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Annual Report 2014

Taiwan Forestry Research Institute

行政院農業委員會林業試驗所

一〇三年度年報

行政院農業委員會林業試驗所 發行
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一〇三年度年報

序

《中庸》記載：哀公問政。子曰：「文武之政，布在方策。其人存，則其政舉；其人亡，則其政息。人道敏政，地道敏樹。」其中人道敏政、地道敏樹的意思，即在勸主政者於處理人民的事務時要迅速執行政務，而經營土地的事務就要迅速種植樹木。每讀至此，我總是欽佩2千多年前孔夫子的大智慧，深知育樹成林對於國土保安、國計民生之影響至鉅，故而諄諄提點，語重心長。

時至今日，「地道敏樹」的見解仍然深具時代意義與普世價值。根據聯合國糧農組織（FAO）《2014年世界森林狀況》報告指出，目前全世界大約有三分之一人口生活在低度發展國家（less developed countries），他們必需依靠木材作為其主要或唯一的能源，利用木質燃料烹煮安全而營養的食物，仰賴森林提供長期和廉價的居所。對於地球村民來說，森林是陸地上最大的生物多樣性寶庫，森林能以各種方式提供民生用品、糧食安全與能源利用等穩定的服務，能在減緩全球氣候變遷上發揮重大作用，也能顯著改善許多脆弱生態系統的水土保持。21世紀的林業議題不僅是各國內政問題，更因為涉及氣候變遷、地球暖化、酸雨、臭氧層破壞、木材非法盜伐與交易、農漁牧業發展、原住民之生存與就業等，早已成為世界保育聯盟、世界貿易組織、世界人權組織等爭相關切與制定行動準則的對象。

有鑑於此，本所同仁經常思考如何精進國內林業研究並持續提升森林經營品質，並於2014年完成多項重要工作：

一、在永續發展與政策推動方面：推動森林永續經營認證，由本所與臺灣森林認證發展協會合作，共同輔導新竹縣竹東鎮正昌製材廠於2014年11月通過國際FSC™森林經營驗證，成為臺灣第一個通過相關認證的林地，代表國內人工林邁入新的負責任經營里程碑。

二、在育林保林及生態保育方面：推動樹木健康管理行動，由本所與臺北市政府、臺灣都市林健康美化協會等團體於5月舉辦「2014樹木保護國際研討會—以大安森林公園為例探討預防天災作為」。另於同月辦理「2014樹木醫/樹藝師工作實務國際研討會」，提供國內訂定樹木健康管理規範之參考。

三、在技術移轉與產學合作方面：本所同仁於7月參加「2014臺灣國際生物科技大展」，展出「樹木褐根病LAMP檢測技術之建立」、「臺灣原生優良檜樹（諾麗果樹）品系、栽培技術及其保健產品」與「珍稀懸垂觀賞植物—垂枝石松之體外人工繁殖技術」等研發成果，獲得熱烈迴響並開拓商機。

本刊做為本所同仁2014年努力成果的彙總，敬請各方不吝指正，並願與國人共勉毋忘聖教，地道敏樹。

行政院農業委員會林業試驗所

所長 黃裕星 謹誌

2015年11月1日

Preface

The book Zhungyoun recorded a passage, in which the Duke of Lu, Aye Gong, asked about the art of politics. Confucius replied: "The benevolent reigning strategies of Emperors Wen and Wu (of Zhou Dynasty) were recorded in the documents, however, only when they were alive, the system worked. When they were dead, the policies and system became extinct. The way of rulers is to act on the right policies expeditiously, and the way of land is to plant trees diligently." Each time I read this, I always marvel at the profound wisdom of Confucius more than two thousand years ago. As he knew full well the great impact of planting trees to form forest on the protection of homeland and national economy, henceforth the wise words to remind the rulers.

Even today, the phrase "the way of land is to plant trees diligently" still rings true with contemporary and universal significance. According to the State of World's Forests 2014 of the Food and Agriculture Organization (FAO) of the United Nations, presently, about one-third of the world populations live in less developed countries. They must rely on wood as their main or even the only energy source. Woody fuel cooking provides safe and nutritious foods, and they rely on forests to provide long term and cheap abodes. For the global villagers, forests are the largest terrestrial treasure troves of biodiversity, which produce stable services for live sustenance, food security and energy utilization in various forms and manners. They mitigate global climate change with tremendous functions; they are also known to significantly ameliorate soil and water conservation in many fragile ecosystems. Thus, the agenda of forestry in the 21st Century is not merely a domestic issue of individual countries, but because of its entanglements in climate change, global warming, acid precipitation, ozone depletion, illegal logging and trade, development of agriculture and fishery, the rights of existence and employment of indigenous peoples etc. it is long on the lists of World Conservation Union, World Trade Organization, and International Human Rights Organization with high priority as well as enacting guidelines for actions.

With these in mind, the researchers of the Taiwan Forestry Research Institute (TFRI) often ponder how to advance the domestic forestry research and persistently enhancing the quality of our forest management. In 2014, we've accomplished several important tasks which are described below:

1. On the sustainable development and policy promotion aspect, we've furthered sustainable forest certification. Through cooperation with the Taiwan Forest Certification Development Association, the TFRI has helped the Jang Chang Lumber Industry Ltd. of Zhudong Township, Hsinzhu County to pass the international FSC™ certification and become the first tract of forest to obtain such certification. This represents that domestic plantation forests have passed a major milestone of achieving responsible management.

2. On the silviculture, protection of forest and ecosystem conservation aspect, we've promoted tree health management actions. In conjunction with the Taipei City Government, and the Taiwan Urban Forest Health and Beautification Association, the TFRI has hosted the "2014 International Symposium on Tree Protection—Using the Daan Forest Park as an example of natural disaster prevention practices." In the same month we've also hosted the "2014 International Symposium on Practical Works of Tree Medical/ Tree Art Professionals" providing important references to stipulate guidelines of domestic tree health management.

3. On the technical transfer and academic-industrial cooperation aspect, the staff of TFRI partook in the "2014 International Exposition of Biotechnology, Taiwan." In which "Establishment of a lysosome-associated membrane proteins (LAMP) inspection method for tree brown root rot disease," "Superior strains of Taiwan indigenous Indian mulberry (*Morinda citrifolia*, noni), its cultivation techniques and production of health food from therein," and "The *in vitro* propagation techniques for a rare pendant decorative fern *Lycopodium phlegmaria* L" etc. All received rave attention and opened up their commercialization.

This yearbook represents the compilation of the achievements of our hard working staff in 2014. We shall welcome your comments and wish with all citizens to not forget the teachings of saintly Confucius: The way of the land is to plant trees diligently.

Director General, Taiwan Forestry Research Institute, Council of Agriculture, Executive Yuan
2015/11/01

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前言

Introduction

前言

林業試驗所103年度編制員額為142人，歲入預算數10,185千元，較上年度增列3,288千元，歲出預算數601,545千元，較上年度減列138,858千元。為期各界瞭解本所103年度施政概況，本刊循例以計畫領域為編輯軸心，刊載已結案之計畫成果40項，分作四類呈現：一、林業科技試驗研究計畫23項（佔57.5%）。二、林業發展計畫暨所外委辦計畫9項（佔22.5%）。三、科技部補助專題研究計畫7項（佔17.5%）。四、行政院國家科學技術發展基金管理會補助計畫1項（佔2.5%）。除完成各類計畫外，103年度亦推動多項施政如下：

一、在林業資源生產技術研究方面：利用基因轉殖技術培育出3個青脆枝與12個臺灣粗榧的毛狀根，用以生產抗癌藥物；建立櫸木185個優良嫁接營養系園；建立1.5公頃相思樹種源後裔與種子園；培育速生樹種桉樹，以提供休耕地造林14公頃；完成5個山坡地混農林經營試區的監測，發現其植被覆蓋與林木生長狀況皆為良好，且茶品質亦有提升；針對2.2公頃銀合歡入侵試驗地完成二階段復育造林等。

二、在產學合作與技術移轉研究方面：獲得南洋紅豆杉台紅2號品種權，完成台紅3號品種技術移轉並促成產業造林8公頃，另赴大陸地區申請台紅1號品種權；培育山葵、土肉桂與牛樟優良品系，完成4件技術移轉案，同時促成產業造林牛樟24公頃；篩選出抗風桉樹品系2種、耐熱牛樟品系3種，以及耐熱與抗病泡桐品系1種，促成產業造林20公頃等。

三、在試驗林生態系示範經營方面：完成造林撫育作業33公頃、造林地清查121.6公頃、林地巡護240次；為改善本所偏遠地區氣象站（如森山、鳳岡山、多納、港口、太麻里、哈盆等地）之資料儲存量與維護便利性，完成氣象監測系統由CR10X型更換為CR1000型；完成國內10種常見綠化樹木腐朽病害之莖幹部及根部病原菌之收集、鑑定、分離培養及菌種保存；為落實林木疫情線上通報機制，受理通報案件2,036筆並進行列管；赴全臺採集昆蟲，製作成乾燥針插標本4,826份，另完成蟲籤、條碼籤、鑑定籤製作及針插工作2,656份等。

四、在國家植物園建設方面：於台北植物園新增蒐集原生植物76種4,610株，完成解說導覽14,569人次及資訊網服務448,106人次，辦理生態保育志工培訓13場及種子教師專業班14場，共培訓1,504人次；於福山植物園新增蒐集蘭科植物20種28株、野牡丹科植物4種48株，完成區內植物之物候調查（每月2次）逾1,700株，辦理解說導覽94,790人次、資訊網服務315,096人次，及自然教育研習18場次；於恆春熱帶植物園完成植物蒐集25種120株及其育苗工作，辦理解說導覽6,504人次等。

此外，本刊亦檢附103年度之重要記事、專題演講、出版品項、技轉案件、專利案件、發表報告、預決算、人力資源等訊息，俾供各界檢視本所當年度之整體施政績效。

Introduction

In 2014, the TFRI has 142 formal employees, and an annual income of NT$10.185 million, which showed a slight increase of NT$3.288 million compared to a year ago. The annual expenditure of the year was NT$601.545 million, which showed a reduction of NT$138.858 million compared to a year ago. In order to have the public know about the general operations of TFRI in 2014, this yearbook, following the previous examples, employed our research project domain as the axis, and enlisted 40 concluding project achievements and presented them in four categories: 1) Forestry science and technology research projects, a total of 23 items (making up 57.5% of the total); 2) Forestry development projects and projects entrusted to external agencies, a total of 9 projects (making up 22.5% of the total); 3) Special topic research projects supported by the Ministry of Science and Technology, a total of 7 items (making up 17.5% of the total); and 4) Project supported by the National Science and Technology Developmental Fund Management Committee, 1 item (accounting for 2.5% of the total). In addition to complete the aforementioned research projects, in 2014, the TFRI also endeavored to promote the following policy items as follows:

Ⅰ. On the forest resources production technology research aspect: We've used gene-transfer technology to create hairy roots of 3 strains of fetid nothapodytes *Nothapodytes nimmoniana* and 12 strains of Taiwan plumyew (*Cephalotaxus wilsoniana*). These can be used to produce cancer-fighting drugs. A total of 185 superior grafted scion strains of Taiwan zelkova (*Zelkova serrata*) were established in a scion garden. TFRI has established a progenitor and seed garden of 1.5 ha for *Acacia confusa*; fast-growing eucalyptus trees were also cultured for the purpose of afforestation 14 ha of dormant farmland; in the interim, 5 slopeland mixed agroforest management test plots were monitored, and found that the ground covers and tree growths were in good conditions, while the quality of tea also showed enhancement. Finally, with respect to 2.2 ha of *Leucaena leucocephala* invaded experimental site, a 2-stage restorative reforestation was completed etc.

Ⅱ. On the academia-industry cooperative projects and technical transfer aspect: The TFRI has obtained the cultivar right of Taihong No. 2 *Taxus mairei* and the technical transfer of Taihong No. 3 and advanced 8 ha of industrial plantation of the cultivar. In addition, TFRI has applied for the cultivar right of Taihong No. 1 to the Chinese Mainland region. TFRI scientists had cultured superior strains of wasabi (*Eutrema japonica*), indigenous cinnamon trees (*Cinnamomum osmophloeum*) and stour camphor trees (*C. micranthum*) and completed 4 cases of technical transfer. In the meantime, we've furthered 24 ha of *C. mcrantum* plantation, screened 2 wind-resistant eucalyptus strains, 3 strains of heat-resistant *C. Micranthum*, and 1 strain of disease-resistant *Paulownia fortunei*, as welll as helped the realization of 20 ha industrial afforestation.

Ⅲ. On the experimental forest ecosystem demonstrative management aspect: The TFRI has completed forest tending operation on 33 ha, inspecting and recording of 121.6 ha plantation sites, completed 240 rounds of forest land cruising and protection. In order to improve the data storage and ease of maintenance for weather stations at remote locations (such as Shenshan, Fonggongshan, Duona, Gangkou, Taimalee, Harpen etc.), the weather monitoring system has been switched from CR10X to the CR1000 model. We've also completed the collection, identification, separation, culturing and microbe preservation of decay pathogens on the stems and roots of 10 commonly seen greening plants. In order to consolidate the on line forest tree diseases reporting mechanism, we've answered 2,036 cases of plant diseases reporting and monitored the case progresses. TFRI scientists have roam the island collecting insects and preparing them into pinned dry specimens for a total of 4,826 items; meanwhile insect labeling tags, bar code tags, and identification tags and pinning work of 2,656 items have completed.

Ⅳ. On the construction of national botanical garden aspect: We've increased newly collected indigenous plants of 76 species and 4,610 individuals to the Taipei Botanical Garden. We've provided guided interpretive tours of the botanical garden to 14,569 persons and information website service to 448,106 person-times. At the Taipei Botanical Garden, there were also 13 ecological conservation volunteers training courses; and 14 seed teachers professional classes hosted to train a total of 1,504 persons. At the Fushan Botanical Garden, we've completed a search and collection task of newly increase 20 species and 28 individuals of plants of Orchidaceae family, 4 species and 48 individuals of plants of Melastomataceae family. Meanwhile, twice monthly phenological observations of more than 1,700 plants in the botanical garden were carried out. There were guided interpretative tour handled for 94,790 persons, information web service of 315,096 person-times as well as 18 sessions of natural education seminar were conducted. At the Hengchuen Tropical Botanical Garden, the task of collecting 25 species of 120 individual plants and their seedling culturing was carried out. A total of 6,504 persons were provided with guided interpretive tours there.

In addition, the yearbook also compiled the chronicle of major events, special seminars, items of publications, technical transfer cases, patent cases, reports published, the budgets and fiscal reports, human resources information etc. So that this yearbook can provide the general public a portal for reviewing the overall performances of the TFRI in 2014.

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研究計畫推動及成果

Development and results of research projects

索羅門群島植物誌編撰

鐘詩文、陳建文、邱文良

索羅門群島為一位於南太平洋上的島國，由近千座小島所組成，其熱帶型氣候及山地型地貌特徵，孕育了十分豐富的熱帶植物。自2012開始的「索羅門群島資源植物調查暨植物誌編纂計畫」，集合索羅門群島農業部及Honiara植物園，日本牧野植物園，以及台灣國合會、國立自然科學博物館、林業試驗所、國立清華大學及辜嚴倬雲植物保種中心等單位之研究人力資源，擬調查瞭解索羅門群島的植物資源，編撰植物誌，並促進其資源之保育。本年度(7月19日至8月2日)，採集地點為索國Honiara island的Mataniko Waterfalls和東部的Mt. Vunga Tabu，採得植物標本總計700號超過1,200份植物標本，並蒐集各植物標本的DNA材料，提供日後的植物分類及親緣關係研究。這些標已置於本所標本館中，可供未來植物分類研究之證據標本及參考。初步鑑定採回之標本，發現索國植物組成與台灣相當不同，不少物種未分布於台灣，甚至從所採集的有限標本之特徵，尚無法辨識其科、屬，必須累積更多的植物標本始能完成更精確的鑑定。此外，為加速植物誌之編撰，亦建立標本與圖像資料庫，完成初步之網站架構，擬將所蒐集之資料上網，邀請國際學者協助鑑定，甚或共同參與本研究。索國之植物分類研究並不發達，早期僅有澳洲及歐美少數學者進行少數地點之採集，許多地區仍未有基本的普查，且目前僅有簡要的植物名錄。為保存及永續利用索國珍貴的植物資源，當地植物誌的編撰克不容緩。目前台灣與索國簽有合作備忘錄，台灣植物分類學者應積極投入本調查與研究，並協助該國在此領域之發展，善盡地球村一分子之責任。

索羅門群島之植物多樣性極高。
High plant diversity in Solomon Islands.

Compiling the Flora of Solomon Islands

Shih-Wen Chung, Chien-Wen Chen, Wen-Liang Chiou

The Solomon Islands is a country consisting of nearly 1,000 islands in Oceania. Its unique geographical location, tropical climate, and mountainous topography provide it with a rich and diverse flora. Since 2012, The "Census and Classification of Plant Resources and compilation of the flora in the Solomon Islands" project was collaboratively launched by the Solomon Islands (Ministry of Forestry and the Honiara Botanical Gardens), Japan (Makino Botanical Garden), and Taiwan (International Cooperation and Development Fund, National Museum of Natural Science, Taiwan Forestry Research Institute, National Tsing Hua University, and Koo Botanical Conservation Center). This project aims to bring awareness of the abundant plant resources and comprehensive flora of the country and to facilitate plant conservation. The survey and collection of the flora of Solomon Islands have been conducted (July 19 to August 2), mainly in Mataniko Waterfalls and Mt. Vunga Tabu of Solomon (Honiara). A total of 700 accessions and more than 1,200 specimens were collected. Those specimens were deposited in the herbarium of Taiwan Forestry Research Institute and Solomon (Honiara) Botanical Garden for the vouchers and references of further taxonomic studies and flora publication. The results of preliminary identification of collections show that the compositions are very different from those of the Taiwan flora. Many species in the Solomon Islands are not found in Taiwan. The family and/or genus of some taxa are even not determined yet. More specimens with more characteristics are necessary to accurately identify those taxa. To speed up the flora compilation, the database of specimens, images and the website structure was built. In the near future, those data will be online for the references of international researchers who are interested in this program. They will also be invited to assist in identifying the plants and even collaboratively join the program. The taxonomic study of plants in the Solomon Islands is underdeveloped. Previously the flora surveys were only conducted in limited locations by a few researchers from Australia, the United States, or Europe. Most of the regions are still without basic survey. At present, only a few simple plant checklists have been published. To preserve and sustainably use those precious plant resources, a comprehensive flora is necessary to be finished as soon as possible. A MOU of compiling the Flora of the Solomon Islands has been signed by the institutes of Solomon Islands. Taiwanese researchers should energetically participate in the program and facilitate the taxonomic study of Solomon Islands, as a member of the planet.

森林藥用植物選育及在平地造林之應用

Selecting and Breeding of Forest Medicinal Plants and Application in the Plain Afforestation

吳孟玲、許原瑞

Meng-Ling Wu, Yen-Ray Hsui

台灣中低海拔地區自然環境及資源迭遭破壞，棲地減少致使藥用植物資源嚴重流失，急需設置野外基因庫進行區外保育，並進行藥用植物亮點物種種原蒐集、保存及有效經營管理。有鑑於蓮華池地區植物生態相極為特殊，具藥效的植物達4百餘種，本計畫利用現地優勢，蒐集原生藥用植物種原，設置野外基因庫，調查與蒐集具有特殊精油成分原生藥用植物5種：刺花椒(*Zanthoxylum acanthopodium* DC.)、山胡椒(*Litsea cubeba* (Lour.) Persoon)、土肉桂(*Cinnamomoum osmophloeum* Kanehira)、臭辣樹(*Euodia meliaefolia* (Hance) Benth.)、過山香(*Clausena excavata Burm.* f.) 並進行藥用植物應用於混農林病蟲的屏蔽作物 (barrier crops) 及防禦研究，以達到生物資源永續利用與提昇混農林業經營管理之目標。

The natural environment and resources of lower altitude areas in Taiwan have been repeatedly disrupted, which results in habitats reduction and serious loss of medicinal plants resources. It□s necessary to set up field gene bank for ex-situ conservation and to collect, preserve and manage the important medicinal plant species and genetic resources effectively. Given the extremely special plant ecology in Lianhuachi area with four hundred plants species are known to show medicinal efficacies, the main purpose of this project is to take the on-site advantages, and collect autochthonous medicinal plant species to set up gene pool on the field. Investigating and collecting of 5 major essential oil-rich medicinal plants: *Zanthoxylum acanthopodium* DC., *Litsea cubeba* (Lour.) Persoon, *Cinnamomoum osmophloeum* Kanehira, *Euodia meliaefolia* (Hance) Benth, and *Clausena excavata* Burm were carried out and their application potential as medicinal plants in agroforestry investigated, including serving as barrier crops of pest and disease, and defense effects?, so as to achieve sustainable utilization of biological resources and to improve the management practices in agroforestry.

