacturing beef processing - Focus on *Escherichia coli* O157. *Food Protection Trends* (in press).
- Seager, T., Tamplin, M., Lorimer, M., Jenson, I. and Sumner, J. (2010). How effective is sponge sampling for removing bacteria from beef carcasses? *Food Protection Trends* 30:336-339.
- Kiermeier A., Mellor G.E., Barlow R.S., Jenson I. (2011) *Assumptions of acceptance sampling and the implications for lot contamination: Escherichia coli O157 in lots of Australian manufacturing beef. Journal of Food Protection* 74:539-544.
- Ross, T and Tamplin, ML. (2011) Stochastic modelling of environmental survival of *E. coli* and changes in risk to public health. 1st International One Health Congress, 14-16 February 2011, Melbourne, Australia.

Animal Disease relating to food safety

- O'Connor, A.M., Sargeant, J.M., Gardner, I.A., Dickson, J.S., Torrence M.E., Dewey, C.E., Dohoo, I.R., Evans, R.B., Gray, J.T., Greiner, M., Keefe, G., Lefebvre, S.L., Morley, P.S., Ramirez, A., Sisco, W., Smith, D.R., Snedeker, K., Sofos, J., Ward, M.P., Wills, R. (2010) The REFLECT statement: Methods and processes of creating Reporting guidelines for randomized control trials for livestock and food safety. Journal of Food Protection; 73: 132–139; Journal of Veterinary Internal Medicine, (2010) 24: 57–64; Preventive Veterinary Medicine, 2010; 93: 11–18; Journal of Swine Health and Production, 2010; 18: 18–26; Zoonoses and Public Health, 2010; 57: 95–104.
- Mild, R.M., Cooper, M.A., Ward, M.P., Armstrong, A.E., Griggs, L.A., Cooper, K.K., Marchello, J.A., Duff, G.C., Law, B.F., Joens, L.A. (2010) A longitudinal study of *Campylobacter jejuni* infection in beef cattle and their environment. *Foodborne Pathogens and Disease*, in review.
- Webber JJ, Dobrenov B, Lloyd J and Jordan D. (2011) Meat inspection in the Australian red-meat industries – past, present and future, *Australian Veterinary Journal*, submitted.
- Benjamin L.A., Fosgate, G.T. Ward, M.P., Roussel, A.J., Feagin, R.A. (2010) Attitudes towards biosecurity practices relevant to Johne's disease control on beef cattle farms. Preventive Veterinary Medicine, 94: 222–230.
- Reddacliff LA, Marsh IB, Fell SA, Austin SL and Whittington RJ (2010) Isolation of *Mycobacterium avium* subspecies paratuberculosis from muscle and peripheral lymph nodes using acid-pepsin digest prior to BACTEC culture. *Veterinary Microbiology*, 145 (1-2):122-8.

Understanding the behaviour of foodborne hazards

- Barlow, R.S. and Mellor, E.A. (2010) Prevalence of enterohemorrhagic *Escherichia coli* serotypes in Australian beef cattle. *Foodborne Pathogens and Disease* 7:1239-1245.
- Duffy, L.L., Small, A. and Fegan, N. (2010) Concentration and prevalence of *Escherichia coli* O157 and *Salmonella* in sheep during slaughter at two Australian abattoirs. *Australian Veterinary Journal* 88:399-404
- Eglezos, S and G.A. Dykes. (2011) Application of heat in postcook meat chillers reduces *Listeria*. *Journal of Food Protection* 74(6):999-1002
- Zulfakar, S, White, J and Tamplin, ML. (2011) Bacterial Attachment to Muscle Extracellular Matrix Proteins. *Australian Society of Microbiology*, July 2011, Hobart, Tasmania.
- Zhang, D, McQuestin, O, Mellefont, LA, Ross, T and Tamplin, ML. (2010) The Influence of Non-lethal Temperature on the Rate of Inactivation of Vegetative Bacteria in Inimical Environments may be Independent of Bacterial Specie. *Proceedings of the Food Protection Annual Meeting*, 1-4 August 2010, Anaheim, California

