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Genetically modified trees – Chapter 3

By Chris Lang, published by WRM and FoEI, December 2004

[Back to contents](#)

3. A web of actors: Some of the research institutions and companies involved

There is no conspiracy to impose GM trees uninvited on an unwilling world. There are no smoky rooms where evil men in business suits get together behind locked doors to plot their next move. Neither do white coated technicians huddle over plans to produce mutant super trees which will take over the world.

However, the companies, research institutions and universities involved in GM tree research work together closely. Companies fund university research departments, and influence what type of research is carried out. Companies, government departments and universities have formed research networks in some countries and commercial ventures in others. Industry-friendly scientific publications, think tanks and mainstream media are always happy to publish pro-GM information. Professional networks, conferences and workshops provide the opportunity for like-minded scientists to get together to discuss their work.

Perhaps because they spend so much time in the company of like-minded people, researchers into GM trees tend to take criticism of their work personally. “Everyone is doing this [research into GM trees] because they believe it will help the environment of the world,” Oregon State University’s Steven Strauss told the Portland Business Journal in 1999, “We’re all terribly offended that some activists have defined what we do as horribly offensive,” he added.^[102] Similarly, Malcolm Campbell, at Oxford University’s Department of Plant Sciences, told the Calgary Herald in 1999, “I don’t get up in the morning and try thinking about who I’m going to step on. I go to work trying to make the world a better place for my kids”.^[103]

I wrote to Campbell with some questions about his research. Although he declined to answer my questions he was keen to show me what a nice chap he is: “On the basis of the tone of the questions you have asked me, I think that you may find that your perspective of me is at odds with who I actually am.” He pointed out that his family has not owned a car “as a matter of choice, for 8 years, and we do everything by public transport – including transporting my wife’s Fair Trade stall from site to site.” While this is all very commendable, I had not asked Campbell whether he took the bus into work. Among the questions I did ask him was whether he had ever conducted any research into the impacts

of large-scale industrial tree plantations on local communities in the South, and whether he had visited any local communities without representatives of the company responsible for managing the plantations.[104]

Criticisms of research into GM trees are not directed at a personal level at the researchers or their lifestyles. They are directed at an economic and politic system and a model of forestry that together are responsible for massive destruction of the world's forests and the livelihoods of local communities.

This section looks at some of the institutions involved in promoting GM trees: the commercial firms, universities and professional networks.

International Union of Forest Research Organisations (IUFRO)[105]

IUFRO is the glue that holds together the network of forestry scientists, academic researchers, company and government officials. IUFRO organises up to 90 meetings a year. Aspects of industrial forestry form the theme of many of these meeting, which have titles like “Eucalyptus in a changing world” and “The Economics and Management of High Productivity Plantations”.

Formed in 1892, IUFRO is the largest and most well known international body in forestry research. IUFRO today has 689 member organisations from more than 100 countries.

In November 2004, a IUFRO conference will take place in South Carolina titled, “Forest Genetics and Tree Breeding in the Age of Genomics: Progress and Future”. According to IUFRO, “This international conference is to bring together geneticists, breeders, applied and basic scientists, managers and professional foresters to exchange the latest information on forest genetics and tree breeding related topics”. [106] The conference sponsors include North Carolina State University, IUFRO, and GM tree firms ArborGen and Cellfor. Field trips after the conference are to Meadwestvaco and ArborGen's GM tree research centres.

IUFRO has a task force on Forest Biotechnology which is currently working on a report on “The whole set of benefits and costs linked to forests biotechnology and genetically modified trees”. The report is to be presented at the IUFRO World Congress 2005 to be held in Brisbane, Australia.