原生藥用植物對台灣茶蠶蛾 (Andraca theae) 的阻隔試驗

Comparison of the barrier effect of 5 native medical plants (*Zanthoxylum acanthopodium* DC., *Litsea cubeba* (Lour.) Persoon, *Cinnamomoum osmophloeum* Kanehira, *Euodia meliaefolia* (Hance) Benth., *Clausena excavata* Burm. f. and *Zanthoxylum ailanthoides*) on *Andraca theae*, which naturally lives on *Camellia oleifera*.

作物/幼蟲存活率	1齡幼蟲存活率	終齡幼蟲存活率	整體存活率
土肉桂 (*Cinnamomoum osmophloeum* Kanehira)	0%	0%	0%
臭辣樹 (*Euodia meliaefolia* (Hance) Benth.)	0%	0%	0%
過山香 (*Clausena excavata* Burm. f.)	0%	0%	0%
食茱萸 (*Zanthoxylum ailanthoides*)	0%	0%	0%
山胡椒 (*Litsea cubeba* (Lour.) Persoon)	0%	0%	0%
油茶 (*Camellia oleifera*)	100%	100%	100%

提昇活化休耕地經濟樹種造林之生產力研究

Enhancing the productivity of short rotation plantaion on fallow land

杜清澤、黃菊美、何政坤

Chin-Tzer Du, Chu-Mei Huang, Cheng-Kuen Ho

農委會自102年推動「調整耕作制度活化農地計畫」，將原休耕給付經費轉為轉(契)作補貼，休耕地可契作短伐期經濟林。短伐期經濟林一般採用集約經營方式追求林木在短期內達到最大生產量，但這些休耕地在農業使用時期，土地可能已劣化將影響林木之生長，因此必須注意土壤的管理及經營，以維持土地之持續生產力。

休耕田土壤性質及苗木品質，影響造林木生長頗大，目前部份林地已栽植之1年苗木有發生成長遲滯或易受風害之現象，於苗栗地區、高雄美濃地區、台東地區3個地區進行調查，知目前休耕地造林之問題有二，一為土壤因農機壓實而產生土壤壓實，進而導致排水不良，是耕地造林首要面對的土壤物理性劣化問題；土壤經壓實後會阻礙根系之生長，桉樹種子苗的根系生長無法伸入1.25 g/cm^{3}的土壤中(Borges等1986)；而當總體密度高於1.25 g/cm^3 時則抑制山毛櫸的更新，對不定根的發展而言，1.25 g/cm^{3}亦為其臨界總體密度，當BD＞1.35 g/cm^3，不定根的發展幾乎完全被限制(Hildebrand等1983)。經調查各樣區土壤之總體密度值如表1，除台東0-15cm深度外皆大於＞1.35 g/cm^3，不利於根系之發展，阻礙林木生長使易遭各種危害。此一問題可進行土壤物理性質改良措施進行改良。二為苗木品質不良，目前苗木多於苗床留置過久，苗木因而產生苗木徒長及盤根現象，在苗木出栽前應進行選苗作業。

The Council of Agriculture launched the "Cultivation System Adjustment and Fallow Land Reactivation Program" in 2013, which encourages short rotation plantation in the form of contract farming as an alternative to fallow lands with subsidies. Short rotation plantations are usually intensively managed to produce high yields. But the soil of fallow land is often degraded during agricultural use that may lead to low production or failure in plantation afforestation. Therefore, in order to maintain sustainable land productivity, proper soil management is necessary. Soil properties and seedling qualities directly influence the growth of seedling planted on fallow land. One-year old seedlings planted in these areas usually grew slowly and were vulnerable to wind damage. To solve the problems of tree growth on fallow land, soil samples of 6 plantations in 3 areas (Miaoli, Meinong, and Taitung) were investigated.

We've identified 2 major problems of fallow land for afforestation. First, soil compaction due to agricultural use in the past leads to poor drainage, and deterioration of the soil physical properties. Compact soil will hinder the growth of roots. For example, no eucalypt seedling root was found to penetrate into soil having a density of 1.25 g/cm^3 or more (Borges, et el. 1986). If the compression leads to soil bulk densities (BD) higher than 1.25 g/cm^3, beech regeneration was inhibited. When BD is above 1.35 g/cm^3, adventitious root development of plants is almost completely suppressed (Hildbrand et al. 1983). The soil BD of the 3 study areas are shown in Table 1. All soil were too compressed for root growth and might result in seedlings susceptible to various stresses, as most of the soil BDs were great than 1.35 g/cm^3, except a sample from Taitung at 0-15cm depth below ground. The compression of soil can be improved by changing the soil physical properties. The second problem is poor quality seedlings. Currently, seedlings remained in a nursery for too long causing them to develop circling root and abnormal elongation of seedlings. Henceforth, good quality seedlings should be carefully selected before outplanting.

各樣區的土壤容積密度(g/cm^3)

Soil bulk density (g/cm^3) of sample areas.

深度 Depth	苗栗1 Miaoli1	苗栗2 Miaoli2	美濃 Meinong	台東1 Taitung1	台東2 Taitung2	台東3 Taitung3
0-5	1.37±2.32	1.32±2.49	1.47±2.49	1.40±2.49	1.40±2.55	1.22±2.40
5-10	1.57±2.33	1.33±2.45	1.42±2.56	1.34±2.49	1.47±2.57	1.28±2.42
10-15	1.51±2.31	1.35±2.40	1.46±2.56	1.30±2.55	1.42±2.53	1.28±2.42
15-20	1.61±2.42	1.43±2.45	1.56±2.64	1.43±2.60	1.48±2.51	1.40±2.41
20-25	1.50±2.41	1.50±2.45	1.61±2.67	1.40±2.54	1.46±2.51	1.47±2.53
25-30	1.60±2.46	1.55±2.48	1.53±2.64	1.55±2.58	1.39±2.53	1.50±2.53
30-35	1.63±2.49	1.54±2.48	1.52±2.64	1.47±2.56	1.53±2.55	1.57±2.57
35-40	1.61±2.48	1.52±2.51	1.54±2.65	1.63±2.46	1.74±2.94	1.61±2.51
40-45	1.62±2.45	1.55±2.53	1.45±2.74	1.53±2.35	1.75±2.72	1.58±2.51

台北植物園經營及參訪者滿意度調查研究

林奐宇、趙芝良、董景生

本計畫以台北植物園兩大類型遊客（一般遊客與學習團體）為對象，實施問卷調查。調查期間自2014年10月至12月止，分別實得有效問卷461份及182份。

一般遊客對於「台北植物園功能」以及「各項服務與設施」兩大題項重要及表現程度分析（IPA）結果顯示，「導覽機資訊的完整度」及「二維條碼解說服務」為應加強改善之重點，其餘題項皆落於「繼續保持」；受訪者對於台北植物園整體表現程度及滿意度之評分則為：解說及資訊服務78.30分、清潔及維護管理81.69分、整體表現程度及滿意度82.91分（及格60分、滿分100分）。開放式題項中，「廁所清潔及數量」以及「垃圾桶數量」為最多遊客反應之項目。

學習團體之問卷結果與一般遊客雷同，但滿意度評分顯著較高。根據「主題導覽活動」、「台北植物園功能」與「各項服務與設施」三大題項重要及表現程度（IPA）分析皆顯示應「繼續保持」；受訪者對台北植物園整體表現程度及滿意度之評分則為：解說及資訊服務92.74分、清潔及維護管理87.38分、整體表現程度及滿意度89.15分。；開放式題項正面回饋（如：很棒；很好）佔多數。

本研究成果可提供後續研究者針對不同屬性遊客之行為及滿意程度進行深入探討，尚可透過多年度或多期調查比對，交叉比對植物園遊客行為及滿意度變化情形。實務上，本計畫則可提供植物園教育解說及主題展示業務推動之參考，並做為軟硬體設施整建規劃與改善之具體建議。

本計畫實施一般遊客問卷調查情形。
General visitors are filling the questionnaire.

A survey on visitors' satisfaction on Taipei Botanical Garden and its management and maintenance

Huan-Yu Lin, Chih-Liang Chao, Gene-Sheng Tung

The purpose of this study was to collect data from two main types of visitors (general visitors and learning-group visitors) to the Taipei Botanical Garden. A questionnaire survey was conducted from October to December, 2014. A total of 461 valid questionnaires from the general visitors and 182 valid questionnaires from the learning-group visitors have been collected respectively.

According to the results from the importance and performance analysis (IPA), a total of 27 questions from two parts related to the "goals of Taipei Botanical Garden" and "services and facilities" were evaluated by the general visitors. Of these, two items, including "iInformation integrity of the navigation machines" and "Two-dimensional barcode interpretation service" have been identified as the most in need of improvement; others fell on the category of "maintaining the status quo." The average satisfaction scores (with 60 points for passing; and 100 points for full score) across the overall performance items were 78.30 points in the "interpretation and information services;" 81.69 points in the "cleanness and maintenance management;" and 82.91 points in "the overall performance level and satisfaction." The most often identified items among the respondents in the open-ended questions were the "cleaning and quantity of toilets" and "the quantity of trash cans."

Moreover, the results from the learning-group visitors have similar responses but with much higher scores of satisfaction. According to the results of the IPA, a total of 33 questions from three parts related to "satisfaction of the themed guided tours," "the goals of Taipei Botanical Garden," and "services and facilities" were evaluated from learning-group visitors and have been identified belonging to the category of "maintaining the status quo". The average satisfaction scores across the overall performance items were 92.74 points in the "interpretation and information services"; 87.38 points in the "cleanness and maintenance management"; and 89.15 points in the "overall performance level and satisfaction". The most often identified items among these group of respondents in the open-ended questions were positive responses such as "great!" and "well done!"

Following the results of this study, some suggestions pertaining to compare the satisfaction score differences among different types of visitors, and further analysis of the in-depth data were recommended. In practice, this study provides suggestions about future improvements in interpretation and education facilities. It also indicates meaningful recommendations for Taipei Botanical Garden to improve its public service and facilities.

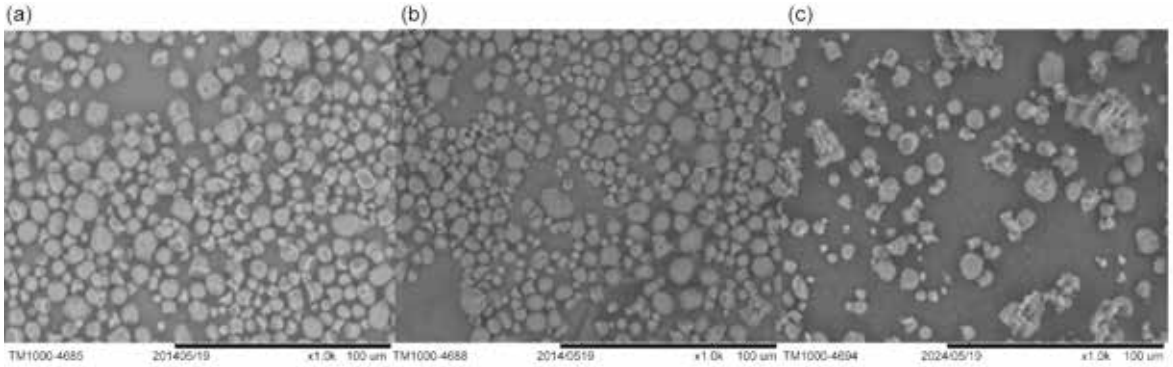
以文字雲方式，分析遊客於開放式題項之反映內容及關鍵字。以假日主題導覽遊客為例，所反映之內容多為正面性文字(如謝謝、解說、很棒、辛苦等)。

Using word cloud method to analyze learning-group visitors' response on the open-ended questions of the contents and keywords. Most are positive feedbacks. (Such as thanks, interpretation, great, work hard, etc.)

台灣地區原產殼斗科植物堅果的開發與利用

張乃航

台灣位於亞熱帶，物種豐富，原生種之殼斗科植物有50多種，其中多數能產生較大型堅果果實，如能開發較大型堅果果實成為食品原料或動物飼料，經濟效益不可限量。本研究以不同乾燥方法，探討青剛櫟、鬼櫟及板栗之種仁粉末的抗氧化能力與總酚含量的關係，及其中澱粉形態特性、橡實粉中直鏈澱粉和抗解澱粉含量。結果顯示粉末中澱粉顆粒大多呈橢圓及多角型，且不同乾燥處理後觀察發現不同的橡實粉色澤不同，分別為青剛櫟粉偏黃、鬼櫟粉偏紅、板栗粉則為粉白色。由於不同橡實粉間多酚含量的差異及乾燥溫度時發生的褐變，不同乾燥處理會造成粉末色澤亮度(L值)有所差異。經40℃熱風乾燥處理的橡實粉，其L值較60℃及凍乾處理者為高，且色澤偏亮。比較不同乾燥處理下，不同橡實粉中直鏈澱粉及抗解澱粉的含量變化。結果顯示以60℃熱風乾燥處理的橡實粉，其直鏈澱粉及抗解澱粉的含量最高。比較三種不同橡實澱粉中直鏈與抗解澱粉的含量，以青剛櫟種仁粉末含有最多直鏈與抗解澱粉。在抗氧化能力測試中，鬼櫟粉以60℃熱風乾燥和凍乾處理後，其DPPH清除自由基的能力及總黃酮含量最高；凍乾處理後的鬼櫟粉，其FRAP還原力和總酚含量也最高。由上述可知，不同乾燥方式會影響三種橡實粉的色澤、直鏈與抗解澱粉的含量及抗氧化活性物質的含量。青剛櫟種仁萃取出之澱粉含較高量之直鏈澱粉，可成為重要之工業澱粉原料，且能成為低GI之食品原料提供減肥食譜及糖尿病患者之用。



青剛櫟種仁粉末經(a)0.5%、(b)0.25%和(c)0.125%氫氧化鈉濃度分離取得之澱粉以SEM放大1,000倍
SEM of *C. glauca* acorn starch granules isolated by a) 0.5%, b) 0.25%, c) 0.125% NaOH solution.

The development and utilization of acorns of the Taiwan Fagaceae plants

Nan-Hang Chang

Taiwan is geologically located at subtropical area. According to the TREES OF TAIWAN (Ou1994), there were over 50 species of Fagaceae plants in Taiwan, most of these widely distributed. They all produce big acorns. Acorns are easy to collect, store, and process. However, the use of acorns for human, livestock, domestic fowl and wildlife foods are negligible. The objectives of the present study are to estimate the influences of different drying treatments of acorns powder on the physiochemical characteristics of acorn starches. Starch powders from *Cyclobalanopsis glauca*, *Lithocarpus castanopsisifolius*, and *Castanea mollissima* acorns were isolated and dried under different conditions. The content of biologically active substances (antioxidants and total polyphenols), the shape of starch granules, and contents of amylose and resistant starch (RS) of differently treated acorn powders were investigated. Starch granules were observed by using scanning electron microscope (SEM). The observed results showed that starch granules of investigated acorns were oval or irregular in shapes. The colors of acorn starches from *Cy. glauca*, were powder-white with a yellowish tinge; the one from *L. castanopsisifolius* were powder-white with a red tone; and that of *Ca. mollissima* were powder-white. The color? whiteness (*L** value) of acorn powders varied according to the contents of total polyphenols. Browning reactions occurred under different drying conditions. The results showed that acorn powders dried with hot air at 40℃ presented higher *L** value than the other drying conditions in the study. The effects of drying methods on the amylose and RS content of the samples were also evaluated. The results indicated that acorn powders dried by hot air at 60℃ had the highest amylose and RS content than the other drying conditions. Meanwhile, acorn starch isolated from *C. glauca* displayed the highest amylose and RS content among the samples. Antioxidant activities of acorn powders were assessed by both DPPH and FRAP assays. The results of DPPH and FRAP assays indicated that *L. castanopsisifolius* acorn powders showed the highest anti-oxidant capacity. According to the results, drying conditions would influence physicochemical properties (color, polyphenol content, amylose and RS content, and antioxidant capacity) of the acorn powders. Therefore, how to establish suitable processes for acorn flour production would be a main contention in the future. The results also suggested that *C. glauca* acorn powder has high amylose and RS content, and may have a great potential in the low glycemic index (GI) functional food industry.

氣候變遷下廣泛分布樹種之選育與利用

簡慶德

為建立櫸木營養系種子園，本研究選拔全台各地櫸木精英母樹，以胸徑90cm以上，樹幹通直，樹形優為首，並採用無性嫁接方法培育苗木。櫸木嫁接成活率高，這些嫁接苗木已分別栽種高雄六龜多納地區和南投魚池鄉地區。

櫸木和樟樹種子為中間型的儲藏性，而烏心石種子為乾儲型的儲藏性。櫸木和樟樹乾燥種子(含水率10%以下)分別浸在液態氮(-196℃)中，發現櫸木種子30個月後發芽率從53%下降至20%，而樟樹種子12個月後發芽率從83%下降至0%，顯示櫸木和樟樹種子乾藏後無論儲藏在何種溫度(如5℃、-20℃、-196℃)，種子仍會持續敗壞。因此，樟樹種子每年都要採收，若需儲藏，只進行短暫的6個月儲藏，而櫸木種子儲藏後應特別注意每年必須檢查一次種子發芽率，以便適時採種更新。烏心石種子乾燥(含水率10%以下)儲藏在5℃、-20℃或-196℃，3年後仍有很高的發芽率，證實為乾儲型的種子。建議烏心石果實成熟採收後，紅色假種皮必須去除，然後乾燥儲藏。櫸木種子沒有休眠性，播種後一個月內發芽完畢。烏心石種子有形態生理的休眠，播種前使用5℃層積處理4-8週，可促進種子發芽。樟樹種子有生理的休眠，且種皮厚硬，胚難以突破種皮發芽，利用15%過氧化氫處理25分鐘，可減弱種皮的機械阻力，促進種子發芽。

Selection, cultivation and utilization of widely distributed trees to adapt to climate change

Ching-Te Chien

In order to establish clonal seed orchards, plus trees of *Zelkova serrata* in nature forests with DBH > 90 cm as well as straight trunk were selected and the scions were collected for grafting. Successful grafting were more than 90%. The grafted seedlings had been planted in Kaohsiung and Nantou Counties.

Seeds of Z. serrata and *Cinnamomum camphora* have intermediate storage behavior, and seeds of *Michelia compressa* has orthodox storage behavior. Further study found that germination of seeds of *Z. serrata* decreased from 53% to 20% when dried seeds (M.C. below 10%) were stored at liquid nitrogen for 30 months, whereas seed germinations of *C. camphora* decreased from 83% to 0% within 12 months. Thus, the stored seeds of *Z. serrata* must be checked for germination every other year and the seeds of *C. camphora* must be harvest every year. However, the dried seeds of *Michelia compressa* are able to be stored at 5℃, -20℃ or -196℃ for 3 years, provided that the arils are removed and the seeds cleaned.

Seeds of *Z. serrata* germinate easily, but seeds of *M. compressa* have morphophysiological dormancy and the seeds cold-stratified for 4-8 weeks can increase germination percentage. Seeds of *C. camphora* have physiological dormancy and seed dormancy would be released by 15% hydrogen peroxide to promote seed germination.

