

April 2011

# RELEASE



NEW ZEALAND  
AGRICULTURAL GREENHOUSE GAS  
Research Centre

The newsletter of the New Zealand Agricultural Greenhouse Gas Research Centre



# Director's Update



## The first quarter of the year has been another busy time for the Centre.

A major milestone for us was holding our inaugural Annual Conference on February 22nd at the Sport and Rugby Institute (Massey University). Kate and Victoria organised an excellent conference attended by 150 delegates including members of our International Science Advisory Group who had flown into Palmerston North for a week. Prior to the conference, the Minister of Agriculture, Hon. David Carter officially opened the New Zealand Ruminant Methane Measurement Centre which is located at AgResearch Grasslands: this new facility provides New Zealand scientists with world-class facilities that rival those found anywhere in the world. It was funded by a capital equipment grant from the NZAGRC.

Post-conference, scientists working on the NZAGRC research programme came together for the first time since the Centre opened for two days of science workshops. The workshops provided an opportunity for members of the International Science Advisory Group and the Stakeholder Advisory Group to discuss firsthand the NZAGRC science programme with the scientists working on the programme. It also allowed scientists working in the four areas of the Centre's programme to review their science plans, share initial results and refine the programme for the year ahead.

Centre staff have also been heavily involved in providing science and administrative support to the Global Research Alliance. Harry and Andy travelled to France to represent New Zealand at the second meeting of the Livestock Research Group. This was an opportunity to discuss results of a global stock-take of research activity which Victoria had analysed and contribute to the proposed future work-plan for the Group. The Centre, working on behalf of MAF has recently negotiated eight new research contracts with New Zealand research providers for projects that support the objectives of the Alliance.

We have also undergone some staff changes. Heather started her maternity leave in late January (her son Joshua was born on February 11) and Kirsty Dunlop joined us on a six month contract. Andy returned at the end of March having spent the last three months in Austria juggling his commitments to the Global Research Alliance and modelling the economic impacts of climate change adaptation and mitigation measures.

Enjoy reading,

**Dr Harry Clark**

## Staff News



Joshua James Knox - born 11.2.2011

The NZAGRC team is delighted to announce that Heather Went (Centre Operations Manager) gave birth to a beautiful baby boy called Joshua James Knox on the great palindromic date - 11.02.2011. Both mother and baby are doing exceptionally well and ventured out to make an appearance at the NZAGRC post conference BBQ!

**Dr Victoria Bradley** has been appointed to cover the Centre Operations Manager role while Heather is on maternity leave. Victoria joined the Centre in September 2010 from her role as Manager of Research Strategy and Policy in the Research Office at Massey University to set up Centre policies, processes and communications. Victoria will be working with Harry and Andy on Global Research Alliance initiatives.

**Dr Kirsty Dunlop** has also joined the NZAGRC team. Kirsty will work full-time until 30 June 2011 in the role of Centre Projects Manager. Kirsty's work will involve managing the Centre's contracts and financial systems. Kirsty joins us from the Research Office at the Northern Alberta Institute of Technology in Canada and is pleased to be back in her home town of Palmerston North.

# A snowy week in France

## – an update from the Global Research Alliance

The Global Research Alliance on Agricultural Greenhouse Gases (the Alliance) has marked another important milestone. Senior officials and science representatives from the Alliance's 31 member countries and four observer countries were hosted for the second full meeting of the Alliance by the French National Agricultural Research Institute (INRA) from 28 February to 4 March.

Senior officials met to discuss a wide range of governance issues and to finalise the draft charter for the Alliance. The charter will serve as the long-term foundation for the activities and membership of the Alliance and is expected to be formally agreed at the upcoming Ministerial Summit of the Alliance in late June 2011 in Rome.

The Research Groups of the Alliance, also enjoyed a picturesque snow covered France. The Livestock Research Group co-chaired by Dr Harry Clark (New Zealand's representative) and Dr Martin Scholten (The Netherlands representative) met to discuss the results from an updated stocktake of current research activities and agree a work plan for near-term activities and longer term goals and aspirations. The work plan includes information and technology transfer activities; capability building; further analysis of existing research activities and the opportunities and gaps they represent; the building of professional networks and databases; collaborative research projects; and actions to support

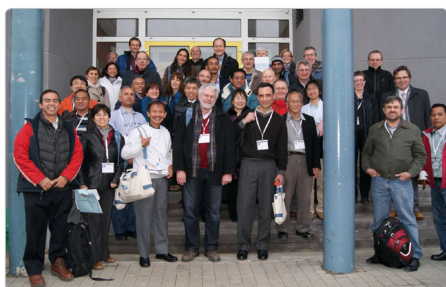
policy development. The work plan will build on projects recently funded by the New Zealand Government in support of the objectives of the Alliance. The NZ projects administered by the NZAGRC, include good practice guides for the measurement of methane emissions from ruminant animals and nitrous oxide emissions from soils, and a technical manual for the construction of low-cost respiration chambers for the accurate measurement of animal methane emissions.