As an organisation, IUFRO is pro-GM trees. IUFRO's web-site states its position on GM trees:

“Deployment of genetically modified organisms (GMOs) in forestry is controversial because of the possible risks involved. Although annual crops using GMOs are accepted in some parts of the world, and extensive research is undertaken, some environmental groups try to stop research on Forest Biotechnology, even acting aggressively. Trials and experiments certainly need to be carefully planned so that biosafety is not compromised, but research as such should not be stopped or restricted. What is needed is more research, laboratory experiments, and extensive field testing within a comprehensive approach to fully evaluate genetically modified trees.” [107]

ArborGen, USA[108]

ArborGen is the world's biggest GM tree company. Formed in April 1999 as a joint venture between Monsanto, International Paper, Westvaco and Fletcher Challenge, ArborGen is a US\$60 million marriage between agribusiness and industrial forestry. Monsanto pulled out of ArborGen six months after it was formed. [109] In January 2000, Genesis Research and Development, New Zealand's biggest biotechnology company, joined the joint venture. Genesis and Fletcher Challenge had been working together for five years on herbicide tolerant GM eucalyptus, poplar and

pine. In 2001, Rubicon bought Fletcher Challenge's biotechnology and South American forestry operations and took over its commitments to ArborGen.^[110] Westvaco has since merged with Mead Paper Company to form Meadwestvaco.

In April 2003, Genesis announced a new plant science subsidiary: AgriGenesis Biosciences.^[111] AgriGenesis takes over Genesis' involvement in ArborGen. AgriGenesis' chief executive officer is Peter Lee, who previously held senior positions with International Paper and Mead Paper Company.

International Paper owns more than 3.3 million hectares in North America.^[112] It is the largest landowner and one of the worst polluters in the US.^[113] The company sells more tree seedlings than any other firm in the world. International Paper funds GM tree research at Oregon State University.^[114]

ArborGen currently has 51 field trials of GM poplar, eucalyptus, pine, sweetgum and cottonwood trees in the US.^[115] ArborGen's scientists have genetically manipulated trees to have less lignin, to grow faster and straighter, to be sterile or to be resistant to disease or herbicide. In 2003, an ArborGen official told journalist Jack Lyne that the company was eight to 10 years away from launching commercial products.^[116]

Horizon2, New Zealand^[117]

Horizon2 was formed in March 2004 from a merger of Carter Holt Harvey Forest Genetics and Rubicon's Trees and Technology.^[118] Carter Holt Harvey is a New Zealand timber firm, which is 50 per cent owned by International Paper.^[119] Rubicon was formed from the break up of Fletcher Challenge Forests and is part of the ArborGen joint venture.^[120]

Horizon2 is carrying out research into GM eucalyptus and radiata pine. The research is aimed at trees engineered to have less lignin, to have increased cellulose, to grow faster, to be resistant to insects, to be stress tolerant and to have altered flowering behaviour.

In one application to New Zealand's regulatory body, the Environmental Risk Management Authority, Horizon2 described its GM tree research as "Improvement of selected, high-value strains of Eucalyptus bred for plantation forestry, to better meet the requirements of foresters and pulp mills in regions overseas where Eucalyptus is a primary source of fibre".^[121] In another application, Trees and Technology stated: "Dispersal of transgenic pollen into the environment is widely considered as undesirable . . . The applicant considers the main benefits of the research will be to allow the safe trialling and release of transgenic Eucalyptus in New Zealand and in other countries".^[122]

Horizon2 has a research contract with ArborGen.^[123] Horizon2 is "providing services to ArborGen to help improve the pulping characteristics of eucalyptus destined for the Brazilian market." A company press release states that Horizon2's future plans include a "market presence" in Chile.

GenFor, Chile^[124]

Chilean-based company GenFor hopes to have its insect resistant GM radiata pine trees ready for commercial release by 2008. Two years ago, Monsanto's former head of forestry predicted that Chile would be the first country to produce GM trees commercially.^[125]

Formed in 1999, GenFor is a joint venture between Chilean technology think tank Fundación Chile and Cellfor (Canada). The company was partly financed by the Chilean Development Agency. A US biotechnology company, Interlink Associates was initially part of the joint venture, but has since sold its share in the venture.^[126]

GenFor's main research focus is GM radiata pine which makes up 80 per cent of Chile's plantations. GenFor's researchers aim to create a GM pine resistant to the European shoot-tip moth, a pest which currently costs plantation companies in Chile US\$3 million a year to control.