人工林地下部周轉率對土壤養分的影響

杜清澤、黃菊美、林國銓

細根是植物和土壤之間的介質，從而在森林的碳、養分和水分循環中起到至關重要的作用(M. Lukac 2012)。雖然活細根生物量僅構成總林分生物量的一小部分，但細根生產率往往超過森林生態系統地上部的生產率(Hendrick and Pregetzer 1993)。他們的持續增長和枯死通常被稱為細根的周轉，在土壤中構成一個主要的碳輸入角色對地下部的碳循環有著顯著的貢獻；因此，準確估計細根現存生物量和其周轉率是非常重要的(M. Lukac 2012)。

本計畫以台灣東部花蓮縣平地造林的人工林台灣櫸(*Zelkova serrata*)、台灣欒樹(*Koelreuteria formosana*)、楓香(*Liquidambar formosana*)、光蠟樹(*Fraxinus formosana*)、烏心石(*Michelia compressa*)、杜英(*Elaeocarpus decipiens*)等6個樹種為對象，估算細根(<5mm)的生產量、周轉率以明解細根的動態變化並分析土壤養分與細根生產量和周轉率等之相關性。各樹種不同深度之細根年產量及周轉率如表1，總結如下：

1. 6個樹種0-30cm深度之細根年產量以楓香的最高(4.02 kg/m^3)，台灣櫸次之(2.89 kg/m^3)，其餘依次為烏心石(2.72 kg/m^3)、台灣欒(2.15 kg/m^3)、光蠟樹(1.91 kg/m^3)、杜英(1.30 kg/m^3)。
2. 不同土壤深度之細根產量各樹種在0-5cm在各月份大都有最大的細根產量。
3. 各樹種不同月份細根生物量生產高峰期在3-9月份，即春末至夏末之間。楓香及杜英之細根生物量高峰是3月份，台灣櫸細根生產高峰在5月間，7月份則是烏心石及光蠟樹細根生物量之高峰期，而台灣欒於9月份為細根產量之高峰期。
4. 試區內各樹種<5mm之細根周轉率如次：楓香及台灣櫸0.96 yr^{-1}最高，而烏心石最低0.79 yr^{-1}；而台灣欒、杜英為0.95 yr^{-1}、光蠟樹為0.94 yr^{-1}。
5. 造林地土壤養分與細根生物量等之相關性各樹種呈現不一致之現象，此方面之研究尚需進一步探討。

各樹種不同深度細根之年生產量及周轉率
The annual productions and turnover rates of fine roots for different tree species.

樹種 *species*	年生產量annual production (kg/m^3)				周轉率turnover rate (year^{-1})			
	0-5cm	5-15cm	15-30cm	0-30cm	0-5cm	5-15cm	15-30cm	0-30cm
烏心石 *Michelia compressa*	3.44	1.20	1.19	2.72	0.57	0.32	0.38	0.79
楓香 *Liquidambar formosana*	1.17	1.16	1.84	4.02	0.61	0.84	0.76	0.96
杜英 *Elaeocarpus decipiens*	1.37	1.62	0.76	1.30	0.62	0.73	0.65	0.95
台灣櫸 *Zelkova serrata*	3.02	1.78	1.16	2.89	0.74	0.84	0.77	0.96
光蠟樹 *Fraxinus formosana*	2.04	1.51	0.94	1.91	0.67	0.82	0.73	0.94
台灣欒 *Koelreuteria formosana*	2.38	2.22	1.36	2.25	0.69	0.87	0.80	0.95

Effects of belowground root turnover in plantations on the soil nutrients

Chin-Tzer Du, Chu-Mei Huang, Kuo-Chuan Lin

Fine roots constitute an interface between plants and soils and thus play a crucial role in forest carbon, nutrient and water cycles (M. Lukac 2012). Fine root productivity often exceeds aboveground productivity in forest ecosystems, despite the fact that live fine root biomass constitutes only a small fraction of total stand biomass (Hendrick and Pregetzer 1993). Their continuous growth and dieback, often termed turnover of fine roots, may constitute a major carbon input to soils and significantly contribute to the belowground carbon cycle. It is important to accurately estimate not only the standing biomass of fine roots, but also its rate of turnover (M. Lukac 2012).

The objectives of the present study were to understand dynamic changes of the fine root, and the correlation among soil nutrients and fine root production for different plantations. For these purposes, the study was conducted in six plantations (*Zelkova serrata*, *Koelreuteria formosana*, *Liquidambar formosana*, *Fraxinus formosana*, *Michelia compressa*, and *Elaeocarpus decipiens*) located in Hualien County, Taiwan. The biomass production of fine roots (< 5 mm), the fine-root turnover rate, and major nutrients of soil for the 6 plantations were measured and estimated. The annual biomass productions and turnover rates of fine roots for the species are shown in Table 1, and summarized as follows:

1. *L. formosana* has the highest annual fine-root production (4.02 kg/m^3) in 0-30 cm of soil depth, the second is *Z. serrata* (2.89 kg/m^3), and arranged in descending sequence is *M. compressa* (2.72 kg/m^3), *K. formosana* (2.15 kg/m^3), *F. formosana* (1.91 kg/m^3), and E. decipiens (1.30 kg/m^3).
2. The monthly investigations of root biomass at different soil depths indicated that the highest biomass of fine roots for all tested tree species was observed in 0-5 cm of soil depth.
3. The peaks of fine-root biomass production for each tree species occurred during the end of spring to the end of summer (March to September). The fine-root production for each tree species peaked in March (*L. formosana* and *E. decipiens*), May (*Z. serrata*), July (*M. compressa* and *F. formosana*), and September (*K. formosana*), respectively.
4. The turnover rates of fine roots (< 5 mm) for each tree species were 0.96 yr^{-1} (*L. formosana* and *Z. serrata*), 0.95 yr^{-1} (*K. formosana* and *E. decipiens*), 0.94 yr^{-1} (*F. formosana*), and 0.79 y^{r-1} (*M. compressa*) , respectively.
5. The inconsistencies in relevances of soil nutrients and fine root biomass for each species indicated that this issue needs to be further explored.

墾丁海岸林復育作業地二階段造林可行性之評估

陳芬蕙

墾丁國家公園內遭外來種銀合歡入侵情形嚴重，林業試驗所與墾丁國家公園管理處自2007年至2009年期間曾於墾丁國家公園進行熱帶海岸林復育作業，於當地復育造林栽植許多海岸原生樹種，然初期多為陽性先驅樹種，缺乏其它演替較為後期的耐陰樹種。位於恆春西海岸的石珠試驗地於2008年銀合歡移除後，隨即進行第一階段造林(17種原生樹種)，為加速海岸林的復育速度與增加其生物多樣性，在銀合歡移除後4年，進行第二階段造林試驗，栽植11種恆春半島林下耐陰原生樹種。本試驗針對上述栽植造林苗木之存活及生長情形定期調查，並持續監測試驗地上天然更新植物之數量變化。

第一階段造林苗木於栽植6年後約有50%存活，平均地徑與高度分別為41 mm、222 cm，以黴楊表現最佳，台灣海桐次之。第二階段造林之林下栽植苗木於栽植23個月後平均成活率為74%，平均地徑與高度為12.9 mm與84.5 cm，如綜合存活與生長情形，以稜果榕與恆春厚殼樹表現較佳。這些適合於恆春半島海岸林復育造林之原生樹種，可供未來其它地區選擇復育栽植樹種時參考。天然更新植被中胸高直徑(DBH)≧1cm之原生木本植物密度從2,000株/ha增加至超過3,400株/ha，平均樹高約為3.5 m，組成以構樹最優勢。銀合歡移除6年後，已成功由天然更新木與栽植苗木逐漸取代銀合歡。

墾丁海岸林復育作業地第二階段造林苗木(A.茄冬, B.水黃皮, C.山欖, D.鐵色)
Subsequent planted seedlings in Kenting coastal forest restoration area
(A. *Bischofia javanica*, B. *Millettia pinnata*, C. *Planchonella obovata*, D. *Drypetes littoralis*).

Evaluation of the second-stage plantings in the Kenting coastal forest restoration area

Fen-Hui Chen

Leucaena leucocephala, an exotic invasive species, has spread widely and seriously threatened the natural ecosystem in Kenting National Park. During 2007 to 2009, TFRI and Kenting National Park initiated a tropical coastal forest restoration project. Many native tree species were re-planted for the restoration purpose. However, a majority of the surviving plants were shade-intolerant tree species, and mid or late successional species were very few. At the Shihtzu restoration site, located at the west coast of Hengchun peninsula, *L. leucocephala* was removed in May 2008, followed by planting of 17 native species in June. In order to facilitate restoration and increase biodiversity, a subsequent planting of seedlings of 11 shade tolerant species were implemented in 2011, 4 years after the first planting. The major tasks of this study were to 1) survey the survival and growth conditions of the restoration seedlings; and 2) to monitor changes in the amount of natural regeneration vegetation and *L. leucocephala*.

About half of the seedlings from the first planting survived after 6 years. The average ground diameter and height of the surviving seedlings were respectively 41 mm and 222 cm. Species with the best performance was *Thespesia populnea*, followed by *Pittosporum pentandrum*. For the second-stage planted seedlings, the overall survival rate of these shade tolerant species was about 74% after 23 months of planting. The average ground diameter and height of surviving seedlings were respectively 12.9 mm and 84.5 cm. When considering both survival and growth, *Ficus septica* and *Ehretia resinosa* were the most successful species. Information of the shade tolerant species will be an essential reference for future restoration plans in Hengchun peninsula.

Broussonetia papyrifera was the most dominant naturally regenerated tree species at the Shihtzu restoration site. The density of natural regenerated trees (DBH≧1 cm) increased from 2,000 to 3,400 individual/ha, and the average height of trees was 3.5 m. Six years after the removal of *L. leucocephala,* natural regenerated and planted trees have gradually and successfully replaced *L. leucocephala*.

油茶之優良品系選拔及提升利用效能研究

Selection of Strains of Oil Camellias and Enhancement of their Utilization

許俊凱

Chun-Kai Hsu

本研究以蓮華池研究中心為基地，進行不同油茶種源之保存、蒐集與利用、油茶種籽儲存及油品品質之研究、油品分析和鑑定，以及油茶相關產品的開發利用，以提供產業界與林農經營管理之參據。

研究成果中，農民之油茶品系部分，則已建立69個優良單株相關經濟性狀等之基本資料建立，作為未來選育工作之依據，同時也建立了4個試驗區域，以進行後續品系檢定與油茶園經營管理研究；油茶種子的發芽特性與其儲藏行為部分，大果種及小果種油茶種子均不耐乾燥，係屬壽命較短的溫帶異儲型種子；小果油茶葉乙醇粗萃物之體內抗氧化試驗部分，抗氧化能力在不同品系之間存有差異。小果油茶葉乙醇粗萃物成分分離部分，已分離並鑑定出4個化合物，皆具有良好之抗氧化活性；至於油茶籽在榨油前之焙烤是否對油品產生影響，結果顯示，經過烤焙處理，可以有效提高油脂的抗氧化活性及氧化安定性，此結果可作為油籽榨油製程設計重要的參考。至於茶籽帶殼與否及炒培處理之榨出油品質比較，結果顯示，無殼者產率高於帶殼者13%。且不論帶殼與否，隨著炒焙條件的增強(130℃,15分鐘)，酚類化合物含量及還原力隨之增加，並且在合宜的炒焙處理條件下，油脂品質佳、儲藏安定性也較佳，此結果可作為油籽榨油製程設計重要的參考。

This study aimed to collect genetic resources of oil Camellias, to analyze the characteristics and oils from different varieties, and their storage conditions, etc., so as to find good varieties and good practices that will contribute to better the oil Camellia industry.

The results of the study are shown as follows:

1. We selected 69 superior trees and measured their economic traits, for the purposes of breeding them in the future. And we have established four sites for comparative tests of family lines of the superior trees, and to carry out studies on cultivation and management.
2. The seeds of oil-tea Camellias are intolerant to low moisture content and possibly belong to the temperate recalcitrant type.
3. The antioxidant capacity of the extracts from the leaves of oil-tea Camellia (*Camellia brevistyla*) was different among strains. The leaves of oil Camellias were collected and extracted by ethanol. The EA fraction was further separated and identified 4 compounds, and all the 4 compounds processed good Camellias activities.
4. The camellia oil quality can be improved and become oxidatively more stable with adequate roasting treatments.
5. Results of roasting the seeds of oil-tea Camellias indicated that shelled seeds produced 13% more oil than those with shell on. Regardless of with or without the shell, along with the increasing intensity of roasting (130℃ for 15min), the phenol content and reducing power also increased. At suitable roasting treatment conditions, the oil quality will be better and oil will be more stable during storage.

派員參加IUFRO 2014年大會

Attending the IUFRO World Congress 2014

黃裕星

Yue-hsing Huang

IUFRO (國際林業研究機構聯合會)世界大會每5年召開一次，以促進國際森林科學合作交流為宗旨。第24屆IUFRO世界大會主題為「永續森林、永續人類：科學研究扮演的角色」，於2014年10月5-11日假美國猶他州鹽湖城舉行。本屆會議聚集了來自全球100個以上國家的2,500名科學家，以及來自北美洲的1,200位專業林業人員，發表對森林科學當前與未來研究需求之報告及討論，逾1,300篇口頭報告，及近1,300篇海報展示。

本屆IUFRO世界大會同時召開研究機構首長論壇(The IUFRO Directors' Forum)，檢討目前林業研究的問題，包括研究地區及議題日趨零碎化、林業研究機構被整併於其他更廣域的研究機構等。針對各國林業研究機構首長的問卷調查結果也顯示，林業研究方向逐漸由應用性林學研究，轉為一般科學研究。除了森林與人類的議題外，更多新的林業研究優先課題，如森林與土壤、森林與水之交互關係等，都有待加強研究。

綜合本次會議心得及建議如下：

(一) 當前林業社群所面對的巨大挑戰，必須由科學家整合成研究網絡，延攬更多相關領域人才，以解決這些高度複雜的議題。

(二) 加強都市林多功能建設並與氣候變遷、糧食安全與國民健康等議題相結合。

(三) 山區農村社區之整合性發展規劃，可借鏡國外經驗，發展類似日本里山事例之山村地區建設模式。

(四) 森林生態系服務功能更趨多元化，應充分彰顯其對人類永續發展之重要性。

The IUFRO World Congress is the biggest event of the organization, and is usually held every five years. IUFRO's main purpose is to foster international collaborations in forest science. The 24th world conference of the IRFRO (International Union of Forest Research Organizations), titled "Sustaining Forests, Sustaining People: The Role of Research," was held on 5-11 October 2014 in Salt Lake City, Utah, United States. The conference brought together 2,500 scientists from more than 100 countries and 1,200 professional foresters from North America. There are more than 1,300 oral presentations and nearly 1,300 posters in this conference.

The IUFRO Directors' Forum is also held with the IUFRO World Congress to review some current issues about forestry research. These include gradual fragmentation of research areas and topics and that some forest research institutes are merging into institutions with a wider specialization. The results of the survey of the directors of national forest research institutes over the world demonstrated that approaches for forest research are gradually shifting from applied science to general science. Addition to the relationship study of forest and humans, there are many other topics, the interactions between forest and soil, forest and water for examples, which have few predecessors and need to be investigated further.

Along with discussions, reports were also released on the issues that should be addressed by current forestry science and by future research. The results and suggestions from the conference are summarized as follows:

(1) With regard to the huge challenge faced by today's forest societies, it requires scientists to recruit more talents in related fields by integrating a research network so that the highly complex issues can be addressed.

(2) It is paramount to strengthen multifunctional urban green infrastructure jointing with issues such as climate change, food security and citizen health.

(3) For planning an integral development of mountain farming communities, it is advised to learn from foreign experience to develop a mountain village model in accordance with Satoyama initiatives.

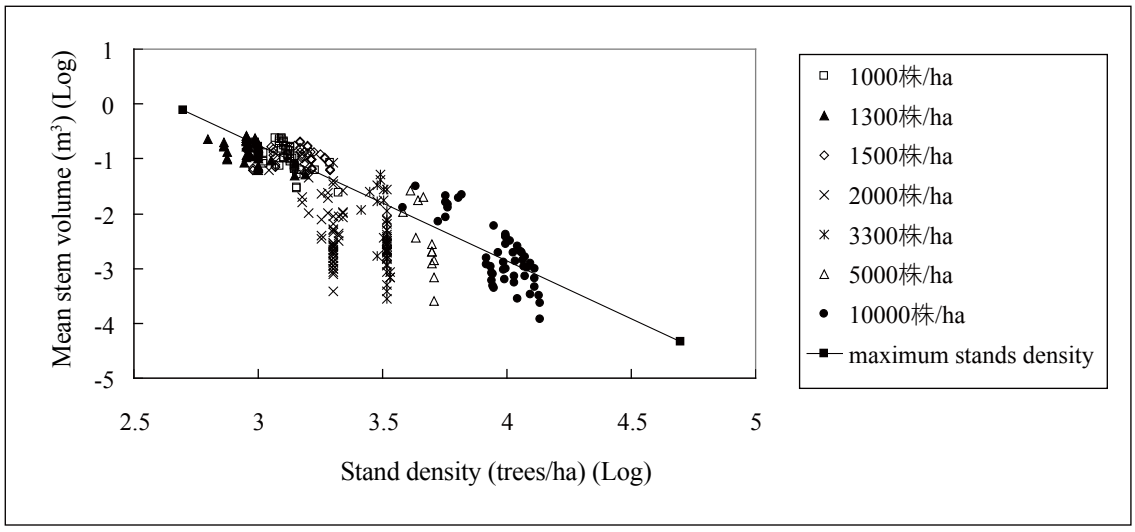
(4) A more diverse ecosystem service of forest is essential to a more sustainable development for the humankind.

棲蘭山檜木林永續經營之研究

邱志明

不同類型檜木林林分組成及結構方面：本年度調查皆伐人工林和天然更新檜木林發生枯死率或自我疏伐，達到5%之樣區為資料，以最小二乘法進行配置二種林分之最大密度曲線或自我疏伐曲線配置，皆伐人工林斜率為-1.70700，截距4.787，天然更新檜木林斜率為-2.122，截距5.615。四種不同類型的檜木林分中，共調查到102種(50科)地被植物，以及21種(11科)天然更新喬木類樹苗。在種類多樣性上，地被植物組成的有效種數為17.3，而擇伐天然更新樹苗的多樣性則較低，僅有6.9，四種檜木林，樣區地被植物有顯著差異，地被植物種類豐富度以枯立倒木整理林最高，其次為未干擾之天然林，再次為人工林，最低為天然更新檜木林。至於在天然更新樹苗的多樣性上，情形則略有不同，大小順序為未經整理天然林、人工林、枯倒木整理檜木林、擇伐天然更新林。

生物多樣性之監測方面：中大型哺乳類調查共有310次獨立之自動相機取樣，攝得2,710筆哺乳類影像。天然林、整理林、人工林3種林相以整理林的物種數最豐富，物種組成於3種林相皆以山羌的相對百分比最高。山羊在3種林相間出現率有顯著差異(ANOVA, p=0.01)，山羌及台灣獼猴於3種林相間出現率無顯著差異。主成份分析顯示天然林與整理林分群不明顯，人工林出現較多的山羊、鼬獾、食蟹獴；天然林N4樣區獨立出現，與山羌、野豬相對出現率高有關；整體看來人工林自成一群。



扁柏天然更新檜木林7種不同林分密度之平均材積軌跡曲線與最大密度曲線

Mean stem volume trajectories and asymptote of the maximum size density for natural regeneration stands of *Chamaecyparis obtusa* var. *formosana*.