Control of hazards and product quality

- Sumner, J., Jenson, I., and Phillips, D. (2011). Microbiology of retail ground beef at the production level. *Food Australia* 66:251-253.
- Sumner, J. and Jenson, I. (2011) The effect of storage temperature on shelf life of vacuum-packed lamb shoulders. *foodAustralia* 66:249-251.
- Tamplin, ML, Small, A, Peddell, S, McQuestin, O, Porteus, BF, O'Callaghan, D, Sumner, JL and Jensen, I. (2010) Evaluation of a Predictive Model for Total Viable and Lactic Acid Bacteria on Refrigerated Vacuum-Packed Beef Primals. Proceedings of the Annual Meeting of the International Association of Food Protection, 1-4 August 2010, Anaheim, California.
- McMeekin, TA and Hill, C and Wagner, M and Dahl, A and Ross, T, (2010) 'Ecophysiology of food-borne pathogens: Essential knowledge to improve food safety', *International Journal of Food Microbiology*, 139 (Supplement 1) pp. S64-S78. ISSN 0168-1605.
- Zhang, D and Ross, T and Bowman, JP, (2010) 'Physiological aspects of *Listeria monocytogenes* during inactivation accelerated by mild temperatures and otherwise non-growth permissive acidic and hyperosmotic conditions', *International Journal of Food Microbiology*, 141 (3) pp. 177-185. ISSN 0168-1605
- Mejlholm, O, Gunvig, A, Borggaard, C, Iom-Hansen, J, Mellefont, LA, Ross, T, Leroi, F, Else, T, Visser, D* and Dalgaard, P, (2010) 'Predicting growth rates and growth boundary of *Listeria monocytogenes* - An international validation study with focus on processed and ready-to-eat meat and seafood', *International Journal of Food Microbiology*, 141 (3) pp. 137-150. ISSN 0168-1605.
- Ross T (2011). Stochastic Modelling of Environmental Survival of *E. coli* and Changes in Risk to Public Health. *Ecohealth*, 7: S102-S102
- Porteus B, Kocharunchitt C, Nilsson RE, Kocharunchitt, C and Ross, T. (2011) Utility of gel-free, label-free shotgun proteomics approaches to investigate microorganisms *Applied Microbiology and Biotechnology*, 90: 407-416

Conference Presentations

- Eglezos, S. (2011) "Reducing *Listeria* in the food processing environment" EML Queensland. *Listeria* Symposium, Sydney, June 10th, 2011.
- Fegan, N. (2010) Understanding food safety concerns associated with *E. coli* in red meat production. International Conference on Food Safety and Food Security, 1-2nd December, Universitas Gadjah Mada, Yogyakarta, Indonesia (keynote speaker)
- Barlow, R.S. (2011) Recent advances in pathogenic *E. coli*. AMPC Advancing The Future for Meat Processing through Engineering, Research, Efficiency and Sustainability, 9-10th June, Sebel Albert Park, Melbourne, Australia (invited presentation)
- Barlow, R. S. (2011) Prevalence of enterohaemorrhagic *Escherichia coli* serotypes in Australian beef cattle. Australian Food Science Summer School, 9-11th February, University of Queensland, Brisbane, Australia (invited presentation)
- Barlow, R. S., Mellor, G. and Fegan, N. (2011) Prevalence of enterohaemorrhagic *Escherichia coli* serotypes in Australian beef cattle. 12th Government Food Analysts Conference, 22-24th March, Health and Food Sciences Precinct, Brisbane, Australia (poster)
- King, T., Lucchini, S., Hinton, J.C.D. and Gobijs, K.S. (2011) Transcriptomic analysis of exposure to inorganic and organic acids reveals acidulant- and strain-specific acid tolerance responses. Australian Food Science Summer School, 9-11th February, University of Queensland, Brisbane, Australia (poster)