The start of the GenFor partnership illustrates the high-tech nature of modern industrial tree plantations. Seven years ago, scientists at Biogenetics, a joint venture between Interlink and Fundación Chile, began research into the shoot-tip moth. At first, they aimed to set up a non-GM breeding programme for resistance to the moth. Biogenetic's scientists contacted Canadian company Silvagen (now called Cellfor) which sold a patented somatic embryogenesis propagation technology, which allows scientists to produce millions of trees from a single parent, without having to wait for the parent tree to seed.^[127] Instead of selling the somatic embryogenesis equipment it wanted, Silvagen formed the GenFor joint venture with Biogenetics.

Cellfor has entered into collaborations with a series of universities, including Oxford, Purdue, British Columbia, Alberta and Victoria.^[128] Cellfor has also worked with the Institute of Molecular Agrobiolgy in Singapore and SweTree Genomics in Sweden. The research which led to Cellfor's patented somatic embryogenesis technology was carried out by Stephen Attree at the University of Saskatchewan.^[129] Attree is now Cellfor's chief of research.

In addition to its research on insect resistant GM radiata pine, GenFor is working on increasing the level of cellulose and reducing the amount of lignin in radiata and loblolly pine.

Aracruz Cellulose, Brazil^[130]

Aracruz's three pulp mills produce a total of two million tons of pulp a year. The company's eucalyptus plantations were established on the lands of the Tupinikim and Guarani indigenous peoples and other local communities.

In 1997, Aracruz produced a statement explaining its position on GM trees:

“Genetics are becoming a powerful tool in modern societies, leading to breakthroughs that improve the overall quality of life and the environment. Many sectors such as agriculture are using genetics, and there is no reason to impose a genetic prohibition on the forestry industry, which, for plantations, follow the same basic concepts as any food crop. The use of genetically modified organisms should be allowed, subject to compliance to national and international regulations.”^[131]

Gabriel Dehon Rezende, Forest Improvement Manager at Aracruz confirmed that Aracruz is currently carrying out GM tree laboratory research but that “Aracruz does not use Genetically Modified Organisms (GMOs) in its field trials or commercial plantations”.^[132]

Nippon Paper Industries, Japan^[133]

In 2002, Nippon Paper, Japan's largest paper manufacturer announced that it had developed a GM salt-tolerant eucalyptus tree. Nippon Paper's scientists grew the trees in laboratory tests in salt solutions one third as salty as seawater. The company stated that it “hopes that this basic research in biotechnology will contribute to the development of plants and trees for afforestation in deteriorated areas, as well as for papermaking materials”.^[134]

Nippon Paper's work on GM trees spans more than a decade. In 1993, the *Nikkei Weekly* reported that Nippon was working on GM poplar trees which would be resistant to polluted environments.[135]

In 1995, Nippon signed an agreement with Zeneca to work on modifying lignin in pulp trees.[136] Activists destroyed Zeneca's GM tree field trial in England four years later, but in 2001, the *Nikkei Weekly* reported that Nippon Paper had developed a GM eucalyptus tree which produced 20 per cent less lignin, 10 per cent more cellulose and five per cent more pulp than non-GM eucalyptus trees.[137]

Oji Paper, Japan[138]

Oji Paper is one of the largest pulp and paper companies in the world. The company has an active research programme into GM trees. Oji Paper's scientists are working on GM trees with reduced lignin,[139] GM trees which can tolerate salty soils[140] and GM eucalyptus that can grow in acidic soils.[141]

Oji Paper owns 190,000 hectares of forests and plantations in Japan and a total of more than 130,000 hectares of plantations in Australia, China, Brazil, New Zealand, Vietnam and Papua New Guinea.[142] In 2003, the *Asahi Shimbun* reported that Oji Paper would start trials of its GM eucalyptus within a year in a massive domed research facility in the US.[143]

Takashi Hibino is a research scientist at Oji Paper's Forestry Research Institute working on producing GM salt-resistant eucalyptus trees. He told me that Oji Paper is not currently planting GM trees and that his research with GM trees is carried out in sealed glasshouses. In response to a question about the potential risks of GM trees he replied:

“It cannot be denied to influence an existing plant environment by the pollen dispersal of GM tree. We advance the development of the method of controlling the pollen formation at the same time as developing a profitable GM tree, and do not execute commercial afforestation until these can be solved.”[144]

In 2001, Japanese newspaper *Nikkei Weekly* reported that Oji Paper began a one hectare field trial of GM eucalyptus in Vietnam in 1998.[145] Oji Paper planned to fell the trees at the end of 2001 and conduct a comprehensive evaluation of the trees, including their environmental impact. Oji Paper declined to reply to questions about the company's activities in Vietnam.