A study on the sustainable management of cypress stands in Chi-lan-shan area

Chin-Ming Chiu

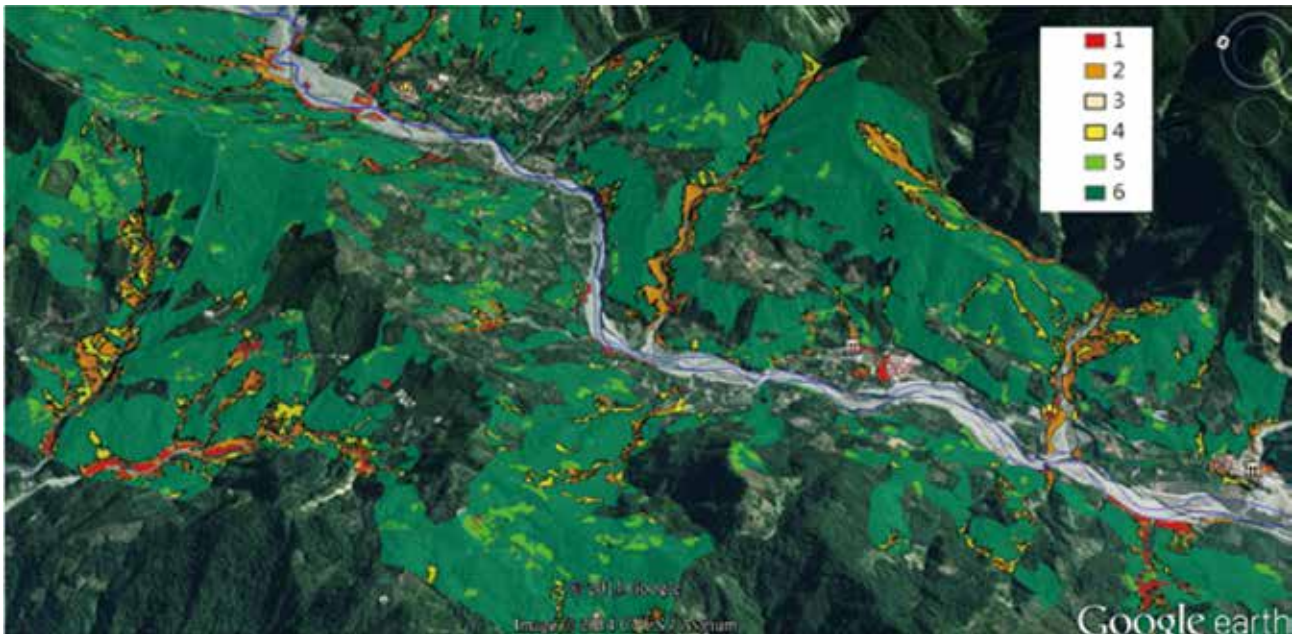
The purpose of the study this year was to investigate the self-thinning of various cypress stands. In the post-clear cut man-made forests and naturally regenerated forests, we've investigated the plots that the tree mortality or self-thinning rates reached 5%, and using the plot data on the number of trees per hectare (P) and the mean stem volume per tree (v) to fit with the least-square method the maximum size-density curve and to obtain the experimental equations. The man-made forest and naturally regenerated forest had slope values of -1.70700 and -2.122, and intercept values of 4.787 and 5.615 in logarithmic scale, respectively. With respect to the estimates of total species diversity, the effective number of species was 17.3 for the ground-layer vegetation and only 6.9 for the naturally regenerated seedlings. Thus, there were significant differences on the diversity of ground-layer vegetation among the four different cypress forest stands. The snags-and logs-cleaned stand held the highest species richness, followed by the undisturbed natural stand, the plantation stand, and the naturally regenerated stand in a descending order. The situation was different for the diversity of naturally regenerated seedlings, and the rank order changed as: the undisturbed natural stand > the plantation stand > the snags-and logs-cleaned stand > the natural regeneration stand.

On the monitoring of large mammals, we obtained 310 independent camera-trapping samples, and retrieved 2710 mammal images. Among the 3 forest types, i.e. undisturbed natural stand, the snags-and logs-cleaned stand and plantation, the managed forest has the most mammalian species. A major part of the mammal images was Reeve's muntjac in each of all 3 forest type. Occurrence frequency of Formosan serow was distinctively different (ANOVA, $p = 0.01$) within 3 forest types, yet it showed no difference for both Reeve's muntjac and Formosan macaque. A principle component analysis (PCA) plot showed no segregation between undisturbed natural stand and undisturbed natural stand. The undisturbed natural stand site N4 is isolated from the other undisturbed natural stand sites, which may relate to the higher occurrence frequency of Reeve's muntjac and Formosan wild-boar. On the whole, plantations were more or less grouped together in their properties.

應用遙測及地理空間資訊技術於公私有林地崩塌監測與影響評估

謝漢欽

本研究從南部地區公私有林地選取、高雄那瑪夏、高雄茂林2個144平方公里試驗區。應用2個試區2007年、2009年及2011年3個時期的福衛二號影像，完成了各個試區3期影像輻射值常態化處理、多譜與全色影像融合及空間幾何再對位處理。以2009年影像為基準，進行紅光段與紅外光譜迴歸常態化處理，產生兩區兩個時期的NDVI植生指標影像。選定2個試區的NDVI影像分類處理程序，萃取3年期非植生覆蓋區域；分析結果2個試區之3期全區分類準確皆達90%以上。應用非植生覆蓋組類，配合物件導向之決策樹後分類處，萃取非植生覆蓋地及崩塌地，以之進行試區3個時期的非植生覆蓋地及崩塌地變遷分析。研究結果顯示，從兩個試區2007至2009年與2009至2011年的林業用地崩塌地面積增加率來看，可看出2009年莫拉克颱風造成崩塌影響要高出之後兩年兩試區在諸多干擾事件的崩塌影響；兩區平均影響力比較下，莫拉克颱風影響力為兩年後5.12倍。試區林業用地之6個崩塌影響分級圖與試區內山村聚落套疊分析，可發現除了接近河道邊緣外，與村落周邊的道路及鄰近山坡落在危險的前1至3級內的區位可以作為警戒及加強水土保持的參考依據。有關位在危險的前1至3級之林業用地部分，土地管理單位可依林道是否可及與是否立即危害到近鄰或下游的山村的安危，擬定治山防洪措施及因應的策略。



將那瑪夏試區崩塌敏感區位分級圖套疊於Google Earth上，可進行不同角度與尺度的3D觀看，並可瞭解崩塌敏感區位對位於試區內山村的空間分布關係，圖右上角圖例以不同顏色顯示崩塌敏感區位分級，紅色1級代表敏感度最高。

The 6-grade landslide sensitivity map of That-Maxia experimental area for evaluating landslide impacts can be overlaid on the Google Earth. The relation of landslides distribution at different scale of 3D views can be seen. And alarm information for the surrounding mountain villages can be provided. The legend on the upper right part of figure represents the 6-grade of landslide sensitivity in different color and the red one stands for the most sensitive level.

Using Remote Sensing and Geospatial Information Technology to Monitor and Evaluate Landslide impacts on the Public and Private Forest Lands

Han-Ching Hsieh

Two experimental areas were selected in this study, Mao-lin and That-Maxia, from the public and private forestlands in Kaohsiung District. Three 144 km^2 FORMOSAT II Satellite images covered the two experimental areas were obtained in 2007, 2009 and 2011 for carrying out the studies. An image preprocessing procedure including solar radiance normalization and geometric correction was developed to derive normalization difference vegetation index (NDVI) for each time image. Using the NDVI images extracted by forest-use land layers, with an decision tree classification approach, the non-vegetation areas and landslide areas could be discriminated from forest-use land. After implementing the landslide change analysis through spatial overlay analysis of the three time periods, eight kinds of landslide area changes could be found. Combining the eight kinds of changes according to landslide stability principle, a 6-grade sensitivity map was made for the evaluation of landslide impacts to the forest-use land of the two experimental areas. The results show that judging from the rates of change of the landslide areas from 2007 to 2009, the average impact of typhoon Morakot is 5.12 times the rate from 2009 to 2011. And, the 6 grades sensitivity spatial layer for the evaluation of landslide impacts can be overlaid on the Google Earth to see the impacts of landslide distribution in different 3D views to the mountain villages and provide adaption strategies for landslide management to the related government agencies.

天然林疫病菌與腐霉菌的調查及影響評估

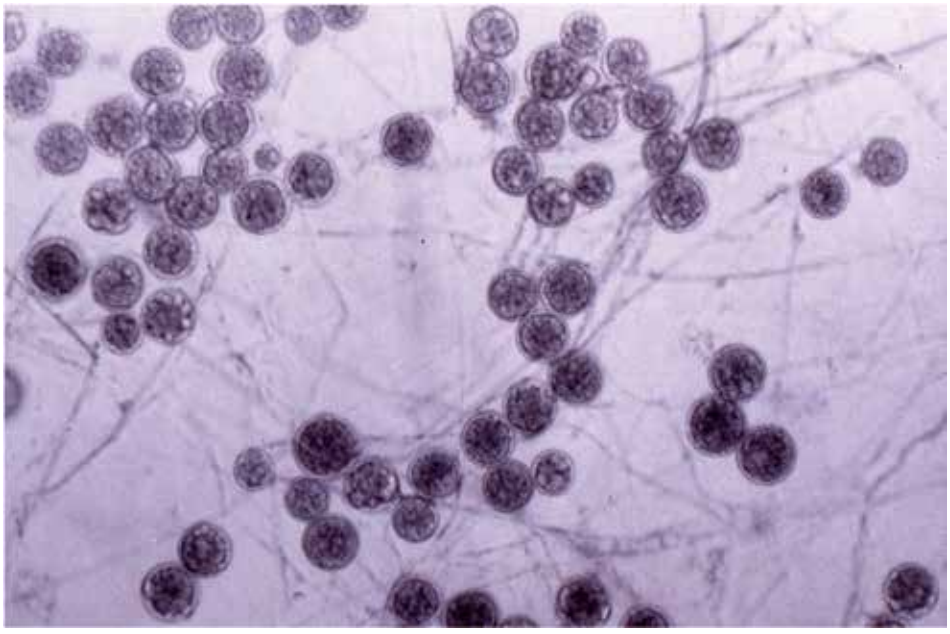
Investigation of *Phytophthora* and *Pythium* in natural forests and evaluation of their influences

張東柱

Tun-Tschu Chang

自東部三個山區(花蓮太魯閣山區、花蓮玉里山區及台東海端山區）採取相關土壤，以土壤誘釣法分離疫病菌及腐霉菌。將採得的土壤大約200ml放入1,000ml的燒杯，加水至300-400ml後加以攪拌，將5-7片杜鵑的幼葉放在土壤懸浮液的表面後放置在室溫下2-5天，當杜鵑葉片產生壞疽斑點時以自來水清洗1-2小時後，再將晾乾病組織放在選擇性培養基中，將此培養皿放在室溫2-4天將可看到菌絲自培養基長出，並移植到10% V-8 juice洋菜培養基。共獲得60多株疫病菌及80多株腐霉菌，已鑑定 的疫病菌有3種：*Phytophthora cinnamomi*, *P. cryptogea*及*P. katsurae*；腐霉菌 有15種：*Pythium deliense*, *P. oligandrum*, *P. splendens*, *P. spinosum*, *P. ultimum*, *P. gracile*, *P. aphanidermatum*, *P.carolinianum*, *p. helivandrum*和 *P. vexans*及5種*Pythium* spp.。另外本計畫也配合德國學者Dr.Jung調查以殼斗科為主的疫病菌，經由型態及DNA分析，初步獲得6個*Phytophthora*新種。在疫病菌中以*P. cinnamomi*的分離株最多，共有46株，經測試其配對型，及A1與A2分別為24及22株型 接近1:1。

Soil samples were collected from three nature forests and a soil baiting method was used to isolate *Phytophthora* and *Pythium*. About 200 ml of soil samples were placed in 1,000 ml beakers, to which distilled water was added to a total 300-400 ml. Five to seven leaf pieces of azalea leaves as baits were floated in each beaker for 2-5days at room temperature. Lesion baits were washed under running tap water for 1-2 hours and blotted dry. Pieces of lesion baits were placed on the selective medium. After incubation at 25℃ for 2-4days, mycelia growing from leaf pieces were transferred to 10% V-8 juice agar. More than sixty *Phytophthora* and eighty *Pythium* isolates were obtained from those soil samples. Three species of *Phytophthora* including *Ph. cinnamomi*, *Ph. katsurae*, *Ph. cryptogea* has been identified; Fifteen species of *Pythium* including *Py. splendens*, *Py. spinosum*, *Py. ultium*, *Py. vexans*, *Py. gracile*, *Py. aphanidermatum*, *Py. carolinianum*, *Py. helicandram*, *Py. Deliense*, *Py. oligandrum* and five other *Pythium* spp. have been identified. *Ph. cinnamomi* was the most dominant species in *Phytophthora*. The 46 isolates of *Ph. cinnamomi* were tested for their mating types. And A1 and A2 mating types were respectively 24 and 22 isolates. The ratio was about 1:1.



Pythium splendens 的菌絲與厚膜孢子
Mycelia and clamydospores of *Pythium splendens*

擴充「台灣外來入侵種資料庫」：潛在外來入侵種

Update and expanding "Taiwan Invasive Alien Species Database": Potential IAS

趙榮台、林朝欽、陸聲山、蔡明諭、許福敦

Jung-Tai Chao, Chau-Chin Lin, Sheng-Shan Lu, Ming-Yu Tsai, Fu-Tun Hsu

本計畫透過專家訪談及文獻收集，擴充、更新「台灣外來入侵種資料庫」及網站，以利專家學者及一般大眾能夠獲得相關資訊，進而降低外來種入侵的風險，維護生物多樣性。自2014年1月1日至11月20日止，共完成(1)維護及更新資料庫網頁：網頁美編、英文版網頁建立與測試；(2)更新資料庫物種基本資料100筆；(3) 依專家學者意見建立「潛在外來入侵種清單」，包括植物118種、動物56種、微生物2種，共計176種潛在外來入侵種；(4) 完成30種「潛在外來入侵種」的基本資料；(5)訪談專家1名。

The aim of this project is to update and expand the content of "Taiwan Invasive Alien Species Database (TIASD)" by interviewing experts and to collect information from literature and documentations so that users can access accurate and authoritative information on invasive alien species of Taiwan through internet. The results of this project from January 1 to November 20, 2014 included: (1) Maintaining and updating database web page: web page design, establishing and testing English version of this database; (2) updating information of 100 invasive alien species listed in the datbase; (3) updating"List of potential invasive alien species", including 56 animals, 118 plants, 2 microbials by literature review and expert consultation; (4) establishing comprehensive information of 30 potential invasive alien species to TIASD; (5)interviewing a specialist.

已完成詳細資訊的30 種台灣潛在外來入侵物種

The list of 30 potential invasive alien species in Taiwan with comprehensive information to TIASD

大閘蟹 *Eriocheir sinensis*	黑瘤地圖龜 *Graptemys nigrinoda*
小花寬葉馬偕草 *Asystasia gongetica*	萬桃花 *Solanum torvum*
小酸模 *Rumex acetosella*	鋪地黍 *Panicum repens*
方環蝶 *Discophora sondaica*	柳頰梅花雀 *Estrilda melpoda*
本州香魚 *Plecoglossus altivelis altivelis*	糖蜜草 *Melinis minutiflora*
地圖龜 *Graptemys geographica*	擬鱷龜 *Chelydra serpentina*
西番蓮 *Passiflora edulis*	鮭色鳳頭鸚鵡 *Cacatua moluccensis*
佛手瓜 *Sechium edule*	薏苡 *Coix lacryma-jobi*
克非亞草 *Cuphea cathagenensis*	瓊麻 *Agave sisalana*
青葙 *Celosia argentea*	藤三七 *Anredera cordifolia*
紅冠臘嘴鷗 *Paroaria coronata*	鵝草 *Phalaris arundinacea*
苦滇菜 *Sonchus oleraceus*	桉樹枝癭釉小蜂 *Leptocybe invasa*
飛機草 *Erechtites valerianaefolia*	板栗癭蜂 *Dryocosmus kuriphilus*
臭茉莉 *Clerodendrum chinense*	米爾頓釉小蜂 *Anselmella miltoni*
野牽牛 *Ipomoea obscura*	檬果癭蚋 *Procontarinia mangicola*

以感測器網絡監測試驗林地物理環境

趙榮台、林朝欽、陸聲山、葉雲吟、蔡明諭、許福敦

前期計畫已整合一自動化資料收集系統，能將台灣南部及東部的野外資料，透過有線及無線傳輸、ADSL及網際網路等通訊資訊技術，儲存於台北總所的資料庫中，進行後續分析與分享。為使系統臻於完善，本計畫其目的在於一、維護、更新、改善本系統；二、以更低廉的成本獲取更完整的紫斑蝶棲地特性數據。本年度主要工作包括，(一)六龜及茂林具通風效果之防水箱補強，改善熱當及進水問題；(二)維修或更換故障六龜乙太網供電(POE)及插座；(三) 排除茂林C點nport故障、重接鬆脫之乙太網供電、更換斷路器；(四)更換大武RS232-485轉換器6台、維修故障氣象資料紀錄器及面板2台、替換故障螢幕及檢測工業電腦與無線電各1台；(五)更換總所儲存設備之損壞硬碟1台。監測儀器異常情形目前僅發生20次，異常情形明顯降低。2013年12月至2014年11月自動回傳至總所之數據超過150萬筆，符合期中預期值。

2013 年12 月至2014 年11 月已回傳總所之氣象資料筆數
Meteorological data has been collected from December, 2013 to November, 2014

樣區	站名(高度)	溫度	濕度	風速	風向	日幅射	合計
六龜	A(4m)	34,382	34,382	-	-	34,382	103,146
	B(4m)	34,382	34,382	-	-	-	68,764
	B(2m)	34,382	34,382	-	-	34,382	103,146
	C(8m)	34,382	34,382	34,382	34,382	34,382	171,910
	C(6m)	34,382	34,382	-	-	-	68,764
	C(4m)	34,382	34,382	-	-	-	68,764
	C(2m)	34,382	34,382	34,382	34,382	34,382	171,910
	D(4m)	34,382	34,382	-	-	34,382	103,146
	E(4m)	34,382	34,382	-	-	-	68,764
茂林	A(4m)	34,382	34,382	34,382	34,382	34,382	171,910
	B(4m)	34,382	34,382	34,382	34,382	34,382	171,910
	C(4m)	34,382	34,382	34,382	34,382	34,382	171,910
大武	A(6m)	3,475	3,475	3,475	3,475	3,475	17,375
	B(6m)	3,475	3,475	3,475	3,475	3,475	17,375
	C(6m)	3,475	3,475	3,475	3,475	3,475	17,375
	D(6m)	3,475	3,475	3,475	3,475	3,475	17,375
	E(6m)	2,324	2,324	2,324	2,324	2,324	17,470
	F(6m)	2,324	2,324	2,324	2,324	2,324	17,470
總計		431,132	431,132	190,458	190,458	293,604	1,548,484

Applying sensor network to monitor forest physical environments

Jung-Tai Chao, Chau-Chin Lin, Sheng-Shan Lu, Yun-Yin Yeh, Ming-Yu Tsai, Fu-Tun Hsu

In the past four years, we have successfully built an automatic system integrating sensor network, information management system, and semantic web system for ecological research. Field data was collected automatically and stored, searched, used, shared, analyzed through information management system and scientific workflow to understand the habitat requirements of overwintering danaid, especially Euploea butterflies. Though we have demonstrated the feasibility of this newly developed methodology, it is, however, far from perfect. The aim of this project is to improve the whole system and make it more stable, reliable and efficient, to develop an early warning mechanism for any failure of sensor, power, transmission, and computer system, as well as to collect more data with less cost for further analysis of the habitat characteristics. The results included (a) reinforcing waterproof cases and improving ventilation for data loggers; (b) replacing one Power over Ethernet (PoE) and an electrical outlet at the Liukuei site; (c) replacing one N-port, and one circuit breaker, and replugging one PoE at the Maolin site; (d) replacing one screen, purchasing and replacing six RS232-485 converters, repairing two data loggers, and detecting the computer and the radio communication system at the Tawu site; (f) replacing a hard disk at TFRI. The frequency of device, transmission, and/or network failure decreased from 57 times recorded in 2012 to 37 times in 2013, and 20 times in 2014. More than 1,500,000 meteorological data has been collected from December, 2013 to November, 2014.