- Mellor, G. and Barlow, R. (2010) Prevalence and characterisation of atypical Enteropathogenic *Escherichia coli* in Australian beef cattle. 51st Australian Society for Microbiology Conference, 4-8th July, Sydney, Australia (poster)
- Mellor, G. and Barlow, R. (2011) Prevalence and characterisation of atypical Enteropathogenic *Escherichia coli* in Australian beef cattle. Australian Food Science Summer School, 9-11th February, University of Queensland, Brisbane, Australia (poster)
- Mellor, G. and Barlow, R. (2011) Prevalence and characterisation of atypical Enteropathogenic *Escherichia coli* in Australian beef cattle. 12th Government Food Analysts Conference, 22-24th March, Health and Food Sciences Precinct, Brisbane, Australia (poster)
- Jordan D. Evolution to a risk-based meat inspection system. Australian Veterinary Association Conference, Adelaide, May 2011.
- Ross, T. (2010). *Listeria monocytogenes*: behaviour in foods. Presentation to Listeria Summit, Sydney, Feb 2010, organised by New South Wales Food Authority.
- Ross, T. (2010). Inactivation kinetics of vegetative pathogens in food fermentations. Presentation to Institute for Food Technology Annual Meeting and Food Expo, Chicago, July 2010.
- Ross, T. (2010). Modelling microbial ecology in food safety risk assessment: *how much detail is needed?* Invited Keynote presentation to FoodMicro 2010, Copenhagen, August 2010.
- Ross, T. (2011). Risk Assessment: Spanning the Chasm between regulation and Regulations? Invited presentation to Danish Microbiological Society Annual Meeting, Copenhagen, November, 2010.
- Ross, T (2010). Risks due to *Listeria monocytogenes* in processed meats. Listeria Symposium, Sydney, June 10th, 2011.
- Small, A. (2011) The Importance of Halal Slaughtering for Quality Meat. International Workshop on Halal Regulation and Standard for Slaughtering. Bogor, Indonesia April 18.
- Small, A, Sumner, J and Jenson, I (2010) Beef Carcase Hygiene in Queensland Australia – Where Hide Cleanliness May Not Be the Biggest Issue. ICoMST 2010, Jeju Island, Korea, August 15-20.
- M. Tamplin, A. Small, S. Peddell, O. McQuestin, B. Porteus, D. O’Callaghan, J. Sumner and I. Jenson (2010) Production and Validation of a Predictive Model for Total Viable and Lactic Acid Bacteria on Refrigerated Vacuum-Packed Beef Primals. IAFP 2010, Anaheim, California, August 1-4.
- Dalgaard, P. (2011) Predicting the growth of *Listeria monocytogenes* in processed meat, Listeria Symposium, Sydney, June 10th, 2011.
- Teichmann, L, Bonney, S. (2011) Process Control and Product Reformulation, Listeria Symposium, Sydney, June 10th, 2011.

MINTRAC network meeting presentations

- Small, A (2010) Improving process hygiene – where next? (Adelaide and Tamworth)
- Small, A (2010) Reducing Carcase Contamination - is Hide Washing one of the Answers? (Melbourne, Wagga, Brisbane, Perth)

Industry publications – Meat Technology Updates:

- Covered anaerobic ponds – October 2010
- Sources of contamination on beef carcasses during dressing – November 2010
- Effect of slaughter method on animal welfare and meat quality – January 2011
- Heat toughening – Part 1: Effect of heat toughening on quality of beef, and the incidence in Australia – March 2011

- Heat toughening – Part 2: Strategies for reducing the incidence of heat toughening in beef carcasses – May 2011

Measurement: towards impact

Many of the foregoing activities can be considered to be:

- Inputs- activities conducted as part of running the program
- Outputs- the product of program activities

However, there are some 'higher order' activities that are indicators that program outcomes (i.e. leadership and influence) are being achieved:

- Invitations to address international conferences
- Opportunities to write reviews and 'opinion' articles in international journals
- Invitations to join international groups

It is difficult, however, to measure the extent to which the outputs and early outcome indicators, influence decision-making by other parties, especially on an international basis.