Tree Genomics, Biotechnology, and Breeding Programme, Oregon State University[146]

Oregon State University's forestry researchers are working on GM trees for herbicide tolerance, sterility, resistance to fungus and insects and reduced lignin.

The Tree Genetic Engineering Research Cooperative (TGERC) at Oregon State University was launched in 1994. TGERC received funding from several pulp and paper companies, including Aracruz, Weyerhaeuser, International Paper, MacMillan Blodel and Potlatch Corporation. Other funders include the National Science Foundation and Oregon State University.[147]

TGERC has now been absorbed into Oregon State University's Tree Genomics, Biotechnology, and Breeding Programme.

Steven Strauss, Professor of Forest Science and Genetics at Oregon State University, is tireless in his efforts to promote GM trees and to play down the risks. Strauss describes Friends of the Earth and Greenpeace as “extremist environmental groups”.^[148] In 2000, he told the *Washington Post* that “The main risk of working with engineered trees is not a biological risk, it’s a political risk because of the hysteria around the world”.^[149]

Strauss acknowledges that “absolutely complete containment [of GM tree genes] is impossible.” However, he argues GM trees would be unlikely to survive in competition with non-GM trees. He told *Scientific American* that “[Transferred] genes in the wild will have very, very little effect”.^[150]

In 2003, researchers at Oregon State University announced that they had found a way of producing shorter GM trees with fat trunks and more usable timber. The trees’ growth would be controlled by using “commercially available growth-promoting sprays”.^[151] Strauss argued that because shorter trees could not compete with wild trees, they would pose no threats to forests.

Oak Ridge National Laboratory^[152]

Scientists at Oak Ridge National Laboratory (ORNL) are working on producing GM trees which would store carbon. The US Department of Energy is funding a three year, US\$5.1 million research project into the possibility of using poplars to store carbon. ORNL is collaborating with the Universities of Florida, Oregon and Minnesota as well as the National Renewable Energy Laboratory and the US Forest Service.^[153] Researchers at Oregon State University are working on the actual genetic modification of trees to store more carbon. ORNL is also looking into the possibility of planting poplars to produce ethanol or other fuels. “We’re talking about millions of acres” ORNL’s Stan Wullschlegler told the *Knoxville News Sentinel*.^[154]

ORNL was set up in 1942, as part of the Manhattan Project – one of three sites in the US which were to develop the atom bomb.^[155] Today, according to ORNL’s director Alvin Trivelpiece, ORNL is a “government-sponsored institution managed by a private corporation to advance science and technology in partnership with universities and industrial firms”.^[156] Since 2000, UT-Battelle, a non-profit joint venture between the University of Tennessee and Battelle, has managed ORNL for the US Department of Energy. Battelle is a science and technology firm with annual revenues of US\$1 billion.^[157]

North Carolina State University^[158]

Ron Sederoff and Vincent Chiang head the Forest Biotechnology Group in the Department of Forestry at North Carolina State University. Chiang and his colleagues have produced a GM aspen tree which has around half the lignin content of non-GM aspen.^[159] The trees also have more cellulose and they grow faster.

While Chiang acknowledges that “There is a need for more data concerning the environmental effects and field performance of transgenic trees,” he adds that “four-year field trials of such trees in France and the United Kingdom show that lignin-modified transgenic trees do not have detrimental or unusual ecological impacts in the areas tested”.^[160] Four years is clearly not long enough to determine the impact on ecosystems over the lifespan of the tree.

