

Welcome to the latest update of the six-year 'Growing Confidence in Forestry's Future' (GCF) research programme (Oct 2013 - Sep 2019) which involves a multi-disciplinary team of scientists at Scion, along with collaborators from other Crown research institutes and universities. The research aims to raise the profitability of current and future commercial forests. It targets different intervention points in the forest growing cycle, for both current and future forests. The goal is to increase the returns from existing forests through mid-rotation interventions aimed at increasing productivity and end-of-rotation segregation, while also focussing on how to increase the productivity and consistency of future forests. Detailed information about the aims of the research programme is contained in the research summary document, which is available from the GCF programme website (www.scionresearch.com/gcff) and the FOA website (www.research.nzfoa.org.nz).

The programme is jointly funded by the Ministry of Business, Innovation and Employment (MBIE) and the

Forest Growers Levy Trust, with the support of the Forest Owners Association (FOA) and the Farm Forestry Association (FFA).

In our newsletters we provide a quick update of the key research activities and findings of the GCF research programme to a wide audience including research, industry, iwi and policy makers. More detailed information on specific outcomes is provided through regular events (workshops, field days and annual conference) and available in peer reviewed science publications and technical reports. Tech transfer and co-innovation of research providers, stakeholders and other interested parties is actively pursued through specific innovation clusters that aim to foster open discussions and fast and efficient uptake of new knowledge and technologies.

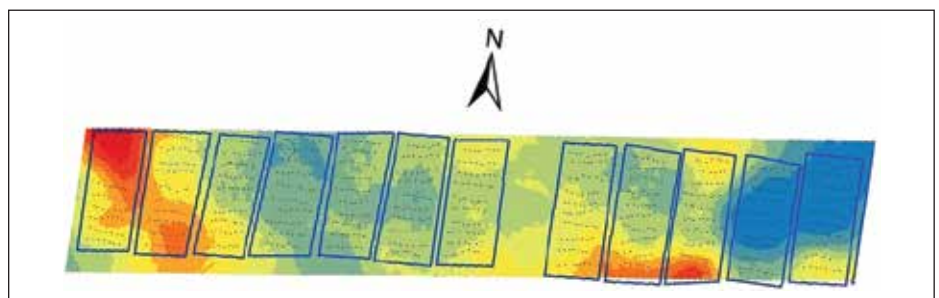
Peter Clinton
(Programme Leader) and the research team

Research update

New tool captures detailed below ground variation

by Graham Coker

Soil properties can now be mapped at scales that were previously cost prohibitive. The Plant Soil Interactions Unit at Scion took possession of a new survey tool called a DualEM-1s, which can measure soil electrical conductivity to a depth of 1.6 m. Soil electrical conductivity is the measure of a soil's ability to transmit a current through the solid, liquid and air phases that make up the soil sampled beneath the device. The primary goal of this tool is to increase our understanding of the spatial distribution of soil properties.



An example of the map created with the Duleam 1 showing variations of conductivity across the site. Blue = low electrical conductivity (= likely to be low soil water levels, TBC) to red = high electrical conductivity (= likely to be high soil water levels, TBC). Plot boundaries are indicated and also individual trees (dots). Tree spacing is 2 m with 4.5 m between ripped lines. Note there is no surface water ponding at this well drained site.

This will enable a major shift in the resolution of soil properties, moving from a plot level to a tree level. Understanding the variation of soil

properties will lead to more accurate assessment of treatment and phenotype responses across new GCF and existing field trials.



Handheld mobile laser scanner ZEB1.

ZEB1 laser scanner helps measure forest stands

by David Pont

A handheld mobile laser scanner was purchased by Scion allowing researchers to develop new methods to characterise forest stands for management and research purposes. Following successful trials of the technology by Scion, the ZEB1 showed real potential to accurately locate and measure individual trees on the ground. Positive features included speed of data capture, quality of the resulting point cloud and ease of use of the system. Poor GPS signal under forest cover makes identifying individual trees a problem. The ZEB1 uses SLAM technology - specifically developed for mapping areas with no GPS - to provide spatial locations. The device scans continuously as the operator moves around an area to provide a single, registered point cloud. This allows scanning of all sides of trees by simply walking around within an area.