6. National Research Priorities & Rural Research Priorities

6.1 National research priorities

Promoting and maintaining good health.

The Food Safety R&D Program contributes to good health by providing a scientific basis for improving the safety of the Australian red meat supply. The two groups identified in this priority, the young and the ageing, are amongst those groups most susceptible to food-borne diseases. Prevention of illness is the aim of Food Safety R&D. Research provides the industry with tools to ensure that contaminated meat does not reach consumers. A consumer-oriented website and other materials educate consumers and food-service workers in safe food handling in an effort to reduce an estimated 5 million cases of food-borne infectious illness occurring annually in Australia.

Frontier technologies.

The Food Safety R&D Program maintains a component of scientific breakthrough research. Areas have included quantitative microbial risk assessment and predictive microbiology. Currently, projects in bacterial physiology and genomics directed to control of food-borne pathogens aim to provide the next breakthroughs. New technologies are always under consideration for application in the meat industry. Scientific contractors are actively involved in international scientific endeavours and building up their own local research groups.

6.2 Rural research priorities

Improving the productivity and profitability of existing industries.

The Food Safety R&D Program has a very clear focus on providing a sound scientific basis for continued development of quality systems within the Australian red meat industry. Providing a sound scientific basis for regulations allows the industry and regulators to control meat processing in a cost-effective way, by concentrating attention on the critical issues, and allowing the industry to innovate while maintaining food safety.

Understanding and responding to domestic and international market and consumer requirements.

MLA is leading or actively involved in a number of key initiatives designed to maintain and improve consumer confidence in the integrity of products produced by the beef and sheep meat industries based on sound science, risk analysis and the adoption and communication of research outcomes. The program also collects data that demonstrate the effectiveness of the Australian supply chain in producing quality products.

The sound scientific approach being taken to substantiate claims for market access is seen as a key factor for current and future market access. The Food Safety R&D Program develops information to support market access and also develops approaches to process validation and data collection and analysis to support future actions for technical market access.

Protecting Australia's community from biosecurity threats.

Threats in other countries are assessed and protocols for assessing their significance to Australia are part of the program's approach to pro-active management of food safety issues. Biosecurity is an approach that is relevant to ensuring that problems in overseas countries do not become established in Australia.

Improving the skills to undertake research and apply its findings.

Undergraduate training: The program works with students and processors to work on projects that have real benefit to the industry, thus giving both parties the opportunity to innovate and see the potential for further innovation within the industry.

Post-graduate training: MLA continues to support investment in post-graduate training with PhD and masters students currently supported through our post-graduate scholarship program and project-based support.

Researcher training: Funds are provided to support researchers to attend leading conferences to present their R&D results and to network with the world's leading scientists in this area.

Industry training: Workshops, network (professional development) meetings, and tools are provided to the industry to increase their knowledge and skills in doing their jobs but also to increase their ability to take up the results of research.

Promoting the developing of new and existing technologies

Researchers working on MLA projects are using cutting-edge proteomic and genomic technologies to provide an understanding of food safety issues and possibly find breakthroughs in food safety. We continue to keep the Australian industry ahead of the world in application of new ideas and approaches to food safety.

7. Triple Bottom Line

7.1 Economic Benefits

Economic benefits accrue, primarily, through the maintenance of Australia's trading position in the international marketplace and continued consumer confidence in the safety of red-meat products on the domestic market. Additionally, cost-effective solutions to food-safety problems ensure that profit margins are maintained.

7.2 Social Benefits

Helping to maintain the health of the nation and consumer confidence in a valuable source of nutrients is the major direct social benefit of the Food Safety R&D Program. Additional benefits accrue from the continued health of Australia's largest rural sector.

7.3 Environmental Benefits

There are no direct environmental benefits from the program.

8. Where to from here

MLA continues to seek opportunities to apply science to the development of food standards, regulations and approaches that may improve public health and ensure a continued favourable trading position for the industry.