Livestock Research Group members also had the opportunity to directly observe and discuss research projects during a field trip to the INRA research stations near Clermont-Ferrand. In a lively mix of presentations, laboratory and field visits in the snow, French scientists presented their work on animal and paddock-scale measurements of methane and nitrous oxide emissions, soil carbon fluxes, and also linkages between the potential impacts of climate change and mitigation options at the farm scale.

Similar trips and meetings were organised for the other two Alliance research groups; Croplands and Paddy Rice.

The Alliance meetings concluded with a one-day workshop, led by France, on soil carbon and nitrogen cycling measurements and modelling, that combined the interests of all three of the Alliance's Research Groups. Discussions between the Groups had clearly identified carbon and nitrogen cycling was an issue of relevance to cropping, livestock and paddy rice and one that would benefit from greater cross-group collaboration. The initial workshop concentrated on the sharing of models and existing data and the potential for testing of models against common datasets to enhance predictive capabilities.

The photos are from the Livestock Research Group field trip courtesy of Marta Alfaro (Chile), Veronica Ciganda (Uruguay) and INRA.



# The methane-free rumen – the solution to all problems?

Gemma Henderson, Mike Tavendale, and Peter H. Janssen

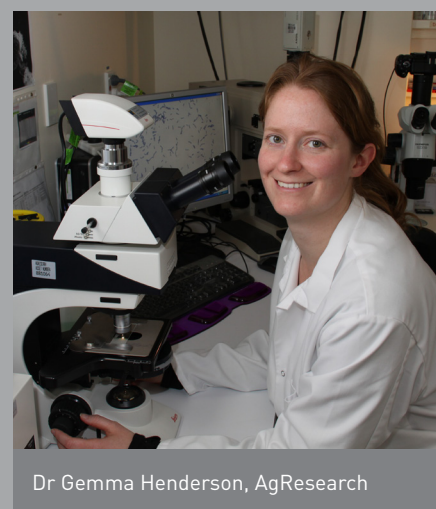
Enteric methane produced by ruminants such as sheep and cows makes up approximately 30% of New Zealand's greenhouse gas emissions. In our quest to develop strategies to reduce methane emissions, we must ensure there is no negative impact on the rumen function.

New Zealand ruminants mainly feed on high-fibre diets such as pasture and silage. Feed is broken down and digested with the help of microbes in the rumen (the ruminant's four-stomach digestive system). One gram of rumen contents harbours some 10 billion microbes. They work as a team to break down feed, producing volatile fatty acids such as acetate, propionate and butyrate and providing the animal with nutrients and energy (see figure). Hydrogen gas is also formed during this microbial fermentation of feed. In the normally functioning rumen, methanogens (methane-producing microbes) combine hydrogen with carbon dioxide to form methane. Inhibiting the activity of the methanogens in the rumen could affect the functioning of the remainder of the rumen microbial community, as hydrogen will no longer be converted to methane. This could have knock-on effects on animal productivity.

Gemma Henderson is leading a project with Michael Tavendale and Peter Janssen that will further our understanding of what will happen when methane production by methanogens is inhibited. The project, funded by the NZAGRC, aims to understand the effect that hydrogen will have in a methane-free rumen. The team will investigate whether a group of microbes called homoacetogens will take over the role of hydrogen disposal from methanogens, or whether other changes occur in response to the hydrogen build-up. Homoacetogens convert hydrogen and carbon dioxide to volatile fatty acids instead of to methane.