農林捕食性天敵昆蟲資源之研究

陸聲山、葉文琪

胡蜂是重要農林害蟲的天敵昆蟲，包括虎頭蜂、長腳蜂、蜾蠃等類群，與國外相比，台灣胡蜂分類學研究相對落後，許多國外的學者來台進行採集，陸續發表許多新種，卻鮮少國內學者參與研究。本研究蒐集台灣地區發表過的蜾蠃相關文獻，整理出有關台灣蜾蠃分類文獻共72篇，並整理出69個已記錄的種名，扣除同物異名及錯誤鑑定，目前確認共有54種。

研究期間赴國內重要標本館檢視此類群相關標本，分別記錄科博館蜾蠃標本122隻19種；中興大學昆蟲標本館458隻21種；屏東科技大學386隻18種；台灣大學昆蟲標本館339隻24種；農業試驗所模式標本共40隻12種，非模式標本共1,456隻40種。除了上述國內典藏之模式標本，本研究亦嘗試與國外各博物館連絡，商借散存於各地有關台灣蜾蠃的模式及其他相關標本，以供標本身份的確認及比較。成功商借國外典藏之蜾蠃模式標本或其圖片分別有：德國德意志昆蟲研究所7種15隻，北海道大學1種1隻，九州大學昆蟲研究室2種2隻，荷蘭萊頓自然史博物館3種9隻，美國佛羅里達節肢動物收藏3種3隻，匈牙利自然史博物館1種2隻。

2012-2014年間，於台灣本島各縣市及離島195個地點採集，共採集到52種1,050隻標本，計畫第三年(2014)採集仍新增7種類，為黑翅前喙蜾蠃(*Anterhynchium melanopterum*)、八重窄腰蜾蠃(*Apodynerus yayeyamensis yayeyamensis*)、黃紋凹背蜾蠃(*Eumenes citreolineatus*)、赭褐凹背蜾蠃中國亞種(*Eumenes labiatus sinicus*)、矛紋佳盾蜾蠃(*Euodynerus nipanicus flavicornis*)、突眼佳盾蜾蠃(*Euodynerus trilobus*)以及甲仙圓領蜾蠃(*Paraleptomenes kosempoensis*)，其中黑翅前喙蜾蠃、赭褐凹背蜾蠃中國亞種以及黃紋凹背蜾蠃已確認為台灣地區(金門)的新記錄種。

本研究將建立第一份台灣蜾蠃亞科昆蟲名錄，除了新種及新紀錄種之發表，對於台灣蜾蠃種類的發生、分布及基本生物學亦有初步之瞭解，除了有利未來推動該類群在農林業生物防治上的應用，對於保育研究之擬定以及資源經營管理工作之應用也將所有所助益。

2007年由作者所發表的台灣三種新紀錄種蜾蠃：
1.黃紋短腹蜾蠃；2.赭腰圓領蜾蠃♀；3. 白紋雙脊蜾蠃♀。
New Records of Three Potter Wasps from Taiwan by the authors in 2007.
1. *Epsilon fujianensis* ♀; 2. *Paraleptomenes m. miniatus*♀;
3. *Subancistrocerus sichelii* ♀.

Study on the predators of agricultural and forestry pests

Sheng-Shan Lu, Wen-Chi Yeh

The wasps of Vespidae, including hornets, paper wasps and potter wasps, are important natural enemies of insect pests. Taxonomic studies of Vespidae in Taiwan were relatively lagging compared to other countries. Several foreign researchers have studied and published many new species or new records of eumenine wasps from Taiwan in the past decades, but only few local researchers devoted effort to this group of wasps. We have collected 72 full-text papers relevant to the eumenine wasps (potter wasps) of Taiwan. We have compiled 69 specific names out of this reference collection, including detected synonyms and misidentifications, and 54 of these have been confirmed to be recorded from Taiwan.

We examined 122 specimens and identified belonging to 19 species from the National Museum of Natural Science, 458 specimens and identified belonging to 21 species from National Chung Hsing University, 386 specimens and identified belonging to 18 species from the National Pingtung University of Science and Technology, and 339 specimens and identified belonging to 24 species from National Taiwan University. We examined 1,456 specimens from the Taiwan Agriculture Research Institute, and identified belonging to 40 species. Thirty specimens were borrowed from oversea, including the Senckenberg Deutsches Entomologisches Institut (15), Hokkaido University (1), Naturalis (9), Florida State Collection of Arthropods (3), and Hungarian Natural History Museum (2) for comparison.

Totally, there are about 1,050 specimens and identified belonging to 52 species from the 195 collection sites between 2012 and 2014. There are seven newly collection species in the third year (2014), which are *Anterhynchium melanopterum*, *Apodynerus yayeyamensis yayeyamensis*, *Eumenes citreolineatus*, *Eumenes labiatus sinicus*, *Euodynerus nipanicus flavicornis*, *Euodynerus trilobus* and *Paraleptomenes kosempoensis*. Among them, *Anterhynchium melanopterum*, *Eumenes citreolineatus* and *Eumenes labiatus sinicus* are three new records from Taiwan (Kinmen Island).

This study will produce the first eumenid name list of Taiwan, and we also expected to have new species or new records found. The establishment of Taiwan eumenid name list, their distribution, and basic biology information could promote biological control in agriculture and forestry in the future. In addition, it will help the development of future conservation plan, and will have applications to resource management.

樹種之纖維型態與化學組成對應於特種紙應用性質需求之研究

Matching Fiber Morphology and Chemical Composition of Tree Species to the Applicative Quality Requirements of Specialty Papers

徐光平

Kuang-Ping Hsu

格拉辛紙 (glassine paper)是在高含水率下、以高壓壓製而成的具獨特光澤、亮度性質的高密度的紙張，較普通紙為薄且高透明性。格拉辛紙的品質受打漿方法或抄紙方法所左右，但所採用之纖維之特性影響很大，其中以纖維內腔徑與纖維徑（L/D）的比值為指標最為重要。

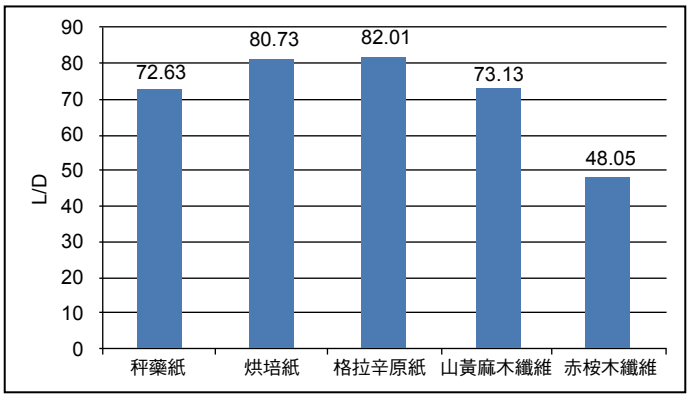
本試驗在試驗材料的纖維形態評估方面，市售格拉辛紙和山黃麻樹種材料之纖維形態所得到的L/D比值相近，介於60%～85%之間，符合格拉辛紙所需要的範圍，而赤桉L/D比值小於60%，若用來製作格拉辛紙的話，將無法達到格拉辛紙所需的透明度品質。而在纖維內腔徑/纖維壁厚度的比值來看，市售格拉辛紙和山黃麻的比值相近，赤桉的纖維內腔徑/纖維壁厚度的比值，差異較大經由Tukey檢定，在P≦0.05時，市售格拉辛紙和山黃麻兩者存有相關性，而和赤桉則沒有相關性存在。由此結果可知，在製作格拉辛紙時，山黃麻樹種應該較赤桉樹種適合當作格拉辛紙的材料。

將赤桉及山黃麻二樹種，分別經由KP法製漿後，評估做為格拉辛紙之原料可行性。於漿料收率方面，赤桉收率(38.4%)遠低於山黃麻漿料收率(53.9%)。於漿料之卡巴值方面，亦以山黃麻(22.3)較赤桉為低(26.9)。於物理性質方面，二樹種之物理強度性質皆符合B glassine（40 g）的標準，但由於山黃麻有較高的收率、較佳的平滑度，可減少製漿成本，適合推廣利用。

Glassine paper is a high density paper with unique glossiness and brightness characteristics formed by a low consistency stock under high pressing pressure. It is usually thinner and more transparent than the common printing and writing paper grade. The properties of glassine paper are affected to a large extent by pulp refining or forming methods; however, the intrinsic characteristics of the fibers, particularly the ratio of lumen to fiber diameters (L/D) used to make the paper appear to exert the greatest influence.

In this study, we've evaluated morphologies of the fibers in the experimental wood materials. Fibers of commercial glassine paper and *Trema orientalis* wood had similar L/D values which fell between the range of 60% to 85% required by typical glassine paper. Fibers of *Eucalyptus camaldulensis,* on the other hand, had L/D value < 60%. Thus, it was deemed unable to reach the transparency requirement of glassine paper. Tukey's test also indicated that at $p \leq 0.05$, there was correlation between the commercial glassine paper and *T. orientalis* fibers while there was no such correlation between the former and *E. camaldulensis* fibers. These indicated that *T. orientalis* is preferred to *E. camaldulensis* as raw material for making glassine paper.

Then both *T. orientalis* and *E. camaldulensis* wood chips were pulped using kraft process. Suitability of their fibers for making glassine paper was evaluated. With respect to the pulp yield, *E. camaldulensis* pulp yield at 38.4% was far inferior to the 53.9% produced by *T. orientalis*. As for the pulp kappa number, *T. orientalis* pulp at 22.3 was also better delignified than the 26.9 kappa no. of *E. camaldulensis* pulp. Evaluation of the resulting products indicated that both species had strength properties complying with the specifications of B glassine (40 g m^{-2}). Due to its higher yield and better smoothness, *T. orientalis* is deemed a more suitable choice with lower pulping cost and worthy of promoting for such purpose.



市售格拉辛紙與不同樹種木片之L/D值變化

L/D values of commercial glassine paper and different species of wood chips

應用木質複合壁體內裝對節能減碳效果評估

Evaluation the effects of using decorative wood composite panels on the energy saving and carbon reduction

塗三賢

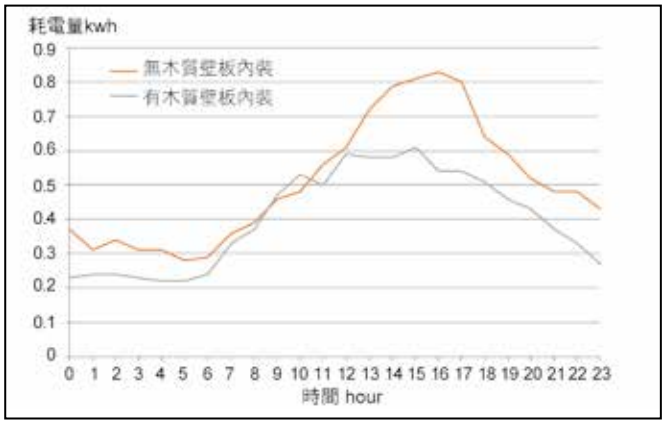
San-Hsien Tu

本研究使用國產的杉木、柳杉與台灣杉壁板，結合聚苯乙烯(PS)板、聚胺基甲酸酯(PU)板與玻璃纖維棉等隔熱材料製作內裝用木質複合壁板，以評估比較不同隔熱設計對木質複合壁板的熱特性的影響。由試驗結果可以得知，在製成木質複合壁板後，試材的熱抵抗值均較明顯地比原單層壁板增加，顯示木質複合壁板會較單層壁板有較佳的隔熱效果。在木質複合壁板壁體中央隔熱層厚度厚度為2cm的情況下，以使用PU板作為隔熱材的設計有比較好的熱阻效果，當熱傳導率值愈高時，試材熱、冷二側的表面溫差則會愈小。

本計畫另設置試驗牆面，以柳杉壁板與PS板製作木質複合壁板。分為使用木質壁體內裝與未使用內裝之2種模式，進行壁體溫度、室內溫濕度變動及熱流動之監測。結果發現室內溫度的變動主要是受室外溫度變動的影響，且大約有2個小時的延時效果；就室溫變動比(室溫日變化量與外氣溫日變化量之比值)來看，測試屋內的室溫變動比約為0.54，表示室溫日變化量約為外氣溫日變化量之54%，顯示使用木質壁板內裝有助牆面溫度的調節，減少因室外溫度的變化所產生的影響，維持室內環境的穩定。檢測試驗屋在控制室溫25℃的條件下，使用木質壁板內裝測試屋每日可減少的耗電量約為2.56kw.h，較未使用木質壁板內裝的測試屋減少21%的耗電量，依能源局公佈之101年度電力排放係數：每度電約排放0.532 kg的CO_2計算，使用木質壁板內裝測試屋每日約可減少1.36kg的CO_2排放量。

The objective of this study was to analyze the effects of different insulation design on the thermal properties of interior decorative wooden composite panels. The results indicated that Taiwan fir (*Taiwania cryptomerioides*) panels have higher thermal resistance and overall thermal resistance values than the other 2 kinds of wooden panels, Japanese cedar (*Cryptomeria japonica*) and China fir (*Cunniinghamia lanceolata*). The study also combined the wooden panel and certain insulation materials to make interior decorative wooden composite panels (WCP) and examined their thermal properties. Results showed that WCP has significantly better thermal insulation effects than the original wooden panels. A WCP based on polyurethane (PU) foam as the insulation material have the best thermal insulation effects than the others. The temperature difference between the hot and cold side of a WCP decreased as its thermal conductance value increased.

The temperature difference ratio (interior temperature difference/ outside temperature difference) of a test hut using WCP as interior decorative panels was 0.54, which means that the interior temperature difference is 54% of the outside temperature difference. The average temperatures of upper and lower parts of RC wall in a non-WCP decorated hut were respectively 31.10 and 30.35℃; whereas the average temperatures of the 2 parts of RC wall in a WCP paneled hut were respectively 30.06 and 30.18℃; and the average surface temperatures of WCP were 29.65℃and 29.64℃, respectively. The results indicated that using WCP as interior decorative panels will help to moderate temperature fluctuations inside the test hut. The overall air-conditioning? power consumption of a non- WCP paneled hut was 12.19 kWh per day, or 0.51 kWh per hour, the overall power consumption of a WCP paneled hut is 9.63 kWh per day, or 0.40 kWh per hour. Overall, the WCP paneled hut consumed 21% less power than the non-WCP paneled one, which means that a WCP paneled hut could decrease 1.36 kg of CO_2 emission per day.



在控制室溫25℃的條件下，由測試屋每小時的冷氣耗電量圖可以看出，使用木質複合壁板內裝的測試屋消耗較少的電量，平均會減少大約21%的冷氣機使用耗電量。

The WCP decorative hut consumed less 21% of overall power than the non WCP decorative one at 25℃of controlled interior temperature.

提高竹材使用年限與有效利用技術之研發

Research and development on techniques for enhancing durability and effective uses of bamboo

黃國雄

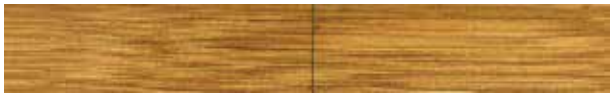
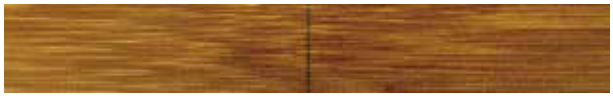
Gwo-Shyong Hwang

本研究以國產麻竹為材料，鋸製成厚度6 mm、寬度2.5 cm、長度3cm與16 cm之試片，將試片置於105±2℃之烘箱絕乾後，於不同溫度160、180、200與220℃，不同時間1、2、4、8與12 h進行熱處理，又以孟宗竹為材料，鋸製成厚度6 mm、寬度2.5 cm、長度16 cm與20 cm之試片，將試片置於105±2℃之烘箱絕乾後，以上下熱板之加熱方式，熱板溫度設定為度160、180、200與220℃，加熱時間為1、2、4、8h進行熱處理。熱處理竹材之試驗內容包括色差試驗、質量損失率與尺寸減少率試驗、吸水試驗、抗彎試驗與抗白蟻試驗。

由試驗結果得知熱處理竹材之顏色隨處理溫度之增高與處理時間之增長而明顯加深，其色差值(△E*)則隨處理溫度之增高與處理時間之增長而增大。熱處理竹材之質量損失率隨處理溫度之增高與處理時間之增長而明顯增加，弦向與徑向尺寸減少率亦均隨處理溫度之增高與處理時間之增長而明顯增加。吸水膨脹率受熱處理溫度增高與處理時間增長而降低，抗膨脹效能亦隨處理溫度之增高與處理時間之增長而明顯增大。熱處理竹材抗彎強度隨處理溫度之增高而明顯降低，抗彎彈性模數受熱處理溫度增高與熱處理時間增長之影響較不明顯。抗白蟻性隨熱處理溫度之增高而獲得改善。

In this study, ma bamboo (*Dendrocalamus latiflorus*) specimens of 6 mm thick, 2.5 cm wide, and 3 cm and 16 cm long were used for heat treatment at different temperatures (160, 180, 200 and 220℃) and different time durations (1, 2, 4, 8 and 12 h) after oven drying at 105±2℃. Moso bamboo (*Phyllostachys pubescens*) specimens of 6 mm thick, 2.5 cm wide, and 16 cm long were also heat treated with hot press at different temperatures (160, 180, 200 and 220℃) and different times (1, 2, 4, 8 and 12 h) after oven drying at 105±2℃. The weight loss, dimensions reduction, color change, re-swelling, bending strength and termite-resistance of the specimens were tested.

The color of the heat-treated bamboo became dark and the color difference (△E*) increased with treatment temperature and time. The weight loss and dimensions reduction of heat-treated bamboo tended to increase with treatment temperature and time. The re-swelling of heat-treatment bamboo decreased with treatment temperature and time. The MOR of heat-treatment bamboo decreased significantly with treatment temperature, however, the MOE values were almost unaffected by the treatment temperature and time. The termite-resistant properties improved by increasing treatment temperature.

Untreatment		
160℃	2h	
	4h	
	8h	
180℃	2h	
	4h	
	8h	
200℃	1h	
	2h	
	4h	
220℃	1h	
	2h	
	4h	

孟宗竹熱處理竹材之顏色變化
Color change of heat-treated Moso bamboos.

木質材料應用在生態工法的建造及材質監測

Applications of wood-based materials in ecological engineering constructions and monitoring of the wood properties

林振榮、余欣怡

Cheng-Jung Lin, Hsin-Yi Yu

木質材料應用在生態工法的建造是一種友善環境及保全生態的方法，然而，木構件在使用期間有劣化破壞的可能，有必要監測木構件的安全性，本計畫完成柳杉(*Cryptomeria japonica*)與放射松(*Pinus radiata*)為材料，設置二座造林木木構件護坡牆；檢測完成新建(3年內)的護坡牆木構件 (南投及羅東林管處轄區二處)共11座，完成已建造超過三年以上的護坡牆木構件共7座(羅東林管處轄區一處)，應用目視木構件評估(Visual Timber Assessment, VTA)及不同非破壞性技術(Nondestructive techniques, NDT)檢測及評估木構件的強度(合計18座護坡牆的木構件)；另外抽取預先埋置土壤中不同時間的木構件試材，進行強度劣化試驗(VTA及NDT)；取樣木構件的樹芯試材，進行內部現存的防腐藥劑含量與材質劣化現況調查；完成實驗室試驗腐朽菌(兩種)對木材(兩種)劣化的變化。結果得知木構件的劣化程度可由VTA法先檢查，再利用NDT法以應力波法或超音波法、Pilodyn法、鑽孔抵抗法檢測及評估木構件的強度。樹芯試材可以評估防腐藥劑保留量及深度。抽取預先埋置土壤的試材，可以評估埋入土中木構件的劣化情形及保留強度。以上方式可以作為未來監測木構件的劣化及強度變化，作為木構件管理的參考。

Wood-based ecological engineering is an eco-friendly method of preservation of the environment and ecology. However, wood components in service may suffer the possibility of deterioration and destruction. Thus, there is a need to monitor the safety of the wood components. Two wood-based ecological constructions made of Japanese cedar and radiata pine were setup in a Nantou County plantation. Also, a total of 11 recent constructions (<3 years) in Nantou and Ilan Counties; and 7 older constructions (> 3 years) in Ilan were monitored and evaluated using visual timber assessment (VTA) and nondestructive techniques (NDT), for a total of 18 constructions. Moreover, wood components from previously tested materials buried in soil for different lengths of time were extracted to understand the retain strengths and to detect deteriorations by VTA and NDT. Increment core specimens were sampled from the wood components to check the inside for the residual preservative content and material deteriorations. Two wood species were assayed with two decayed fungi in the laboratory. The results indicated that the deterioration and strength of wood components could be detected and evaluated by the VTA and NDT methods. The NDT methods included stress wave or ultrasonic wave, Pilodyn, and drilling resistance techniques could be applied to gauge the strength retention of wood components. The preservative retention and its depth of penetration could be examined effectively using the core specimens. The deterioration and strength retention of soil-buried wood components could be estimated by inspecting and evaluating other similarly pre-buried specimens. The strength retention and degree of deterioration of the wood components established by the above methods could be applied to the management of wood-based constructions in actual service.