The Food Safety R&D program will continue to concentrate on research, but will also increase its focus on communication and adoption activities. In research the food safety program will focus on three key areas: product, processes and systems. This may include creating new, or improving existing product, processes and systems in the red meat processing industry.

One significant change in direction of this iteration of the Food Safety R&D Program is an increased focus on communication of program outcomes with public health organisations and increasing the shared understanding of the significance of red meat in foodborne disease.

CASE STUDY: Elevated microbial counts on sheep and beef carcasses in 2010-11

Background

Interrogation of the ESAM database has revealed higher Total Viable Counts (TVCs) and *E. coli* prevalence during 2010-11, compared with those determined over the period 2008-10. The object of the present study is to adduce possible reasons for this increase.

Conduct of the study

An expert elicitation by the MLA Risk Management panel considered the elevated counts and concluded that they were probably linked with adverse rain events during 2010-11 in eastern Australia, manifested at the abattoir by increased contamination of hides and fleeces.

To test this hypothesis:

- Rainfall levels were monitored via the Bureau of Meteorology website.
- The ESAM database was interrogated over the period April 2007 through June 2011.
- TVCs and *E. coli* prevalence were plotted using R version 2.11.1 (R Development Core Team, 2010).

Results

Rainfall

In Figures 1 and 2 are presented rainfall anomalies for the periods July 2009-June 2010 and July 2010-June 2011, respectively. During the former period rainfall patterns did not vary significantly from long-term average for the area concerned, except in Western Australia and parts of the NSW seaboard, which were somewhat drier. By contrast, during July 2010-June 2011 Eastern Australia in general and Queensland in particular received significantly more rainfall than the long-term average, while Western Australia continued to be drier than normal.

Microbiological status of carcasses

A broad-brush approach to assessing the effect of rainfall was undertaken by comparing counts on sheep and on steers/heifer carcasses in WA against those in the rest of Australia. As indicated in the graphs on the following page, for both categories there were clear differences between trend lines on product from WA compared with the rest of Australia. For carcasses in WA the trend line was either flat or declined slightly over the period, while in the rest of Australia there was an abrupt upward trend beginning in mid-2010.