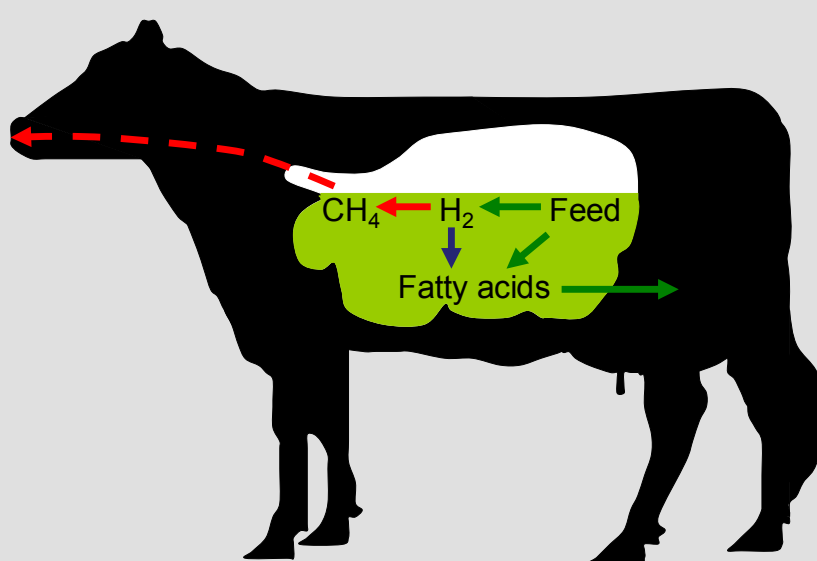
The team will follow the changes in the rumen when different methane inhibitors are added. Monitoring genes diagnostic of different species will show which microbes increase or decrease following addition

of methanogen inhibitors. By measuring the different fermentation end products in the rumen, it is possible to find out which feed degradation pathways are active when methane production is inhibited, and what the fate of hydrogen is in the absence of methanogens. Ideally, any methanogen inhibitor that will be used on farms should avoid the build-up of hydrogen and perhaps increase the production of volatile fatty acids, which would contribute to the animal's nutrition. This work builds on research funded by the PGgRc that discovered that ruminants potentially harbour many previously unrecognised alternative hydrogen-utilising homoacetogens (1).



Dr Gemma Henderson, AgResearch

1. Henderson, G., G. E. Naylor, S. C. Leahy, and P. H. Janssen. 2010. Presence of novel, potentially homoacetogenic bacteria in the rumen as determined by analysis of formyltetrahydrofolate synthetase sequences from ruminants. *Appl Environ Microbiol* 76:2058-66.



Feed is normally fermented in the rumen to produce hydrogen (H<sub>2</sub>) and, importantly, the volatile fatty acids that form a major part of the animal's nutritional needs [green arrows]. Methanogens use hydrogen to form methane (CH<sub>4</sub>) which exits the rumen into the atmosphere [red arrows]. When the methanogens are inhibited, the activity of homoacetogens could form volatile fatty acids from the hydrogen instead [blue arrow].



# How is MOLLY helping our predictive capability?

An international collaboration led by DairyNZ is using 'MOLLY', a complex dairy cow model that mimics the reaction of a real cow to changes in pasture availability and quality, to improve our predictive capability of farm production and profit. 'MOLLY' can take account of feed degradation and fermentation to calculate the effect of changes in feed types on the farm system to enable farmers to understand how change in feed type affects energy production and GHG emissions.

The DairyNZ team is led by Principal Investigator Dave Clark and includes Drs. Pablo Gregorini, Garry Waghorn and Pierre Beukes, scientists from AgResearch (Drs David Pacheco, Ronaldo Vibart and Kumar Vetharaniam) and overseas collaborators from the USA and The Netherlands.

The NZAGRC provides funding to the team through its Integrated Systems research programme to improve the ability of MOLLY, and other models, to predict methane emissions by developing better descriptions of microbial pools in the rumen, the breakdown rate of feed particles and the time course of fermentation products. Dave Clark and his team will guide the implementation of these key controllers of methanogenesis into MOLLY to gain a better understanding of hydrogen production in the rumen and rumen thermodynamics. Microbes in the rumen breakdown plant material and grow on the sugars and ammonia released, and generate fermentation products (e.g. volatile fatty acids and hydrogen). The former can be used for energy by both the microbes and ruminants. The hydrogen is, in part, used by specialist microbes (methanogens) to produce methane which is removed from the rumen and released from the mouth. Incorporating the complex process of methanogen and other microbial growth, fermentation activity and product removal



L-R Mr Dave Clark, Dr Pierre Beukes, Dr Pablo Gregorini, Dr Alvaro Romera

“Currently we have excellent whole farm computer models (e.g. DairyNZ Whole Farm Model and Farmax) that can predict farm production and profit quite accurately. Our goal is to validate and then improve these predictions so that they can handle a wide range of current and future farm systems”.

into MOLLY will allow the team to predict the consequences for methane production using a wider range of feeds, feed modifiers and changing the microbial species present in the rumen.