Commonwealth Scientific and Industrial Research Organisation (CSIRO), Australia^[161]

Scientists at CSIRO’s Forestry and Forest Products are conducting several research projects into GM trees. For example, CSIRO’s Simon Southerton is working on producing GM eucalyptus trees that grow faster, produce better wood and which are sterile.^[162] CSIRO’s scientists, far from worrying about reduced biodiversity in GM tree

plantations, acknowledge that plantations of sterile trees will be less attractive to animals. However, they argue, this is an improvement over non-GM tree plantations. According to CSIRO, plantations with fewer animals mean reduced impacts on wildlife when the plantation is logged.

About 75 per cent of CSIRO's funds come from government and the remainder from industry and other groups. In 2004, the Australian government announced a three-year agreement to give CSIRO US\$1.1 billion in core funding. [\[163\]](#)

Dr Geoff Garrett, CSIRO's Chief Executive Officer explained in a press release in May 2004 that "CSIRO's strategic objectives . . . are all about producing the best possible research outcomes for the benefit of all Australians. We must continue to help Australia grow, both economically and socially". [\[164\]](#)

Forest Research, New Zealand[\[165\]](#)

In March 2004, CSIRO Forestry and Forest Products and Forest Research announced plans to merge their operations. [\[166\]](#) The joint venture will have a turnover of US\$30 million a year and will consist of half of the 180 staff of CSIRO Forestry and Forest Products staff and one-third of Forest Research's 340 staff.

Forest Research is a government-funded research organisation with "approximately" 12 staff using GM technology according to Forest Research's Christian Walter. [\[167\]](#) They are looking at wood formation, flowering and the environmental impacts of GM. Forest Research has several GM tree research projects including GM pine trees modified for insect-resistance and improved wood quality, GM fir trees engineered for pest and pathogen resistance, gene coding for wood quality traits, antibiotic and herbicide resistance genes, and genes involved in reproductive development. [\[168\]](#) Forest Research is also carrying out research into the formation of lignin in trees. [\[169\]](#)

In 2002, Christian Walter at Forest Research stated, "Forest Research does not have intentions to release genetically modified trees. Nor do we intend to produce trees for release" [\[170\]](#).

However, in July 2003, Forest Research planted GM pine and spruce trees in two field trials in New Zealand. The GM trees are designed to be resistant to the herbicides Buster and Escort and the reproductive cycle of the trees had been altered – thus affecting wood growth. [\[171\]](#) Before it approved the trials, the New Zealand regulatory body, Environmental Risk Management Authority, received more than 700 submissions about Forest Research's application of which 96.5 per cent opposed the trials. [\[172\]](#)

Forest Research is conducting a study, with funding from the UN Food and Agriculture Organisation "on the status and trends of the development of genetic modification in forest trees, and the application of genetic modification in forestry". [\[173\]](#) The study will be based on a questionnaire sent to forest management and research institutions and on public sources of information. In June 2004, FAO's Pierre Sigaud told me that the report would be released "in the next few months". [\[174\]](#)

Chinese Academy of Forestry, Beijing[\[175\]](#)

Forestry scientists at the Chinese Academy of Forestry started research into GM poplar trees in the late 1980s. From 1990 to 1995, they were helped by an FAO-run project which provided capacity building, technology transfer and laboratory support. The US\$1.8 million project was funded by the United Nations Development Programme. [\[176\]](#)

The Chinese Academy of Forestry is working with the College of Life Sciences at Beijing University on a research project looking at the genes involved in wood formation in *Populus tomentosa* trees. Lu Meng-Zhu of the Research Institute of Forestry at the Chinese Academy of Forestry told me “My research involves transgenic work for producing insect tolerance and modified wood property trees, of course, transgenic research is also a tool in our basic research in wood formation at the molecular level”.[177]

For more than ten years, the Federal Research Centre for Forestry and Forest Products at Waldsiedersdorf in Germany has maintained close contact with Chinese forestry scientists working on GM trees. Hu Jianjun of the Chinese Academy of Forestry was based at the Research Centre in Waldsiedersdorf for several months in 2004.[178]

Department of Plant Sciences, Oxford University, England[179]

Forestry education at Oxford University was a product of the British Empire. Wilhelm Schlich, then-Inspector General of Forests in India set up the Royal Engineering College at Coopers Hill in the south of England in 1885. Ten years later Schlich founded and became the first director of the Imperial Forestry Institute, which became part of Oxford University.[180] In later years the name was changed to the Oxford Forestry Institute and today the OFI no longer exists, apart from as a building within the Department of Plant Sciences.