Conclusions

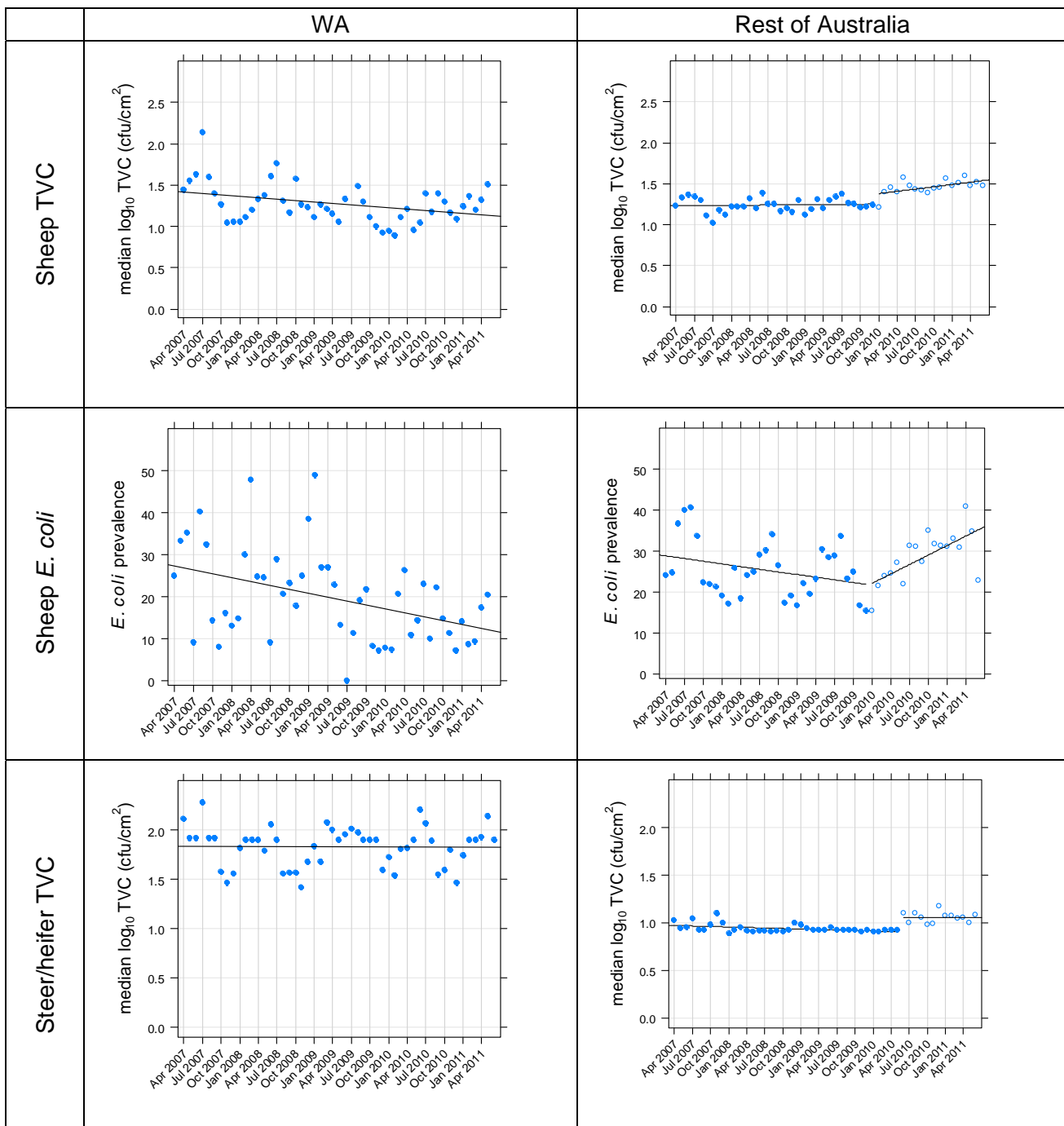
The present study provides evidence of a temporal alignment between microbiological counts on carcasses (ovine and bovine) and extreme rainfall events which occurred in eastern Australia during 2010-2011. Studies in Australia have shown that the condition of fleece¹ and hide² of animals presented for slaughter can present a “incoming problem” which exceeds the capacity of slaughter and dressing operations to maintain the usual hygienic status of the carcass.

¹ Kiermeier, A., Jenson, I. and Sumner, J. (2009) Tool to assist understanding of routine microbiological monitoring results of sheep carcasses. Food Protection Trends 29:428-434.

² Kiermeier, A., Bobbitt, J., Vanderlinde, P., Higgs, G., Pointon, A. and Sumner, J. (2006) Use of routine beef carcass *Escherichia coli* monitoring data to investigate the relationship between

hygiene status of incoming stock and processing efficiency. International Journal of Food Microbiology 111:263-269.

Monitoring of four year trends in microbiological parameters: by species and microbe