Being able to modify how MOLLY models fermentation processes will help improve our prediction of the effect of using different feedstuffs in a range of farming systems. However, there may be a need for even more complex description of rumen function to allow us to predict the likely outcome of rumen modification by either vaccines or novel modifiers, and to help us understand

why some animals produce less methane emissions than others even when fed the same quantity and quality of feed. This project therefore integrates with other programmes funded by the NZAGRC so that new data coming out of the programmes can be used to continuously improve model predictions.

“The ultimate aim of this programme is to provide dairy, sheep and beef farmers with management systems that will reduce on-farm emissions of methane and nitrous oxide and deliver increased farm profit” says Dave Clark.



Hon. David Carter formally opening the NZRMMC



The NZRMMC hosted by AgResearch at Grasslands campus, Palmerston North

## New Zealand Ruminant Methane Measurement Centre is opened by the Honourable David Carter, Minister of Agriculture

The New Zealand Ruminant Methane Measurement Centre (NZRMMC) was officially opened on 22nd February by Hon. David Carter, Minister of Agriculture. The NZRMMC is the largest purpose built facility of its kind in the southern hemisphere and provides New Zealand scientists with an enviable opportunity to accurately measure methane emissions from more than 25 ruminant animals at the same time.

Funding of \$1.2 million from the New Zealand Agricultural Greenhouse Gas Research Centre (NZAGRC) has enabled the building of new respiration chambers for sheep and cattle and the upgrading of an existing building to provide a single, purpose designed facility to house all of AgResearch's existing sheep and cattle respiration chambers. The facility houses 24 respiration chambers for sheep and four respiration chambers for cattle and allows continuous measurements of methane emissions under highly controlled conditions. The new facility enables the easy flow of animals from the acclimatisation stage to the measurement phase which reduces labour requirements and experimental costs. Animal welfare is

a priority and the state of the art building is fully air conditioned to deliver fresh air to the respiration chambers at a temperature and relative humidity which maximises animal comfort; it has a back-up power supply in case of a power cut, and is continuously monitored in case of emergency.

Dr Harry Clark, Director of the NZAGRC said "the new facility provides New Zealand scientists with world class facilities and

equipment and clearly demonstrates New Zealand's commitment to reducing agricultural greenhouse gas emissions. Our goal is to develop technologies and practices that reduce agricultural emissions and the NZRMMC will enhance New Zealand's capacity in the methane measurement area and facilitate the forging of the national and international partnerships that are necessary to achieve this goal".



(R-L) Hon. David Carter (Agriculture Minister), Dr Harry Clark (Director, NZAGRC), Mr Sam Robinson (Chair, AgResearch) check out the sheep prior to them going through to the methane measurement chambers.



# “Science globalisation is the future”:

## The key message from the New Zealand Agricultural Green House Gas Research Centre conference

One hundred and fifty Green House Gas (GHG) mitigation focused scientists, policy makers and industry bodies made the trip to Massey University's Sport and Rugby Institute to attend the inaugural NZAGRC Annual Conference.

The conference was a perfect opportunity to celebrate the NZAGRC's first year of operation, and listen to science, government and industry perspectives on agricultural GHG mitigation initiatives and perspectives. The annual conference is an essential element of the NZAGRC's vision “to be an internationally renowned centre for research and development into agricultural greenhouse GHG solutions”.

The Honourable David Carter opened the conference, followed by a speech from the Chief Scientist to the Prime Minister, Sir Peter Gluckman. Sir Peter spoke about the need to globalise New Zealand science in order to strengthen the economy and protect social and environmental development. He suggested that “it is important to ensure that we (NZ) are partners in programmes that can benefit New Zealand through access to funding and infrastructure” and emphasised the role played by the NZAGRC as a facilitator for achieving this.

Fonterra, represented by John Hutchings, General Manager – Sustainable Production, introduced their emissions reduction plan to reduce the carbon footprint of milk and spoke of their commitment to collaborative research in carbon emission mitigation measures. John explained how Fonterra is excited about the research findings that will emerge from the Centre's science programme and is committed to helping translate the findings into applied practice.