Before being absorbed into the Department of Plant Sciences, research at OFI gradually focussed more and more on the molecular level. Corporate funding increased, and included funding from Shell Forestry. In July 1999, OFI hosted the International Union for Forestry Research Organisation’s “Forest Biotechnology ’99” meeting at which 190 of the world’s top forestry scientists spent a week discussing GM trees. The conference was sponsored by Monsanto and Shell.

Malcolm Campbell is one of the world’s foremost researchers into lignin in trees and into GM trees engineered for reduced lignin. Before his move in August this year to the University of Toronto, Campbell was based at Oxford University’s Department of Plant Sciences.[181] Much of the research carried out under Campbell at Oxford involved poplar and eucalyptus trees[182] – two of the pulp industry’s favourite fibre sources.

[4. Legislation, regulation and market forces »](#)

Footnotes

[102] Quoted in Kristina Brenneman, [Genetic tree farmers slammed by activists](#), *Business Journal* (Portland), 26 November 1999.

[103] Quoted in Bruce Thorson, Chips are flying over altering trees, *Calgary Herald*, 24 July 1999.

[104] I wrote to Campbell on 19 June 2004 with some questions for an article I was writing for WRM’s June 2004 Bulletin (available [here](#)). Campbell replied the following day. Instead of answering the questions, he invited me to

visit him in his laboratory “so we can discuss the complexities of your questions at greater length.” On 15 August 2004 I wrote to Campbell to let him know that I would be in Oxford the following week and that I would like to take him up on his offer of visiting his laboratory and interviewing him. He replied the following day to tell me that he was now at the University of Toronto in Canada. I wrote to him on 15 September 2004 explaining that as I had no plans to travel to Canada I would be very grateful if he could answer the questions I had previously asked him. He replied on the same day, once again declining to answer my questions: “I hope that you will find some time to visit me. On the basis of the tone of the questions you continue to ask me, which still remains despite my willingness to meet with you, I think that you really must visit me, as it is clear that you have an agenda-driven perspective of me that is completely at odds with who I actually am.”

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[106] [Forest Genetics and Tree Breeding in the Age of Genomics: Progress and Future](#), North Carolina State University conference announcement.

[107] IUFRO [Task Force Forest Biotechnology](#).

[108] [ArborGen, USA](#)

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[109] Viola Sampson and Larry Lohmann, [Genetic Dialectic: The Biological Politics of Genetically Modified Trees](#), The Corner House, Briefing 21, December 2000.

[110] The three Rs: Rubicon, research, restructuring, *Evening Post* (Wellington), 11 October 2000.

[111] [Genesis Research Appoints Chief Executive](#), Genesis Research press release, 5 August 2003.

[Genesis Research Transfers Plant Science Business To AgriGenesis Biosciences](#), Genesis Research press release, 17 December 2003.

[112] Monica Shaw, Big and Better: International Paper's new CEO, John Paraci, says you have to work to make big simple, *Pulp and Paper International*, May 2004.

[113] Ricardo Carrere and Larry Lohmann, *Pulping the South: Industrial tree plantations and the world paper economy*, World Rainforest Movement and Zed Books, 1996.

[114] [TGERC Profile History and Structure](#), Tree Genetic Engineering Research Cooperative, University of Oregon.

[115] [APHIS database](#) downloaded 17 May 2004.

[116] Jack Lyne, [Forestry Biotech Startup ArborGen Will Keep HQ Rooted in Charleston](#), *Site Selection Online Insider*, 13 January 2003.

[117] [Horizon2](#), New Zealand

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[118] [Biotechnology Venture Eyes New Horizons](#), Rubicon press release, 4 March 2004.

[119] [Our History Timeline](#), Carter Holt Harvey.

[120] Rubicon's [web-site](#).

[121] Horizon2 application submitted to New Zealand's regulatory body, [Environmental Risk Management Authority](#), 23 December 2003.

[122] Trees and Technology application submitted to [Environmental Risk Management Authority](#), 10 March 2003.