設置護坡牆兩座在蓮華池研究中心(左圖放射松、右圖柳杉)
Wood-based material applied in ecological engineering at Yuchih, Nantou.

宜專一線沿線所設置之生態工法。
Wood-based material applied in ecological engineering at Yilan.

坑內坑與廟前坑森林步道和日月潭所設置之生態工法。
Wood-based material applied in ecological engineering at Nantou.

木竹生質材料利用與能源開發研究

林裕仁、余欣怡

本計畫利用漂流木與目前僅低度利用之竹種產製木質燃料顆粒與竹質燃料顆粒進行試驗，所測得5種生質燃料顆粒之燃燒熱值均達瑞典與歐盟之木質燃料顆粒所要求之熱值標準。本研究並與民間具燃燒木質顆粒鍋爐設備廠家合作，完成刺竹、長枝竹、麻竹、綠竹等4種竹質顆粒燃料實際燃燒試驗，其溫度均超過1,000℃，其中以麻竹竹質顆粒為最高，綠竹較低。4種竹質顆粒燃料爐渣殘留量均少，可達到目前業界使用木質燃料顆粒熱值需求。此外，本研究進行不同條件之非硫製漿法(THFA)與蒸煮爆碎處理製漿製作漂流木漿及以蒸煮爆碎處理製作長枝竹漿，並將漿料以酵素水解方法，予以糖化，評估紙漿化學組成分、醣類組成分分析、紙張物理性質及糖化率等性質。紙漿化學組成分方面，隨處理強度增強，各成分的含量均呈現降解現象，其中以半纖維素之降解程度為最大，其次為木質素，再其次為纖維素。紙張物理性質中，當處理強度為3.85時，於稀硫酸用量超過0.5%時，抗張強度、撕裂強度、破裂強度及耐摺力則愈差。於酵素水解糖化率方面，經過蒸煮爆碎後之漿料可促使糖化率明顯提高，從長枝竹原料的30.6%的糖化率，經過蒸煮爆碎後之平均糖化率為87.4%，提高2.86倍。本研究結果具提昇國內木竹資源利用，達到開發木竹材具競爭力之多樣化生質能源產品與材料，提高木竹材利用之附加價值及達到節能減碳之效能。

竹質燃料顆粒經燃燒機實際燃燒測試可達1000℃以上，可符合業界使用木質燃料顆粒熱值需求。

The burning temperature of bamboo fuel pellets using a specialized burn boiler made by private manufactory could reach up to 1000℃, which is match up to industry requirements for wood fuel pellets.

Study on the utilization of woody and bamboo biomass and developing their energy potential

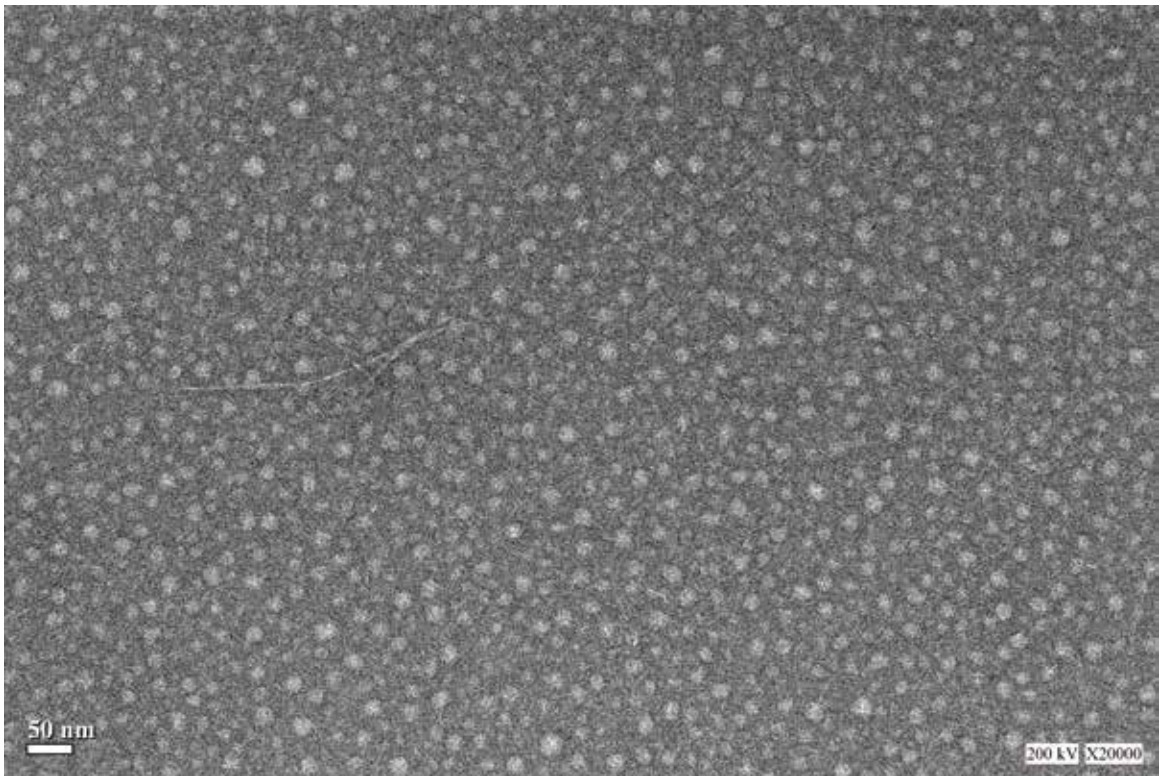
Yu-Jen Lin, Hsin-Yi Yu

In this study, drift woods and current under-used bamboos were made in to wood and bamboo fuel pellets and their basic properties analyzed. The average calorific values of 5 bio-based fuel pellets all reached the standards of the basic requirement in calorific value for wood fuel pellets in Sweden and European Union. A burning tests of the four bamboo fuel pellets from thorny bamboo, long-branch bamboo, ma bamboo, and green bamboo were also implemented using a boiler test, which was made by a private manufacturer in Taiwan special for wood pellets needs. The results showed that the heating temperature from these 4 bamboo pellets all exceeded 1,000℃. Among them, the highest heating temperature was generated by ma bamboo pellet, and the heating temperature of the green bamboo pellet was relatively low. There were only little residues after burning of the 4 bamboo pellets, meeting the industrial needs in practice. In addition, the components, physical properties and the components after saccharification of the pulps depending on different operating conditions were evaluated. A tetrahydrofurfuryl alcohol (THFA) process at atmospheric pressure digestion of drift woods, and steam explosion process for drift woods and long-branch bamboo(*Bambusa dolichoclada*) were carried out. With respect to pulp chemical compositions, along with increasing treatment intensity, all component content tended to degrade. Hemicelluloses suffered the greatest degradation, it was followed by lignin, and cellulose was the least affected. As for handsheet physical properties, at treatment intensity of 3.85, dilute sulfuric acid dose exceeding 0.5% resulted in pulps having poorer tensile, tear and bursting strengths. Enzymatic hydrolysis results suggested that steam exploded pulp effectively enhanced saccharification rates, from the original long-branch bamboo chips value of 30.6% to 87.4% for the exploded pulp, a 2.86 times increase. The results of this study could promote different utilization routes of domestic woody and bamboo resources, develop diverse competitive bio-based energy products and materials, increase the value-addition of using woody and bamboo materials, save energy consumption and reduce carbon dioxide emissions.

海藻奈米纖維素作為紙漿添助劑之研究

何振隆

本研究計畫為以六種不同藻類為試驗原料，如:台西石髮藻(*Enteromorpha linza*)、台西剛毛藻(*Cladophora* sp.)、泰國石髮藻(*Enteromorpha intestinalis*)、螺旋藻(*Spirulina platensis*)、小球藻(*Chlorella pyrenoidosa*)及擬球藻(*Nannochloropsis oculata*)，以化學法--TEMPO氧化法，完成此六種奈米海藻纖維素之製備，並分別評估其物理性質。於粒徑量測方面，以雷射粒徑分析儀分析，所得結果，此六種奈米海藻纖維素，其粒徑大小為介於35.7~384.0 nm，均符合奈米纖維素之定義；再者，於未經凍乾及經凍乾之六種海藻奈米纖維素粒徑中，經凍乾之海藻奈米纖維素粒徑較未經凍乾者為大，即為這些高分子聚合物經過冷凍乾燥後再覆水之後所測得之粒徑卻有增大的趨勢。於海藻奈米纖維素以掃描式電子顯微鏡及穿透式電子顯微鏡分析得知，掃描式電子顯微鏡於拍攝海藻奈米纖維素為不適合，而於穿透式電子顯微鏡為適合，且可觀察微細結構。用寬角X-ray光譜分析六種海藻之奈米纖維素，得知海藻之全纖維素經過TEMPO氧化法後，所得之奈米纖維素，其主要吸收峰2θº均消失不見，其原因為海藻之全纖維素經過TEMPO氧化法後，其結晶領域遭受嚴重破壞所致。以全反射式傅利葉紅外線光譜(FTIR-ATR)分析得知六種海藻奈米纖維素均有產生1,740 cm^{-1}波峰，此為因經過TEMPO氧化反應之纖維素結構中，其第6個碳上的羥基(OH)會轉換成羧基(COOH)，而此時經過TEMPO氧化纖維素的羧基之C=O的伸展振動波峰為1,740 cm^{-1}所致。添加小球藻奈米纖維素之紙張物理性質測試得知，於抗張強度增加91%、撕裂強度增加71%、破裂強度增加128%、耐摺力增加76%及零跨距強度增加39%等。因此，添加小球藻奈米纖維素可增強紙力並做為特殊機能紙。



小球藻(*Chlorella pyrenoidosa*)奈米纖維素以穿透式電子顯微鏡分析
Nano-cellulose derived from *Chlorella pyrenoidosa* as observed using transmission electron microscopy (TEM).

Studies on the preparation of algal nanocrystalline cellulose as an papermaking additive for enhanced performance

Chen-Lung Ho

In this study, we completed the preparations of 6 algal nanocrystalline celluloses (*Enteromorpha linza*, *Cladophora* sp., *Enteromorpha intestinalis*, *Spirulina platensis*, *Chlorella pyrenoidosa*, and *Nannochloropsis oculata*) using the TEMPO oxidation treatment and evaluated their physical properties. With respect to the particle size distribution, laser scattering analyzer indicated that the nanocelluloses had particle diameters between 35.7 to 384.0 nm which complied with the definition of a nanomaterial. In addition, of the freeze-dried and nonfreeze-dried algal nanocelluloses, the former had larger particle sizes than the latter, suggesting that freeze-dried algal nanocelluloses had tendency of re-aggregating upon rewetting. Scanning and transmitting electron microscopy observations of the cellulose preparations indicated that SEM was not suitable to provide clear images while TEM was a better method for observing minute structure of the samples. Wide-angle X-ray diffraction analyses of the 6 algal nanocellulose suggested that after TEMPO oxidation, the major 2θ diffraction peaks of the holocellulose tended to disappear. This was deemed to be caused by severe degradation of the crystalline regions of the cellulose after TEMPO oxidation. Total attenuation FTIR (FTIRATR) analyses of the samples indicated that all the samples produced peaks at ca. 1,740 cm-1, which suggested that TEMPO oxidation modified the celluloses, creating carboxylic (COOH) groups at the C6 hydroxyl, and the C=O stretch had peaks at 1,740 cm^{-1}. Nanocellulose preparation from *C. pyrenoidosa* when added to paper handsheets increased its tensile, tear, burst, folding endurance and zero-span tensile strengths by as much as 91%, 71%, 128%, 76%, and 39%, respectively. Thus, the preparation showed a great potential as a strengthening agent for paper and as special functional paper ingredient.

林木純露生物活性與市場接受度分析

葉若鋆

所謂是純露是指蒸餾萃取精油過程中，伴隨著精油被冷凝出來的蒸餾水，由於含有精油可溶於水的成分，而有著特殊的氣味與功效。本研究針對林木枝葉所生產的純露進行研究，包括土肉桂葉純露、白千層葉純露及檜木(紅檜及扁柏)葉純露，其中土肉桂葉純露所含有效成分濃度高及風味接受度高等優點，極具市場潛力。

原生種的土肉桂已知有多種品系，市面上的土肉桂純露主要是以桂皮醛型土肉桂萃取，其桂皮醛含量約300～2,000ppm，刺激性高不建議用於敷臉，但可用於少量的發炎處理，此外桂皮醛具有通經作用，孕婦禁忌飲用。土肉桂純露的pH值在3.7～4.1之間，含有微量的鐵、鋅、銅、錳元素，含量遠低於國家飲用水水質標準，並不影響適飲性，反而可視為膳食中的微量元素的補給。

桂皮廣泛地被使用於中西料理，土肉桂純露也可像味醂或料理酒的使用方式添加至各種食材中，用來沖泡咖啡、燉煮湯品、滷製肉類或茶葉蛋，製作麵包或點心，增添料理的層次與風味。

土肉桂純露具有良好的殺菌力，根據實驗結果，土肉桂純露對於一般室內常見引發過敏的黑黴菌、橘青黴、綠色木黴等真菌，以及大腸桿菌、金黃色葡萄球菌等致病菌均有良好的殺菌效果，同時安全性高且不具刺鼻性，可用於幼兒玩具或食器棚架的擦拭，以及地板消毒清潔之用。稀釋後仍可抑制口腔中的變形鏈球菌、遠緣鏈球菌等，幫助降低齲齒的發生率，可做為漱口水或口腔芳香噴劑。低濃度下即對白色念珠菌有良好的抑制效果，有助於減少陰道搔癢，改善個人衛生。

土肉桂純露及土肉桂
Hydrosol of *Cinnamomum osmophloeum* and the *C. osmophloeum* tree.

The bioactivity and market acceptance of aromatic hydrosols from trees

Ruo-Yun Yeh

The so-called hydrosols are the aqueous fractions accompanying cooling of oil-bearing steam during essential oils extraction. Because the water soluble compounds of the essential oils dissolved in them, certain fragrances and effects can be derived. In this study, we focused on the hydrosols derived from foliages of forest tree species, including those of *Cinnamomum osmophloeum*, *Melaleuca leucadendra*, *Chamaecyparis formosensis* and *Ch. obtusa* var. *formosana*. Among these, the *C. osmophloeum* hydrosol has the advantages of containing higher concentrations of effective ingredients and good acceptance of the fragrance, thus is deemed to possess high market potential. *C. osmophloeum* hydrosol contains rich cinnamic aldehyde which renders a special taste of pungent sweetness.

It is known that the indigenous *C. osmophloeum* has several different chemotypes. The commercial *C. osmophloeum* hydrosols are mainly extracted from the cinnamic aldehyde chemotype. The cinnamic aldehyde content of these is about 300 to 2,000 ppm which due to its stimulating nature is not recommended for use in facial applications, but amenable to topical anti-inflammation use at low dose. Furthermore, cinnamic aldehyde is conducive to menstruation flow, hence shall be forbad to ingestion by pregnant women. The pH of *C. osmophloeum* hydrosols lie between 3.7 and 4.1, with trace amounts of iron, zinc, copper, and manganese at concentrations way below those stipulated for the national drinking water standard and not affecting their drinkability. Conversely, these trace elements might supplement our dietary requirements. Cassia bark is widely used in different cuisines, whereas *C. osmophloeum* hydrosol can also be used like mirin or culinary wines to various dishes. Or else, be added to coffee, soups , soy-sauce basted meats or tea-leave eggs, incorporated in dough for making bread or pastry therefore adds nuance and zest to the food.

The hydrosol of *C. osmophloeum* has good germicidal capacity. According to the experimental results, it possesses excellent fungicidal actions against the common household allergy-inducing *Aspergillus niger*, *Penicillium citrinum* and *Trichoderma viride* fungi; and bactericidal actions against pathogens of *Escherichia coli and Staphyloccocus aureus*. It is both safe and nonirritating to the smell; thus can be used in cleaning of baby toys, food utensils or floor. Upon diluting, it can inhibit growth of tooth caries-causing *Streptococcus mutans, and S. sobrinus* in oral cavity, helping to lower occurrence of tooth decay. Thus, it is also suitable to be used as mouth rinse or oral refreshing agent. It also has excellent inhibitory effect at low concentration against *Candida albicans*, which is helpful in mitigating vaginal itching and improving personal hygiene.

痲瘋樹優良品系之選育及高產種子園之建立

游漢明、馬復京

本計畫自2011年5月開始執行至2014年6月完成全期計畫。計畫完成目的在中油公司燕巢樣區之痲瘋樹優良品系及高產種子園的設置，樣區面積1.2公頃，共栽植前期計畫選育出的痲瘋樹58個種源。經過3年的栽植，綜合各單株的開花，結實的表現，2014年的開花及結實調查結果，估計結實量的表現，以種源34號678kg/ha、種源57號671.8kg/ha、種源52號582.7kg/ha及種源55號526.5kg/ha具高產潛力品系，種源4(D-3-8)有最高的雌花數416個、種源2(D-2-2)403個次之、種源3(D-3-3)375個、種源3(D-6-8)305個具有高產潛力。綜合而言種源1、2、3、4、5在103年較佳的雌花總數，與商業品系種源34號的差異不大，符合我們選種的期待。就種子形態及含油率的季節性表現，一般而言7、8、9月的種子重量、種子體積(形態)及含油率均有降低的趨勢，而10月及1月則回昇，應是養分回流(累積)的結果。由種源之種子重量、及種子寬度或可作為高油品系的選種參考，但仍需再確認。從主要脂肪酸成分分析的結果各個種源間，並沒有差異。我們完成4次的雜交授粉作業，共採得665粒種子，育成309株苗木並已栽植於燕巢樣區。雜交苗中♀34×♂32及♀1×♂32 單株已有開花，顯示種源32號帶有早花(早熟)因子，雜交苗木的DNA分析，以4種方法測試，其中JM8　SSR引子PCR反應可得分辨親本的條帶，但並不穩定，需要進一步的調整測試。

誌謝

本計畫承蒙台灣中油股份有限公司煉製研究所委託研究「痲瘋樹優良品系之選育及高產種子園之建立」案號:9912013，技術經費補助，特此誌謝。

Selective breeding of superior strains and establishment of a high-yield seed orchard of *Jatropha curcas L*.

Han-Ming Yu, Fu-ching Ma

This project began in May 2011 and concluded in June 2014. The purposes of the study were to screen for superior provenances and establish a 1.2 ha high-yield seed orchard of *Jatropha curcas* at the Yenchao plantation of the China Petroleum Co. In the project, we've planted 58 provenances of *J. curcas* in the plantation obtained from a previous study. After 3 years of growth and summarizing the flowering and fruiting performance of individual plants, in 2014 the survey indicated that fruit-bearing of Provenance 34 estimated at 678 kg/ha was the best; it was followed by 671 kg/ha of Provenance 57; 582 kg/ha of Provenance 52; and 526 kg/ha of Provenance 55. These were provenances with potential for high yields. As for flowering, Provenance 4 (D-3-8) borne the highest female flowers of 416; it was followed by 403 female flowers of Provenance 2 (D-2-2); 375 flowers of Provenance 3(D-3-3); and 305 flowers of Provenance 3(D-6-8). Overall, Provenances 1, 2, 3, 4, and 5 borne female flowers that were not much different from the commercial strain of Provenance 34 and meet our expectation of culling requirement. With regard to the seasonal variations in *J. curcas* seed morphology and seed oil content, generally, during months of July, August, and September, the seed weight, seed volume (morphology) and oil content tended to decrease; whereas seeds harvested during October and January of next year showed rebound, probably because reflux (or accumulation) of nutrients. The seed masses, seed widths of the provenances might be useful references in selecting high-oil-bearing provenances. This, however, still require further confirmation. There were no significant differences among the seeds from different provenances in their major fatty acid compositions. In the interim of the study, we've done 4 batches of cross-pollination breeding, and a total of 665 seeds were obtained. From the seeds, 309 seedlings were cultured and planted at the Yenchao plantation. Among the cross-breeders, plants of ♀34×♂32 and ♀1×♂32 already flowered, indicating that Provenance 32 bears precocious genes. DNA analyses of the cross-breeders proceeded along 4 different methods of assay. Of these polymerase chain reaction (PCR) based on JMS and SSR primers could provide bands that allow differentiating the parent stocks. The readout is not stable, however, and requires further adjustment and testing.