Scion researchers are now carrying out further trials of the system including the scanning of inventory plots used to characterise forest stands for management purposes. The project team aims to develop methods to extract tree locations, diameters, pruned heights and stem shape information from the ZEB1 point clouds as an alternative to conventional manual and subjective measurements. See press release below by 3D Laser Mapping on use of the ZEB1 scanner: <http://www.3dlasermapping.com/news-events/news-stories/360-zeb1-laser-scanner-helps-nz-scientists-measure-foreststands>

Sustainable production over multiple rotations - long-term site productivity (LTSP) trials update

by Loretta Garrett

The research team has been busy in the field sampling the LTSP trials to determine if planted radiata pine forests in New Zealand can be sustainably managed into the future. They recently completed the end of rotation sampling of the Woodhill long-term trial and have now started sampling the Tarawera long-term trial. These trials are part of a larger trial series specifically installed about 30 years ago to test the impacts of harvest removals and fertilisation on site productivity. Rotation-age data from the LTSP trials coming up for harvest (Woodhill, Tarawera and Berwick) will allow the programme to build on earlier trial findings, advancing global knowledge on the sustainability of growing successive rotations.



Preparation for biomass measurements.

Preliminary analysis from Woodhill, a low nutrient sandy site, showed that: a) fertilising reduced the age at which

trees achieved 35 cm DBH by 3-5 years; b) unfertilised FF (forest floor removed) treatment took 3 years longer to reach 35 cm DBH than other unfertilised treatments; and c) there was no long term effect on rates of nitrogen mineralisation by soil microbes, which is in contrast to results from 2003 where there was a significant decrease with FF compared to WT (whole tree removed) and SO (stem only removed) treatments. Therefore, this function had recovered by end of rotation. Once data collection and analysis are completed full results will be published and available through the GCFF and FOA websites or the research team.

Data from the recent and future field work will also allow the long-term impacts of intensified management practices to be modelled. For example, these data can be used to further develop the Nutrient Balance Model (NuBaIM). This model provides projections of productivity and nitrogen pools in radiata pine plantations, and enables the effects of various management practices to be predicted with a reasonable degree of confidence (Smaill, et al., 2011). The outcome of the work is to ensure that current and future nutrient (e.g., nitrogen) resources can be sustainably maintained in New Zealand's planted forests under intensified forestry management practices.

Ref: Smaill, S. J., Clinton, P. W., & Höck, B. K. (2011). A nutrient balance model (NuBaIM) to predict biomass and nitrogen pools in *Pinus radiata* forests. *Forest Ecology and Management*, 262(2), 270-277.



Woodhill forest long-term trial site, 2014.

Update on spatial economic modelling

by Richard Yao

The importance of ecosystem services and the role they play in determining the overall business case for forestry is being investigated by the newly extended economic team at Scion, which had two new economists join the team. Interest is high in this research area and already ten forestry companies have expressed their interest to participate in the validation and refinement of the spatial economic model developed with the support of Future Forests Research Ltd. Their vital information will allow the research team to provide a validated and extended model in the future.

In August 2014, Richard Yao delivered a presentation on "A framework for analysing forest ecosystem services" at the New Zealand Agricultural and

Resource Economics Society (NZARES) conference. In his presentation, Richard provided an overview of the spatial economic framework that allows the estimation of key quantifiable values provided by planted forests such as timber, carbon, avoided sedimentation and flood mitigation. The forestry-focused framework received a lot of interest from the participants who consisted of delegates from universities, national government agencies, CRIs, regional councils, Fonterra and consultants. There was interest in the audience to estimate the full value of ecosystem services from other productive land uses (e.g., dairy, sheep and beef, horticulture) into the framework. Future work will include a scoping exercise to evaluate four new ecosystem services and develop spatial layers for some of these with the aim of demonstrating the full value of existing key planted forests in the country.