On 14 January 2005, World Rainforest Movement and Friends of the Earth International received an e-mail from Peter Richardson at Horizon2 pointing out that the sentence: "The applicant considers the main benefits of the research will be to allow the safe trialling and release of transgenic Eucalyptus in New Zealand and in other countries" was written by the New Zealand regulatory agency, ERMA, and not by the applicant, Trees and Technology. This was not clear from the application form when I accessed it on 27 May 2004. EMRA has since deleted this sentence from the copy of the application form on its web-site.

Peter Richardson stated in his e-mail to WRM that

"ERMA have apologised for the appearance of the second sentence in their assessment of the application in error, since nowhere in the application was any suggestion made that the GM trees to be made would be released into the environment, indeed the application stressed that the work would all be done in containment. ERMA have gone to considerable trouble to correct their online references to this, and I expect you to, as well."

Although Richardson states that Trees and Technology's application does not mention releasing GM trees to the environment, the application does mention commercial use of GM trees. In the application, Trees and Technology state: "Dispersal of transgenic pollen into the environment is widely considered as undesirable and the ability to

produce transgenic plants that do not produce pollen would facilitate the trialling and commercial use of such translines in other countries.”

Obviously, commercial use of GM trees would involve release of GM trees to the environment.

[123] [Biotechnology Venture Eyes New Horizons](#), Rubicon press release, 4 March 2004.

[124] GenFor, Chile
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[125] Casey Woods, [Here come the super trees](#), Latin Trade, May 2002.

Wood’s article is my main source for the section on GenFor. Fundación Chile and Cellfor declined to answer my questions about their involvement in GenFor.

[126] E-mail from Ramon Garcia, Interlink’s President, 22 July 2004: “Interlink is not involved with GenFor. We divested our interest in GenFor a couple of years ago”, wrote Garcia.

[127] [Silvagen Inc.](#), Finnish Forest Research Institute (Metla).

[128] [Collaborations](#), Cellfor.

[129] Charles Mann and Mark Plummer, [Forest Biotech Edges Out of the Lab](#), *Science*, Vol. 295, No. 5560, 1 March 2002.

[130] [Aracruz Cellulose](#), Brazil

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[131] Aracruz Position Regarding FSC Certification, Aracruz Cellulose, Brazil, 1997.

[132] E-mail from Gabriel Dehon Rezende, Forest Improvement Manager at Aracruz, 23 July 2004.

[133] [Nippon Paper](#) Industries, Japan

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[134] [Nippon Paper Industries Successfully Develops Genetically Engineered Salt-Tolerant Eucalyptus](#), Nippon Paper Industries press release 8 March 2002.

[135] Genetic engineers grow poplars highly resistant to pollution, *Nikkei Weekly*, 27 September 1993.

[136] Zeneca Plant Science, Nippon Paper, & Shell Research to develop genetically modified trees for low-energy papermaking, *Business Wire*, 28 March 1995.

[137] Pulp makers race to enhance eucalyptus, *Nikkei Weekly*, 27 August 2001.

[138] [Oji Paper](#), Japan

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[139] Pulp makers race to enhance eucalyptus, *Nikkei Weekly*, 27 August 2001.

[140] Takashi Hibino, Naoko Ishige, Keiko Kondo and Atsushi Furujyo, [Genetic improvement for environmental stress resistance in eucalyptus](#), poster presentation at the Plant & Animal Genomes XII Conference, San Diego 10-14 January 2004.

[141] [Genetically modified eucalyptus grows in acidic soil](#), *Asahi Shimbun*, 16 July 2003.

[142] [Meeting the Challenge of the Global Market. Oji Paper in Perspective, 2002, Year Ended March 31, 2002](#), Oji Paper, Tokyo.

[143] [Genetically modified eucalyptus grows in acidic soil](#), *Asahi Shimbun*, 16 July 2003.

[144] E-mail from Takashi Hibino, Oji Paper's Forestry Research Institute, 16 April 2004.

[145] Pulp makers race to enhance eucalyptus, *Nikkei Weekly*, 27 August 2001.

[146] [Tree Genomics, Biotechnology, and Breeding Programme](#), Oregon State University
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