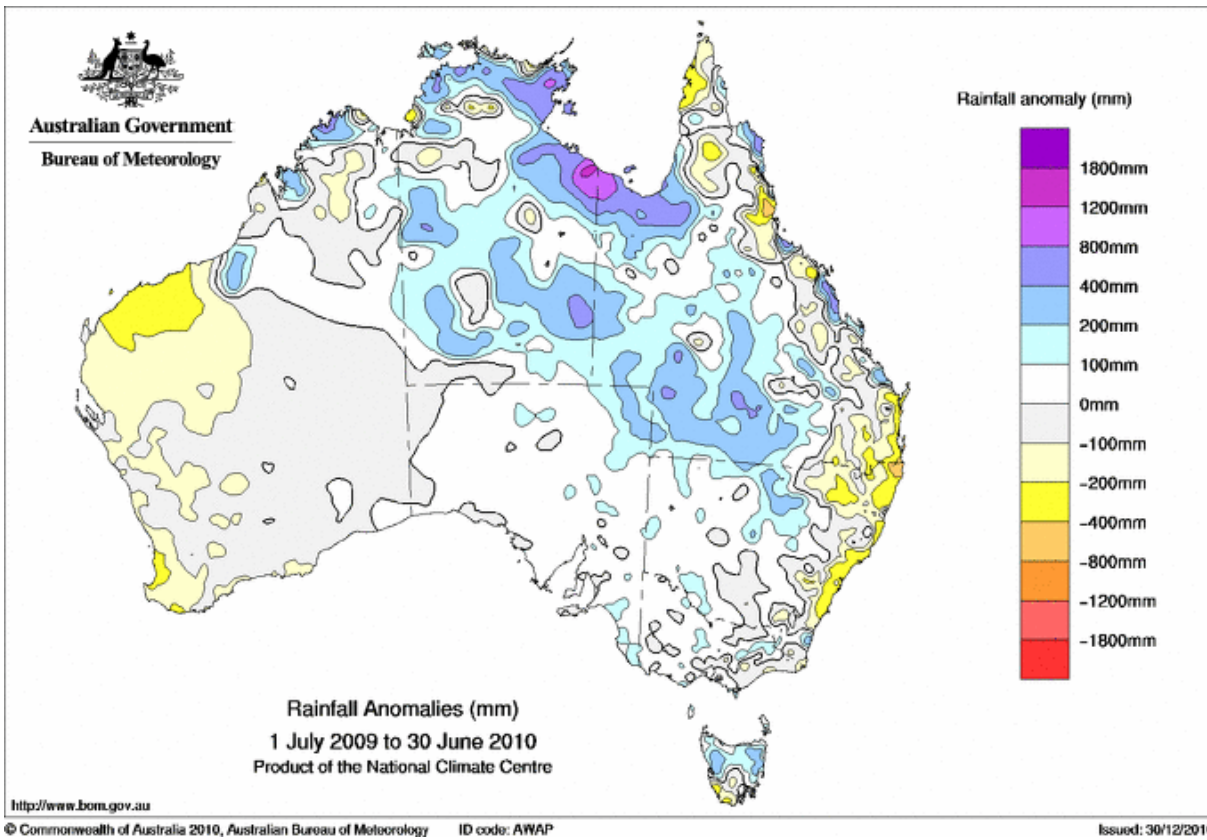
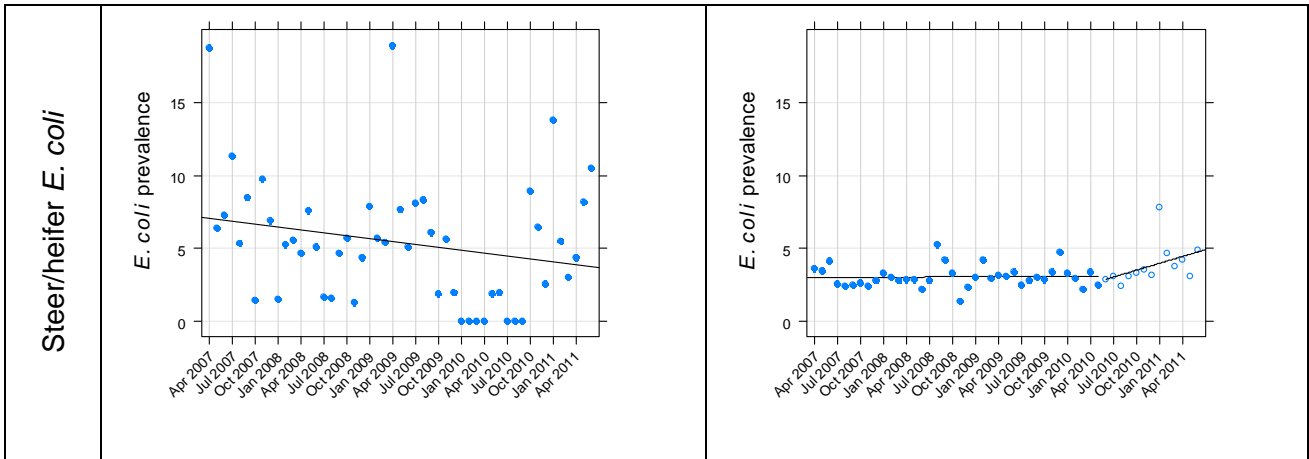