5. Productivity research and current activities/ mid-rotation interventions to boost productivity - a review of the US Southeast experience (Eric Jokela, University of Florida)
6. Interventions to add value to the current resource (John Moore, Scion)
7. Maximising value capture from the current resource (Glen Murphy, Waiariki IT)
8. Use of remote sensing in research and industry: an international perspective (Mike Watt, Scion)
9. Application of remote sensing by the NZ forest industry (Aaron Gunn, Blakely Pacific)
10. Lasers, satellites, and drones: an overview of remote sensing research (Jonathan Dash, Scion)
11. Phenotyping the forest - what is the size of the prize (what could we achieve if we can properly match genotypes to sites)? (Heidi Dungey, Scion)
12. Phenotyping in the forest for improved health: developing screening protocols (Emily Telfer, Scion)
13. What are the key environmental drivers for genotypes in New Zealand and Australia? (Washington Gapare, CSIRO)
14. What is the size of the pie? The productivity gap. (Dean Meason, Scion)
15. Using process based models to close the gap (Mike Battaglia, CSIRO)
16. How can we quickly close the gap - accelerating forest productivity (Simeon Smaill, Scion)
17. Sustainability under intensified regimes - what are the challenges? (Tim Payn, Scion)
18. Inter rotation management on steeplands (Chris Phillips, Landcare)
19. Getting the most value from your forest - spatial economic modelling (Richard Yao, Scion)
20. Primary sector innovation (James Turner, AgResearch)
21. Technology transfer and uptake - industry experience and observations (Elaine Birk, Rayonier)
22. An industry perspective on co-learning (Andrew Karalus, Nelson Forest).

Engagement



Kick-off conference

A successful GCFE kick off conference was held from 10-12 June in Rotorua, and included presentations from a number of world leading scientists, industry representatives and programme scientists as well as a poster and tech session, and a field trip. The field trip encompassed a visit to Scion to see the Orman Wing laboratories and wood quality research facilities, followed by a visit to Tarawera Forest to discuss issues around productivity and sustainability. The conference was attended by 74 participants and included members from industry, government and iwi.

All presentations are now available on the GCFE website <http://scionforestry-future.wordpress.com/news-and-events/gcfe-conference-presentations/>. They include:

1. Welcome and introduction (Warren Parker, Scion)
2. Overview of the research aims of the GCFE programme (Peter Clinton, Scion)
3. How has the industry come together to support research and development through the forest growing levy (Russell Dale, FOA)
4. Why the government is investing in the biological industries and how they see it empowering the Business Growth Agenda (Prue Williams, MBIE)



Innovation clusters

Four new innovation clusters (phenotyping platform, product quality improvement, productivity enhancement, and sustainability) have been or are being formed to encourage partnership and co-innovation across research, industry, and other stakeholders and interested parties. This partnership and co-innovation will be achieved through an open and highly collaborative approach to knowledge development. Ultimately, it is anticipated that greater science impact will be achieved through early uptake and adoption of research outcomes. The innovation clusters will focus on knowledge sharing and the development and dissemination of new ideas and encouragement of innovation uptake.

The innovation clusters are intended to serve a number of purposes. These include:

1. To encourage the use of co-innovation principles to problem solving and to science uptake;
2. To enable interactive learning through partnership between researchers, industry, government, iwi and other key parties;
3. To facilitate the adoption and implementation of new knowledge through appropriate exchange and transfer mechanisms;
4. To foster existing and establish new linkages among interested parties to ensure science uptake and impact; and
5. to review and share advances in knowledge and how these may be implemented into practice.

The working of the innovation clusters and their members is based on the following basic principles:

- a. To be inclusive and incorporate participants from various interest groups with background in the specific innovation cluster areas and uptake;
- b. The membership of each cluster group may change over time to reflect the stage of the research progress and requirements of the innovation activities;
- c. To engage with and value all sources of knowledge and be respectful of other views;
- d. To facilitate and encourage open and constructive discussions; and
- e. To be champions for change and foster uptake of new approaches, research and technology developments ('ambition for change').

Contact details for the leader of each innovation cluster group are available

on the GCFE website with an open invitation to new members.