Prior to and post lunch saw an introduction to the Centre's science programmes by Dr Peter Janssen (methane) and Professor Hong Di (nitrous oxide) followed by a talk by Professor Jacqueline Rowarth which explained the underlying issues surrounding soil carbon storage in pastoral soils. These



(Top L) Hon. David Carter opens the Annual NZAGRC conference. (Top R) Sir Professor Peter Gluckman, Chief Scientist to the Prime Minister inspires the audience

sessions were designed to give a broad overview of the three major work streams and how the NZAGRC science programme fits together and builds on other funded science programmes.

Presentations by New Zealand Government officials completed the day's events. Paul Stocks, Deputy Director General: Policy, Science & Economics; Dr Gerald Rys, Sustainable Land Management and Climate Change Programme; Laura Hogg, Global Research Alliance; and Jo Tyndall, New Zealand Climate Change Ambassador provided the delegates with an overview of New Zealand's science funding environment and a global context for New Zealand's GHG emission mitigation efforts.

Rod Oram gave a very successful round up of the day and ensured delegates went away with some things to think about. Thanks also go to our dedicated NZAGRC member, the PGGRc manager Mark Aspin, who gave a final wrap up at the end of the conference urging delegates back to their labs and offices to continue with their work.

**Dr Harry Clark, NZAGRC Director, presented an overview of the Centre's achievements in its first year; including:**

- funding a 'core' set of programmes to 2014;
- developing an NZAGRC science programme that complements and aligns with other New Zealand funding programmes;
- the completion of large capital expenditure projects including the NZAGRC Centre building, opened in March 2010 by the Right Honourable John Key; the New Zealand Ruminant Methane Measurement Centre (opened on the morning of the conference (see page 6), and the New Zealand Nitrous Oxide Measurement Centre which will officially open on 1 April 2011;
- leading New Zealand science input into the Global Research Alliance.



Lincoln University students funded by NZAGRC (from left to right): Anne-Maree Hill, Aimee Robinson, and Bianca Das.

Nicole Schon – NZAGRC postdoctoral fellow

# New Zealand Agricultural Greenhouse Gas Research Centre Capability Development Fund

The Capability Development Fund is a key activity for the NZAGRC; in order to develop enduring mitigation solutions, young talented scientists need to be given the opportunity to develop skills in the GHG emissions mitigation research arena. We approach this in two principal ways:

First, the provision of dedicated NZAGRC PhD and Post-Doctoral Scholarships funded from within the core science programmes and second, the provision of undergraduate and post graduate scholarships from a separate Capability Fund administered by Massey and Lincoln universities.

The Capability Fund can already claim success. Two first year undergraduate students spent their summer on an internship at AgResearch. Cameron Shaw and Samantha Edgar (Massey University) both received NZAGRC Pipeline Scholarships to work with Professor Tony Parsons and Dr Susanne Rasmussen from December through to February 2011. Cameron said that "the summer has been a huge learning experience for me". Samantha agreed; she found the opportunity "to gain firsthand experience in the industry extremely valuable in beginning to foster the skills that research demands". A third student Anne-Maree Hill spent her summer on a Pipeline Scholarship at Lincoln University where she has just enrolled in a PhD programme with Professors Hong J. Di and Keith Cameron.

Three more students at different stages of their studies have been awarded a scholarship by the NZAGRC Capability Development Fund.

## Bianca Dias

Bianca is an NZAGRC-funded Honours Student. Bianca was a Future Leader Scholar in the Environmental Science Programme at Lincoln University. For her Honours project, Bianca will be working on diurnal fluctuations of nitrous oxide from the soil. She is supervised by Professor Tim Clough.

## Aimee Robinson

For Aimee the opportunity to undertake a Master's degree at Lincoln University sponsored by a two year NZAGRC Pipeline Scholarship (2011 – 2013) is the next step in her pursuit of a career in soil science.

Encouraged by her year 13 biology teacher, Aimee enrolled as a Future Leader Scholar in the Lincoln University environmental science programme. Her interest in soil science led to the creation of the Lincoln University Soil Society with a fellow student, to promote undergraduate interest in the field and connect students with potential employees and industries.

Aimee says she applied for the NZAGRC pipeline scholarship "because I was interested in focusing my studies on greenhouse gases and knew the importance of their mitigation in agricultural industries

in New Zealand. I also knew I could continue my interest in soil science in this field due to the importance of soil and its manipulation for a reduction in greenhouse gases such as nitrous oxide".

## Nicole Schon

Nicole is the first recipient of a dedicated NZAGRC Post Doctoral Fellowship and she is attached to Dr Alec Mackay's team working in the NZAGRC soil carbon research programme. Nicole says "I am excited about the opportunity to advance my science career through a Post Doctoral Fellowship with the NZAGRC and AgResearch".