雲林縣「減碳造林 綠色園丁」專案輔導計畫

蔡景株、黃正良、李欣怡、林渡真、王靖堯、曾紹君

全球暖化及氣候變遷問題日益嚴重，為降低環境二氧化碳濃度，維持森林面積及增加植樹造林面積已成為減緩溫室效應之重要方式之一。植樹造林除可吸收二氧化碳降低溫室氣體之排放外，還具有淨化空氣、改善生態環境、提供休閒空間、美化生活環境等功能，兼具環境保護及提升生活品質之效果，亦為雲林縣重要施政工作之一。

雲林縣政府自民國99年起積極推動「百萬植樹計畫」及「2,600公頃減碳造林計畫」，由於造林苗木品質、栽植地點及樹種、林木撫育管理、病蟲害管理等，皆攸關造林或綠美化之成功與否，為落實「適地適木」觀念，並強化雲林縣政府各機關、學校、社區、農民及民眾有關植樹、養護及林木健康管理等造林綠美化專業知能，因此委託林業試驗所技術服務團隊予以協助輔導，以確保雲林縣內綠色造林與綠美化績效，提升造林減碳效能，並改善生活環境品質。

雲林縣至101年12月止，平地造林已完成1,104公頃，計4,370筆造林地，3,200戶林農參加，包括嚴重地層下陷區之造林及，濱海地區之造林面積，造林工作量相當龐大且艱難，急需專業人力及技術輔導農民造林，以免影響造林績效。

林業試驗所自100年9月至103年8月，積極與雲林縣政府合作，辦理相關綠美化與造林專業輔導工作，包含綠美化與造林講習66場次 267小時14,016人次參與、現地訪視輔導393場次1,188人次參與、媒體廣告宣傳2次、編印造林宣導刊物6份、辦理植樹相關活動與記者會8場次3,900人次參與、及造林地樣區監測14處，樣木1,307株，藉由本計畫提供林業技術協助、專業訓練課程及林農之現地諮詢輔導等，以解決政策推行之難處。

藉由一系列宣導講習、專業輔導課程及現地勘查輔導造林等工作，結合雲林縣減碳造林及百萬植樹計畫，提高植樹及造林成活率並建立正確維護管理知識。透過雲林縣政府各機關、社區、學校、農民的共同參與，將能提升綠色造林之績效、增加造林地碳吸存量，落實造林減碳效能，減緩溫室效應，營造健康森林、打造綠色優質生活環境的雲林。

平地造林可改善農地景觀，其木材收穫可提升農民收入(蔡景株攝)
Plain afforestation will improve landscape of farmland and future timber harvest will increase income of farmers. (by Chnug-chu Tsai)

The Counseling Program of “Less carbon, more green” in Yunlin County

Ching-Chu Tsai, Jeen-Lian Hwong, Hsin-Yi Lee, Du-Jhen Lin, Jing-Yao Wang, Shao-Jun Zeng

Nowadays, global warming and climate change are serious problems in every country. Maintaining current forests and increasing afforestation area have become important ways to decrease the greenhouse gas effect. Afforestation can not only absorb CO_2 to reduce the concentration of green-house gas, but also clean air, improve ecological environment, provide recreational spaces and beautify living environments. Enhance the effects of both environmental protection and living qualities are important policy implementations in Yunlin County.

Yunlin County Government promoted a “Million tree project” and a “2,600 hectares carbon sequestration via reforestation project “since 2010. The quality of seedlings, planting sites, tree species, forest tending management and pest management are critical to the success of afforestation or greening. In order to fulfill the concept of “planting right trees to the right sites “the Yunlin County Government collaborated with the TaiwanForestry Research Institute to enhance professional knowledge of tree planting, tending, forest health management and greening among the various offices, schools, communities and farmers in Yunlin County.

The Yunlin county Government commissioned Taiwan Forestry Research Institute (TFRI) to ensure afforestation and greening performance, enhance the effectiveness of carbon sequestration, and improve the quality of the living environment.

The planned afforestation areas in Yunlin County have accomplished1109 hectares, total 2,736 households, and 4,373 parcels of lands until 2012 including coastal areas. The afforestation effort is enormous and difficult, requiring professional persons to help farmers and to avoid affecting the final performance.

The Yunlin County Government has collaborated with TFRI from September 2011 to August 2013. On the greening and afforestation counseling, there were 66 sessions of greening and afforestation workshops with 14,016 people participated for a total of 267 hours; 393 field work counseling sessions with attendance of 1,188 people, 2 rounds of media advertising, published 6 kinds of afforestation pamphlet, held 8 sessions of press conference on the tree planting activities with 3,900 people attending and set up 14 monitoring plots with 1,307 sample trees. The program provided forestry technical assistance, professional training courses and field counseling to the local people.

Through a series of workshops, professional courses and field counseling on afforestation, and the aforementioned 2 projects have achieved good rate of planting and forest maintenance and managementEfforts of the Yunlin County Government through various organizations, communities, schools and farmers, will see performance of afforestation improved, carbon sequestration increased and implemented, global greenhouse effect mitigated, and a healthy forest and high quality of green living environment established in the near future. (repetitions)

平地造林副產品可增加農民收入(蔡景株攝)
Non forest products form plain forests will increase income of farmers. (By Chnug-chu Tsai)

桉樹優良品系採穗園建立

鍾振德

農委會從2013開始調整耕作制度活化農地計畫。為了增加木材與紙漿原料供給，此計畫鼓勵農民將休耕地栽植林木，並以木材生產為目標，政策主要在增加木材與紙漿原料的自給率，以供給國內木材與造紙工業需求。桉樹優良品系的營養系林提供顯著的收穫，均質與高品質的木材。本研究之目的在於建造桉樹優良品系採穗園，這些優良品系為抗桉樹枝癭釉小蜂(*Leptocybe invasa*)，且選拔自生長優良精英樹，最初先以嫁接方式繁殖成苗，之後再以組織培養繁殖這些優良品系，並由此組織培養苗扦插擴增建立採穗園。建立三種型態的採穗園，包括土床、容器與礫耕栽培。礫耕槽寬120公分，深25公分。由於採穗園位於苗圃附近，扦插繁殖比較有效率，對於扦插優良品系的發根動態容易掌握。微扦插技術已成為主要的繁殖方法，因為其發根率較高且縮短發根所需時間，除此之外，微扦插插穗較幼年性、發根能力較好，生產扦插苗的流程較短。營養系之間的發根速度有很顯著差異，在溫室裡扦插，微扦插發根時間一般在5到6週之間。

A clonal garden of Eucalyptus was established by gravel-bed culture.

The establishment of clonal gardens by Eucalyptus elite clones

Jeng-Der Chung

In 2013, the Council of Agriculture (COA) initiated a "Reactivation the idled fallow land program," so as to enhance domestic timber and wood pulp supply, this project encourages land owners to plant trees with a timber production objective. The major advantage of the policy is to increase the self-supply rate of wood pulp for Taiwan's wood and paper industry. Clonal plantations of elite Eucalyptus clones provide significant gains in forest productivity, uniformity and wood quality. The aim of this study was to establish clonal gardens using elite Eucalyptus clones. All the selected clones show anti-galling pest (*Leptocybe invasa*) capability and initially propagated by using grafting from superior trees. We developed a micropropagation technique for elite clones of Eucalyptus hybrid, enabling the formation of a clonal mini-garden. Nodal segments from clones of *Eucalyptus* hybrid sprouts of mini-stumps were used as explants. Three types of clonal gardens were established including open-field soil, container, and gravel-bed culture. Gravel-bed troughs are generally 120 cm in width and 25 cm deep. Efficiency of clonal propagation was increased because the mini clonal gardens could be located inside the nurseries. It was also easy to determine the dynamics of adventitious rooting in mini-cuttings of the clones. Mini-cutting techniques had been used for the propagation due to its higher rooting rates and reduced time. In addition, since the mini-cuttings ar more juvenile in nature, they have better rooting ability and shorter plant production cycle. The clones showed different rates of adventitious rooting. The optimum time for the permanence of the mini-cuttings inside the greenhouse for rooting was between 5 and 6 weeks, which varied depending on the clonal materials.

生態調查資料庫系統維護及資料管理計畫

鄭美如

林務局為了規劃、保育或經營等目的，進行許多委託研究計畫，累積了大量的成果報告書，但未收納計畫執行過程所收集的原始資料，無法累積成為林務局內的基礎調查資料，更難以提供進一步的研究與資訊分析供經營管理者或決策者使用。林務局自100年起，委託林試所建置以Ecological Metadata Language (EML)為資料標準之「生態調查資料庫」，並訂定「林務局生態調查研究計畫資料繳交與使用作業說明」、建立標準作業程序書，要求林務局內各單位及所屬各林管處所辦理之生態調查研究計畫，應依照作業說明，建置研究計畫之詮釋資料及原始資料，並上傳至生態調查資料庫。本計畫為延續前一年度「林務局生態分布調查計畫資料庫規劃及建置作業」計畫，除定期舉辦資料繳交說明會及軟體操作研習會外，並重新製作Morpho數位教材及協助編製上傳歷年已結案之計畫詮釋資料。此外，協助林務局各委託調查計畫執行團隊建置與上傳計畫之詮釋資料與原始資料，各項資料均須通過審核方能進行資料公開，提供自由下載使用。截至103年7月底，該資料庫已累積275份資料集，公開的亦有257份資料集，原始資料筆數超過147萬3千筆。

林務局詮釋資料編輯軟體Morpho數位教材首頁(http://metacat.tfri.gov.tw/MorphoDT/)
The homepage of the e-learning of Morpho (http://metacat.tfri.gov.tw/MorphoDT/)

System maintenance and data management of the Ecological Information database of Taiwan Forestry Bureau

Meei-ru Jeng

Taiwan Forestry Bureau has sponsored and conducted numerous research projects for many years, accumulating huge amounts of ecological data for forest management and conservation purposes. However, the raw data of most projects were not properly documented and stored, which hinder the policy makers from data reuse and further analyses. Since 2011, Taiwan Forestry Research Institute (TFRI) has helped the Forestry Bureau with the system design and implementation of ecological information database, using a metadata standard based on Ecological Metadata Language (EML). Moreover, TFRI edited a (digital) manual of regulations that described a standard operating procedure for processing the ecological information of research results. The protocol was distributed to every branch of the Taiwan Forestry Bureau, and specified the procedure of uploading raw data and metadata to the database. Workshops on user's guide of EML were held routinely, revised the e-learning of EML editing (Morpho), and the editing and storing of ecological raw data form past researches gradually progressed. After being approved for public access, the uploaded data is free for download and use. Until July 2014, the database had stored 275 datasets, including 257 public access ones, and more than 1,473,000 records.

中港加工出口區綠帶維護與美化栽植計畫

張怡萱、吳進益、黃正良

經濟部加工出口區中港園區持續委託林試所辦理「103年度中港園區整體植栽改善計畫」，針對經一路、經二路人行道綠帶進行改善作業，栽植喬、灌木及草花共計4萬2,890株。

為使下一階段園區綠帶經營與撫育管理策略能符合現場需要，透過分級撫育管理策略將園區現有綠化成果分為粗放經營區、精緻經營區、行道樹管理及新植經營區四大類別：工作內容包括綠帶修剪、澆水、施肥、支架維護及病蟲害防治等常態性撫育工作。

另依各分區位置規劃撫育管理及景觀塑造目標，經營重點區域植栽特色，將園區由粗放式經營轉變成重點區域精緻型維護管理。為因應後續計畫栽、補植之需103年度培育所需喬、灌木共計1萬5,000株。此外，透過定期舉辦的綠美化技術講習會及專人現場輔導廠商，鼓勵園區廠商認養區內公共綠帶，逐步將園區綠化各項實務經驗與觀念移轉至園區，擴大綠化成效，並朝全園區綠美化遠景努力。

中港園區大通路綠美化成果(吳進益 攝)
The effect of landscape greening and gardening of the Da-Tong Road of CEPZ. (by Chin-Yi Wu)

The greening and gardening of industrial parks — the case of Chungkang Export Processing Zone (CEPZ)

Yi-Hsuan Chang, Chin-Yi Wu, Jeen-Lian Hwong

The Chungkang Export Processing Zone continuously entrusted the TFRI to handle the "overall CEPZ planting improvement" plan in 2014. The planting improvement work of Jing-Yi Road and Jing-Er Road was completed, with a total of 42,890 trees ,shrubs and herbs planted.

In order to make the next phase of the operation and greenbelt park management tending strategy tol meet the needs of sites, a graded tending strategy, the results of dividing the existing green parks into extensive management districts, fine management districts, tree management zones, and newly planted trees management districts four categories. The work content includes nurture works of pruning, watering, protecting and pest prevention process.

In accordance with the objectives of district planning and shaping of the landscape tending goal, establishing the key areas with characteristic plantings, the extensive managed districts of the park will burn transformed into key areas of the fine management type. In order to conform the demands of make-up and new planting to the follow-up plan, a total of 15,000 trees and shrubs were planted and fostered in 2014. In addition, by holding regular seminars and on-the-site workshops of green beautification technology to the audience of CEPZ company staffs, we encourage the companies to adopt the tasks of maintaining the green belts in the park. Thereby to transfer the experiences on afforestation and tending of the green spaces to the ownership of the site, allowing a sustainable greening of the park.

中港園區遊憩區綠美化成果(吳進益 攝)
The effect of landscape greening and gardening of the Recreation Area of CEPZ. (by Chin-Yi Wu)

桉樹枝癭釉小蜂現況調查及建立防治標準作業流程

Prevalence of Eucalyptus tree gall wasps, *Leptocybe invasa* and establishing a standard operating procedure for its prevention

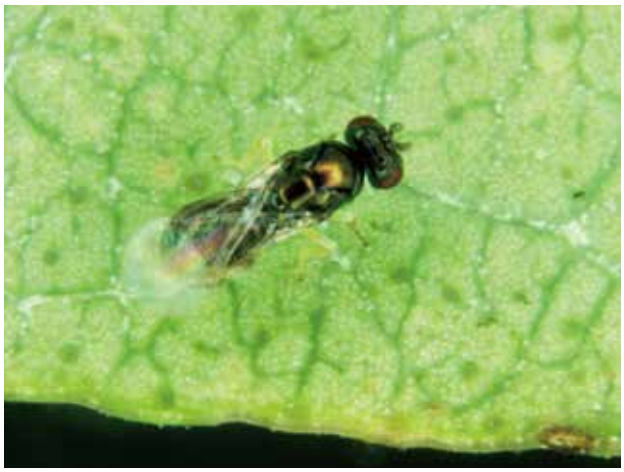
董景生

Gene-Sheng Tung

全球各地廣泛種植的桉樹是闊葉林重要的商用造漿樹種，過去少見蟲害，近年來造癭的釉小蜂科昆蟲肆虐歐洲、中東、印度、巴西、中國與南非等地，造成許多國家與造林公司的重大財損。2010 年台灣記錄到桉樹上的蟲害病徵，受感染後的植株生長遲緩甚至死亡，元兇為造癭的桉樹枝癭釉小蜂 *Leptocybe invasa* (Hymenoptera: Eulophidae)。本計畫藉由普查了解台灣目前蟲害分布現狀與影響，並藉由監測預警避免蔓延，另針對桉樹大型植株進行藥劑試驗，提出用藥量與施用方法。在雲林古坑鄉的試驗地，以公告緊急防治藥劑 9.6% 益達胺進行化學防治試驗，藉由解剖蟲癭計算幼蟲死亡率，輔以高效液相層析儀 (HPLC) 測定藥劑移行量，並估算藥劑的有效施用量後，擬定防治標準作業程序。目前台灣地區的桉樹受感染情形，台灣西部除苗栗縣、高雄縣外，其他縣市都有程度不一的感染；而東部地區，較嚴重感染區域則呈現點狀分佈。

Eucalyptus, a worldwide planted trees, is an important commercial broadleaf trees. Pests of Eulophidae cause huge damages to the trees in many countries of Europe, the Middle East, India, Brazil, China and South Africa. In 2010, we recorded eucalyptus pest symptoms on infected plants after finding growth retardation and even tree death in Taiwan. The gall wasp is identified as *Leptocybe invasa* (Hymenoptera: Eulophidae). In order to understand current status of its distribution and the pest impact scenario in Taiwan, we announced a insecticide dosage and treatment method based on our insecticide test results. The results are related to the larval mortality and the residual insecticide dosage was determined by using high-performance liquid chromatography (HPLC). We developed a standard operating procedure (SOP) of prevention and carried out a pest control advisory. Presently, in western Taiwan, most counties except Miaoli and Kaohsiung have varying degrees of infestations of Eucalyptus. In the eastern region, the pest showed a punctuated distribution of the more serious infections.

以藥劑注射方式，防治桉樹枝癭釉小蜂的感染。
Prevent *Leptocybe invasa* with tree injection. *Leptocybe invasa*.



桉樹枝癭釉小蜂成蟲
An adult wasp of *Leptocybe invasa*.

林木疫情監測及防治體系及重大病蟲害網路綜合管理研究

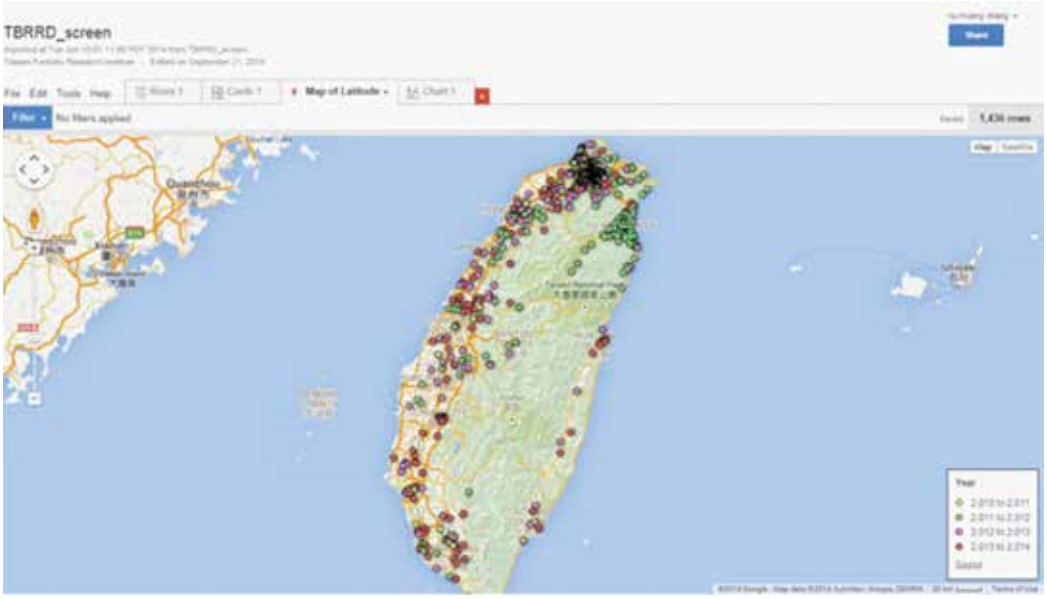
Research on the monitoring and prevention system of forest epidemic diseases

吳孟玲

Meng-Ling Wu

103年本計畫持續更新、維護、管理及開發農委會「林木疫情監測及防治體系」各網站系統。依體系分工架構協助林務局維護「林木疫情管制、策劃與防治中心」網站，擴充管理系統功能，以及強化林業試驗所「林木疫情鑑定與資訊中心」之網站功能，包括開放地圖範圍查詢功能、新增各縣市案件查詢及危害種類查詢等功能，並每日定時備份虛擬主機系統及網站資料庫，增加網站運作穩定及安全性，使二網站中心形成網狀聯繫，統合行政資源，協助落實國內林木疫情管制之效能。本計畫亦將「林木疫情鑑定與資訊中心」、「樹木褐根病調查通報系統」及「筆筒樹疫情監測網資訊網」三網站彙整於統一資料庫，提升資料整合查詢、分析之效能，並將褐根病檢疫及林木非破壞性檢測等服務新增至「林木疫情鑑定與資訊中心」服務項目內，103年1月1日累計至11月30日，受理林木疫情之通報案件共計1,843件。整合「樹木醫學中心」與「林木疫情監測及防治體系」網絡，及其服務業務，開發樹木醫學中心相關網絡服務系統，並辦理樹醫座談會及研討會共計2場，針對各縣市政府業務相關人員，持續辦理「林木疫情監測及防治體系」網站教育訓練課程共計8場，以利防疫工作之推展。

This project purports to maintain and update the web systems included in the "Forest Epidemic Diseases Monitoring and Prevention System." According to a division framework system, to continuously support the Forest Bureau on maintaining the "Forest disease & pests control, planning and prevention center;" to extend services and upgrading the "Diagnosis and information center of forest diseases and pests." These include make open to the public the search services by maps; search individual cases by counties; search diseased tree categories; and newly added a virtual computer to back up all web data and thus increased the safety of the websites. Integrated administration resources is also executed in this project, making the forest monitoring system a connected net and increase the efficiency of disease control. "Brown root rot investigation system" and "Fern trees disease monitoring system" were also integrated to the "Center of forest disease & pests control, planning and prevention" and stored in the same data base so that higher efficiency in searching, analyzing and monitoring of diseases could be provided. Services of brown root rot detection and nondestructive detection of trees were also added to the "Center of forest disease & pests control, planning and prevention center." A total of 1,843 cases were accepted and consulted by the "Diagnosis and information center of forest diseases and pests" from January 1st to November 30st in 2014. We've also developed a tree medical center related services and integrated the "Tree medical center" with the Center of forest disease & pests control, planning and prevention, and conducted 2 tree medical symposiums. To popularize disease control, 8 training courses were also conducted for various county officials in this project.