Figure 1: Rainfall anomalies (mm) for the period July 2009-June 2010 (Bureau of Meteorology, available at <http://www.bom.gov.au/jsp/awap/rain/index.jsp>)

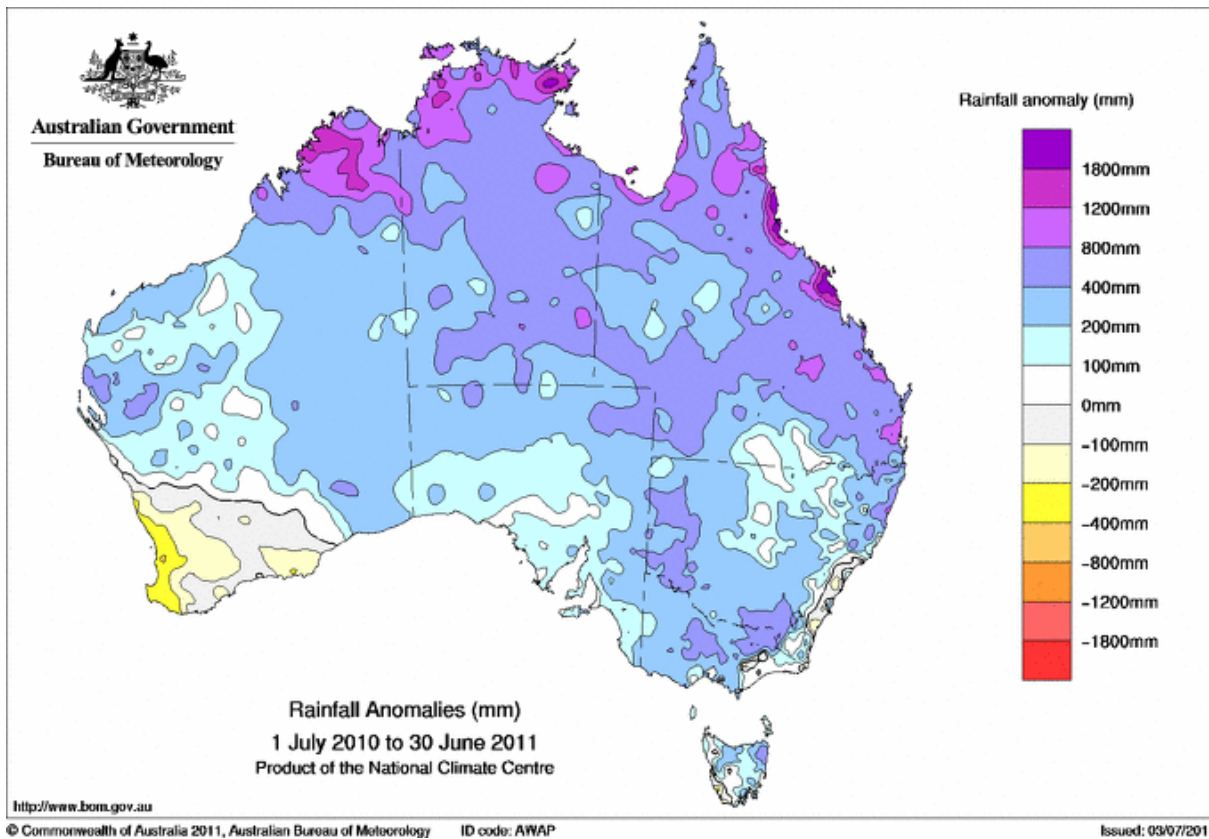


Figure 2: Rainfall anomalies (mm) for the period July 2010-June 2011 (Bureau of Meteorology, available at <http://www.bom.gov.au/jsp/awap/rain/index.jsp>)