In August, members of the Sustainability Innovation Cluster held a field day out at Oponae Forest with several forest environmental managers. Together the group discussed long term site productivity and steep-land forest management. The retirement of forest land is being investigated given the

extreme challenges of harvesting and on-going management on some sites. The group discussed various options including killing the pine crop but leaving it in place to stimulate native regrowth. Scion is exploring potential trials and this may lead to accelerated conversion to native vegetation and open up new ways of managing these difficult forests and new product mixes.

FOA Technical Committee

The first quarterly review meeting of the FOA Technical Committee comprising industry personnel and researchers of the GCFE programme was held in mid-July. Updates on a number of key areas were provided, including: the sampling of trials for wood quality assessment; a review of mid-rotation interventions; the use of process-based models to predict potential productivity of radiata pine; the assessment of the long-term site productivity trials; and, the establishment of innovation clusters. The meeting was very up-beat and plenty of positive feedback was received from the industry members of the group.

FOA Forest Research Committee

In August, the FOA Forest Research Committee held its meeting at Scion, Rotorua. After updates on progress to

date and the Our Land and Water National Science Challenge, the committee members took a tour of the new Orman Wing laboratories and facilities, observed at first hand a demonstration of the handheld terrestrial laser scanner ZEB1 and had a look at the value recovery lab and the new destructive sampling equipment, which is currently in construction. The committee was fascinated seeing the ZEB1 and its function in action and impressed by the new equipment under construction.

International linkages

Forest and Wood Products Ltd (FWPA) collaboration - Scion has been invited to participate in a CSIRO-led proposal to FWPA to investigate the causes of mortality in radiata pine and what future climate change might mean for the levels of mortality. More details to come in our next newsletter.



Looking ahead

Innovation cluster meetings

Productivity Enhancement Innovation Cluster meeting, 6 November 2014, Rotorua. If interested contact Graham Coker at graham.coker@scionresearch.com

Product Quality Improvement Innovation Cluster meeting, 26 November 2014 (TBC), Rotorua. If interested contact John Moore at john.moore@scionresearch.com

Iwi engagement

A hui for a group of forest owning iwi is currently in planning for early 2015. Details TBC and will be available on GCFE website.

GCFE annual conference 2015

24-26 March 2015 (TBC).

Selected recent publications/ presentations related to the GCFF programme

Barry LE, Yao RT, Harrison DR, Paragahawewa UH, Pannell DJ. (2014). Enhancing ecosystem services through afforestation: How policy can help. *Land Use Policy* 39: 135-145.

Heaphy MJ, Lowe DJ, Palmer DJ, Jones HS, Gielen GJH, Oliver G, Pearce SH. (In Press). Assessing drivers of plantation forest productivity on eroded and non-eroded soils in hilly and steep land in eastern North Island, New Zealand. *New Zealand Journal of Forestry Science*.

Phillips CJ. (2014). Forestry in steep eroding hill country: the good, the bad, and what the science says. New Zealand Institute of Forestry (NZIF) Annual Conference, 7 July 2014, Napier.

Watt MS, Meredith A, Watt P, Gunn A. (2013). Use of LiDAR to estimate stand characteristics in young Douglas-fir plantations. *New Zealand Journal of Forestry Science* 43:18, 175-184.

Watt MS, Meredith A, Watt P, Gunn A. (2014). The influence of LiDAR pulse density on the precision of inventory metrics in young unthinned Douglas-fir stands during initial and subsequent LiDAR acquisitions. *New Zealand Journal of Forest Science* 44: 18.

Yao RT, Harrison D, Monge J, Velarde S. (2014). A Framework for Analysing Forest Ecosystem Services. Conference presentation at the New Zealand Agricultural and Resource Economics Society (NZARES) Conference, 30 August 2014, Nelson.

Yao RT, Scarpa R, Turner JA, Barnard TD, Rose JM, Palma JHN, Harrison DR. (2014). Valuing biodiversity enhancement in New Zealand's planted forests: Socioeconomic and spatial determinants of willingness-to-pay. *Ecological Economics* 98: 90-101.

To learn more about the research projects in the programme:

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Visit

the programme website
www.scionresearch.com/gcff
or
www.research.nzfoa.org.nz

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