After graduating with a first class honors degree in Soil Science from Massey University in 2007, Nicole was accepted into a PhD programme which explored the response of soil invertebrates to pastoral management, and their links to soil services.

Nicole will continue her research into deep burrowing anecic earthworms with the post doctoral fellowship. She says "there is potential to introduce these deep burrowing earthworms to enhance carbon storage in our soils and I am excited to have the chance to explore the potential to do so".





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Livestock Emissions &  
Abatement Research Network

GLOBAL  
RESEARCH  
ALLIANCE

ON AGRICULTURAL GREENHOUSE GASES

# STOP PRESS

## Global Research Alliance Senior Scientist (GRASS) Award

### Supporting research in agricultural greenhouse gases

The New Zealand Government has announced funding for senior scientists to participate in an exchange programme to enhance collaboration and the building of mutually beneficial research partnerships between New Zealand and other Global Research Alliance countries.

#### Focus areas

- Methane emissions from livestock and livestock wastes
- Nitrous oxide emissions from livestock wastes
- Enhancement of pastoral soil carbon sinks
- Integrated whole farming systems impacts at all scales as they relate to livestock emissions.
- National inventory development as it relates to livestock emissions

#### Eligibility

To be eligible, you must:

- Have a PhD or be a scientist with at least 5 years experience participating in/leading major projects that align to the priorities of LEARN, the Alliance or other relevant national strategies
- Demonstrate impact and leadership in your professional field
- Be able to contribute to scientific research and its application in your home region and the larger Alliance network, based on your networking record
- Work in collaboration with a New Zealand research organisation
- Be resident and normally employed on a permanent contract by a research organisation in an Alliance member country
- Be fluent in English

#### Funding

The exchange must be between 6 weeks and 6 months duration.

- Up to \$30,000 for 6 months (pro rata for less than 6 months) will be provided to recipients to cover actual and reasonable living expenses
- Up to \$5,000 will be provided for economy airfares and travel/medical insurance
- Up to \$5,000 will be awarded for associated research costs

**For further details about the award and to get an application form go to the NZAGRC website ([www.NZAGRC.org.nz](http://www.NZAGRC.org.nz)) or contact Dr Victoria Bradley at the NZAGRC - 06 351 8305 or [victoria.bradley@nzagrc.org.nz](mailto:victoria.bradley@nzagrc.org.nz)**

# New Zealand Agricultural Greenhouse Gas Research Centre welcomes its International Science Advisory Group

The NZAGRC were delighted to welcome eight members of its International Science Advisory Group (ISAG) to Palmerston North for a week of meetings from 20 - 26 February 2011.

The ISAG is an international panel of experts in agricultural greenhouse gas mitigation from research groups around the world, who assist the Centre in ensuring that the level of scientific research undertaken in the Science Programme is world class. The ISAG members travelled from the UK, Canada, Europe and Australia to meet our scientists and participate in the NZAGRC inaugural annual conference and two-day science workshops.

In Palmerston North for the ISAG meetings were: Professor Jamie Newbold (Aberystwyth University); Dr Richard Eckard (University of Melbourne); Professor Keith Goulding (Rothamsted Research); Dr Peter Kuikman (Alterra); Dr Tim McAllister (Agriculture and Agri-food Canada); Professor Mark Morrison (CSIRO); Professor Johan Six (University of California) and Professor Keith Smith (University of Edinburgh).

The pictures were taken at the BBQ to welcome the ISAG, held at Wharerata (Massey University) after the NZAGRC Annual Conference on 22 February.



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## Upcoming events

### Global Research Alliance Ministerial Summit

Date: June 2011  
Location: Rome, Italy

### National Fieldays

Date: 15-18 June 2011  
Location: Hamilton, New Zealand

### 8th International Symposium on the Nutrition of Herbivores (ISNH8)

Date: 6-9 September 2011  
Location: Aberystwyth, Wales, UK  
Website: [www.isnh8.org](http://www.isnh8.org)

### Low Carbon Earth Summit-2011 (LCES-2011)

Date: 19-26 October 2011  
Location: Dalian, China  
Website: [www.lcesummit.com/index.asp](http://www.lcesummit.com/index.asp)

### NCGG6 (Non-CO<sub>2</sub> Greenhouse Gases)

Date: 2-4 November 2011  
Location: Amsterdam, The Netherlands  
Website: [www.ncgg.info](http://www.ncgg.info)