褐根病防治檢體檢測分布。

Test sites distribution of the brown root rot.

103年濕地生態資料文件建置及上傳教育訓練計畫

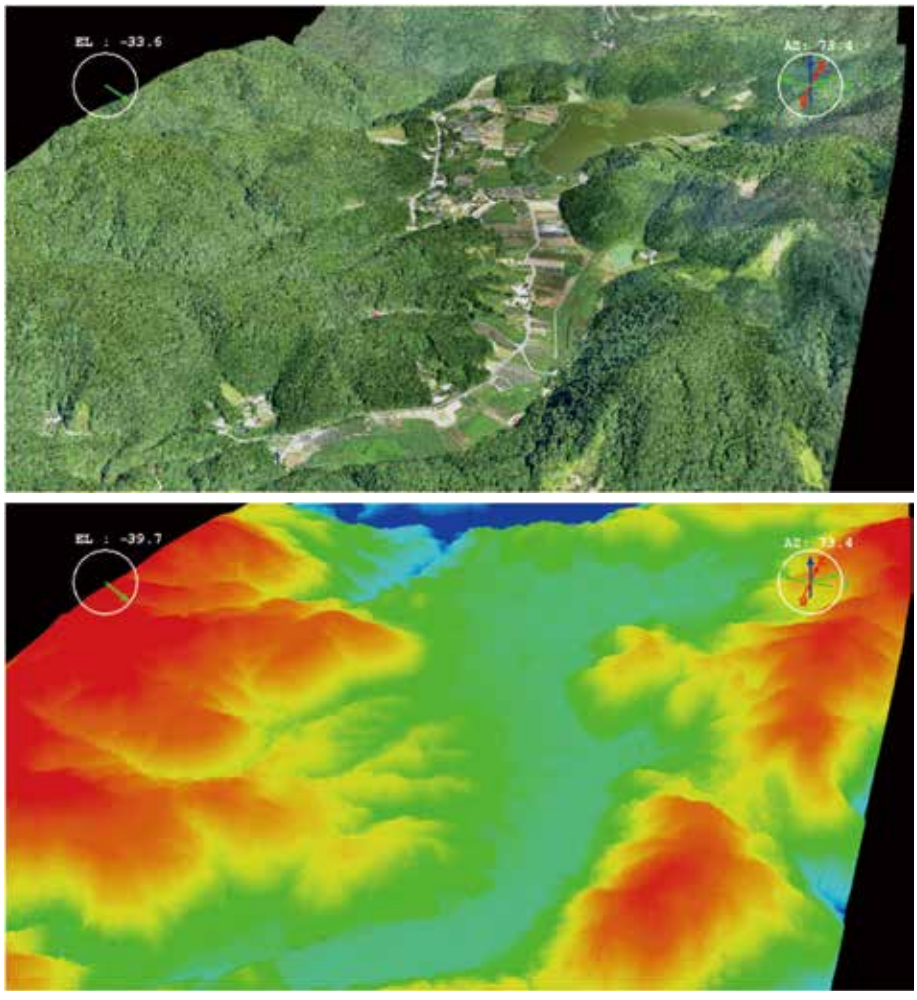
The 2014 training workshops program for editing and archiving ecological data packages of wetland research

王豫煌、陸聲山、林朝欽

Yu-Huang Wang, Sheng-Shan Lu, Chau-Chin Lin

營建署城鄉發展分署為蒐集國家重要濕地基礎資料，自99年度起推動全國濕地生態資料整合、資訊系統建置與更新維護作業，做為我國濕地保育政策及復育工作之規劃、管理、決策、整合及民眾參與的重要參考資料來源。本年度主要工作成果為：1)持續協助委託機關辦理四場次「濕地生態詮釋資料文件建置及上傳」訓練研習；2)提供濕地監測調查及資料庫維護團隊有關濕地生態監測資料管理與資料格式、標準擬訂之諮詢服務；3)測試以無人載具及航攝影像後處理軟體進行雙連埤濕地高解析正射影像與地表模型之製作，做為濕地地景變遷監測與地表水文模擬之資料來源。

The baseline data is important for the planning, management, decision, and public involvement in the conservation of national wetlands. For collecting the baseline data, the Construction and Planning Agency of the Ministry of the Interior started to promote integration of wetland ecological data as well as setup and maintenance of the wetland information system in 2010. The main outcomes of this projects in 2014 were: 1) hosting four training workshops on editing and archiving the metadata and raw data from wetland research and monitoring programs; 2) providing consulting services on data management and data standards for wetland surveys; and 3) conducting a pilot study on adopting unmanned aerial vehicles (UAV) and aerial photogrammetry to generate high-resolution, ortho-rectified image and digital surface model (DSM) of the Shuanlienpi Wetland for monitoring landscape change and hydrological modelling of wetlands.



無人載具航攝影像後製產生的雙連埤濕地正射影像疊覆於地表模型及其地表三維點雲資料以應用於未來濕地地景變遷監測及地表水文模擬。

Using UAV aerial photography and post-processing software to generate the ortho-rectified aerial image overlaid on the digital surface model (DSM) and the DSM point cloud data of Shuanlienpi Wetland for monitoring landscape change and hydrological modelling of wetlands.

龍坑及南仁山生態保護區環境教育活動模式與環境衝擊評估

Assessment of environmental impacts caused by educational activities in Longkeng and Nanjen Shan Ecological Protection Areas

王巧萍

Chiao-Ping Wang

南仁山生態保護區為少數僅存之低海拔原始熱帶季風雨林，龍坑則因高位珊瑚礁崖崩景觀受保護，兩處植群組成深受地質與東北季風影響，進而影響其動物相。為達環境教育功能，兩處均以每日限量(龍坑200人、南仁山400人)方式提供一般遊客進入。入園總量進行管制已執行多年，均未加以檢討修正，故本研究透過現場觀察，了解遊客環境教育活動行為模式與活動影響區域，分別由生態(植被、土壤硬度及螞蟻)、設施及社會承載　三面向進行遊憩承載量評估。

遊客踩踏使步道土壤硬度增加、植被種類減少、高度最矮；植物物種歧異度、覆蓋度與外來種比例均以步道兩側中度干擾區最高，低干擾之林下對照區者居中，符合中度干擾假說。兩保護區植被保存良好，唯遊客活動及果皮垃圾為步道上外來種植物建立與擴散之隱憂。兩生態保護區均受外來種螞蟻入侵，且越靠近入口處螞蟻種類越傾於少數優勢物種或外來種。

兩保護區受訪者旅遊動機均以觀光遊憩為主，觀賞動植物增加生態知識為次。主要旅遊動機與主要旅遊印象相呼應，但以環境教育為次要的旅遊動機卻未反應在旅遊印象上，且以環教為重遊意願者只有原來的一半，遊客重遊動機以休閒娛樂的登山健行及觀賞風景為主。僅三成遊客有解說員導覽，是否有解說員陪同導覽對遊客旅遊印象沒有差異。

綜合評估建議，南仁山暫無調整人數上限之需，龍坑則不宜開放人數上限，且應研擬分散遊客入園時段之方式，並加強違規入園取締。兩處均應特別加強遊客垃圾管理，並研擬提升解說員專業導覽能力及環教成效之經營策略。

Nanjen Shan, the few remaining virgin low-elevation tropical monsoon rainforest in the world, and Longkeng Ecological Protection Areas, where the high cliffs of coral reefs, are famous for their distinguishing protected landscapes in the Kenting National Park. Both areas are strongly influenced by the northeast monsoon. The maximum daily number of people allowed to enter the Ecological Protection Areas for environment educations is respectively 400 people in Nanjen Shan and 200 people in Longkeng for many years without revision. Therefore, their ecological, facility and social carrying capacities are measured in this study to evaluate the environmental impact caused by educational activities.

Visitors cause an increase of soil hardness, a decrease of plant species and average plant height. Plant coverage, biodiversity and the proportion of exotic species are the highest in the plots along trails under intermediate disturbance. Although the vegetation is well preserved in both areas, educational activities might increase the spread of exotic species along the trails. Both areas are invaded by exotic ant species, and the invasion is more significant near the entrances.

Motivation for visiting is dominated by sightseeing rather than plants and animals observation or ecological education. Visiting impressions echoed the main visiting motives. Although environmental education was chosen as the second motive for visiting these areas, visiting impressions, however, were not correlated to the educational activities. The revisiting motivation was built on hiking and sightseeing at both areas. Only 30% of visitors were guided by interpreters and there was no difference of the visiting impressions between visitors with or without an interpreter.

According to the results of this study, there is no necessity to adjust the maximum number of visitors for Nanjen Shan ecological protection area. However, it is urgent in need of developing a new strategy to disperse visitors in time segments and to strengthen the interdiction of illegal entry to Longkeng ecological protection area. Trash from the tourist shall be well managed and the functions of environmental education in both areas should be enhanced.

林木種子休眠與代謝產物關係之研究

簡慶德

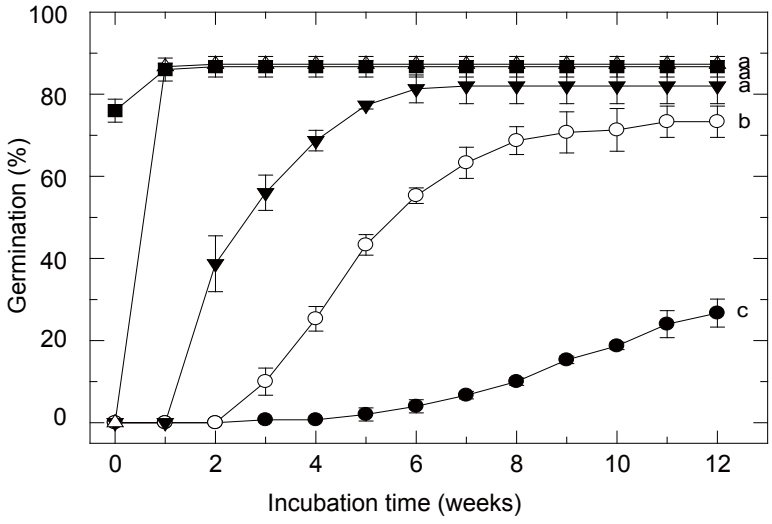
槭樹屬種子有休眠性，需要暖低溫組合濕層積處理或低溫5℃濕層積處理，以打破種子休眠。因此，種子有生理的休眠。然而，過去槭樹屬種子層積發芽機制未被詳細研究。本研究以臺灣紅榨槭種子為材料，探討不同的溫度對種子發芽效應，分析新鮮種子和5℃低溫層積12週種子的內生植物荷爾蒙變化、種子總糖量和總澱粉量、各種中性糖量和胺基酸量，並利用電子顯微鏡了解種子胚之細胞構造及低溫層積前後細胞內變化。新鮮種子在發芽溫度15/5℃下最佳，24週後發芽率達83%；經5℃層積12週的種子，一週後的發芽率即可達80%以上。種子內植物荷爾蒙離層酸含量經5℃層積12週減少約3.3倍，其含量約等於種子萌發量；5℃層積12週之激勃素GA_3、GA_7含量能用氣相層析質譜儀被檢測到，但此二種激勃素在新鮮種子未被發現。很多的蛋白質體和脂質體存在種子上胚軸生長點、第一片真葉和子葉細胞內，但低溫層積使得這些蛋白質體和脂質體大大地減少。總澱粉量在新鮮種子、低溫層積種子及萌發種子無顯著差異，但總糖量在層積及萌發種子顯著增加。5℃層積12週種子之總胺基酸量增加。結論是臺灣紅榨槭種子經低溫5℃層積處理改變植物荷爾蒙、蛋白質、脂質和糖類等，最後促進種子發芽。

臺灣紅榨槭翅果
Winged fruits (Samaras) of *Acer morrisonense*

Study on relationship between tree seeds dormancy and metabolites

Ching-Te Chien

Seeds of most *Acer* species are dormant and require moist warm plus cold stratification or only moist cold stratification (moist chilling) to break the dormancy. Thus, they have physiological dormancy. However, there are no detailed studies on the mechanism of dormancy break by stratification in the genus. The subject of this study is *Acer morrisonense* (Aceraceae), which grows at the highest elevation and is endemic to Taiwan. The effect of various temperatures on seed germination, and changes of plant hormone, sugars, amino acids and embryo ultrastructure were determined. Fresh seeds incubated at 15/5℃ for 24 weeks have reached a germination plateau of 83%, whereas seeds treated at other temperatures had lower percentages. Thus, the optimum temperature of *A. morrisonense* seeds was 15/5℃. Seeds cold-stratified at 5℃ for 12 weeks germinated at > 80% in one week. Total ABA content of seeds to cold stratified for 12 weeks was reduced about 3.3-fold, to a concentration similar to that when the seeds germinated (radicle emergence). Endogenous GA_3 and GA_7 were detected by GC-MS in cold stratified seeds but not in fresh seeds. Numerous protein and lipid bodies were found in the plumule apical meristem, first true leaves and cotyledons of fresh seeds. Protein and lipid bodies decreased drastically during cold stratification. There were no significant differences in total starch of fresh seeds, cold-stratified seeds and radicle-protruded seeds, but total soluble sugar increased significantly in cold stratified seeds and radicle-protruded seeds. Concentrations of total amino acids in seeds increased after cold stratification. Conclusion that cold stratification involves in the changes of plant hormone, proteins, lipids and sugars in seeds of *A. morrisonense* and finally promotes seed germination.



臺灣紅榨槭新鮮種子在低溫5℃層積下之累積發芽率。低溫層積的種子放在25/15℃變溫箱發芽。

Cumulative germination percentages of fresh *Acer morrisonense* seeds stratified at 5℃ in dark for 0 (control, ●), 4 (○), 8 (▼), 12 (Δ) weeks and then incubated at 25/15℃ in light after cold stratification

全球氣候變遷下菲律賓受威脅之經濟蕨類植物的保育

邱文良

全球氣候變遷造成各項生物資源之存續危機，已是全人類所需嚴正面對的挑戰，再加上因人口劇增所需的大量農地、經濟高度發展所需的大面積土地開發，因而導致自然生物棲息地的急劇下降，更造成了許多物種的消失，其中不乏對人類有經濟價值的蕨類植物。近50年來菲國土地受大量開發，蕨類植物棲地亦遭大量破壞，許多具經濟價值之蕨類植物受到嚴重威脅，亟需保育。

本合作計畫與菲國研究人員共同調查其境內具經濟潛力之蕨類植物，評估其受威脅狀態，進行其生物學特性與生物多樣性研究，探討其生殖方式，進行區外保育，以減輕其區內濫採壓力，從而達到永續利用之效果。

全期計畫三年間分赴岷達那爾的阿波山區、基坦格勒山區及尼格羅島的巴林沙沙雅等地採集調查，分別採集到28科150種、27科213種及30科231種蕨類植物，採集之標本複份分別存放於臺灣林業試驗所、菲國中央岷達那爾大學與國家標本館。由採集調查之材料，於計畫期間經整合、實驗、分析，計有下列成果：(1)發現一個在菲律賓未曾被報導的新種屬植物*Stenolepia tristis* (Blume) Alderw.,並發表於該國期刊*Philippine Journal of Science*；(2) 綜合菲國、台灣及亞洲地區之蕨類，完成亞洲地區稀有之886種蕨類植物評估及發表，其中包括菲律賓種類13屬、71種；(3) 選取一產於菲律賓具園藝價值潛力的稀有蕨類植物*Aglaomorpha cornucopia* (Copel.) Roos，進行其孢子培養，成功於13週後產生幼孢子體，結果可協助菲方繁殖本稀有植物，進行區外保育及園藝景觀之應用；(4)以在菲國所採集之鳳尾蕨屬材料，結合歷年來在其他地區蒐集之該屬材料，進行分子親緣關係研究，並與菲國研究人員共同撰文、發表； (5)各項研究均與菲國人員共同進行，訓練其年輕科學家，共享心得與成果，達到國際合作目的。

一種具園藝觀賞價值的菲律賓稀有蕨類植物
Aglaomorpha cornucopia (Copel.) Roos: a rare horticulture-potential fern in the Philippines.

Conservation of Threatened and Economic Pteridophytes in the Philippines as Affected by the Climate Change

Wen-Liang Chiou

The crisis of biological resources caused by climate change has become a severe challenge to overcome globally. The increasing human population and economic developments need numerous agriculture lands and thus destroy large area of natural habitats, resulting in rapid decreasing of biological diversity including many ferns with economically potential. During the past 50 years, the Philippines have also faced the same harsh situations. Conservation of many ferns having economical potential therein is urgently needed.

This collaborative research, focusing on the threatened and economic ferns in the Philippines, is conducted by pteridologists of both the Philippines and Taiwan. The aim is to facilitate the conservation and sustainable uses of those threatened ferns by means of investigating them in the Philippens, evaluating their threatened statuses, and exploring their taxonomy and reproductive biology,.

During a 3-year study, investigation and collection of ferns were conducted in Mt. Apo (Mindanao), Mt. Kitanglad (Mindanao), and Balinsasayao (Negros), and respectively a total of 150 species (belonging to 28 families), 213 species (27 families), and 231 species (30 families) of ferns have been found and collected. At least three duplicates of each were collected. Each of those duplicate specimens has been deposited in the herbarium of Taiwan Forestry Research Institute, Museum of Central Mindanao University, and the Philippines National Herbarium, respectively. Results of experiments and analyses based on those materials and some others from elsewhere are: 1) a newly recorded genus *Stenolepia* is found in the Philippens; and a paper antitled "*Stenolepia* Alderw. (Dryopteridaceae), a fern genus new to the Philippines" has been published in *Philippine Journal of Science*; 2) results of the statuses of evaluating 886 species of ferns in Asia, including 71 Philippines species, are published; 3) a rare fern endemic to the Philippines, *Aglaomorpha cornucopia* (Copel.) Roos, was selected and cultured by spores. The sporelings were produced successfully after 13 weeks of culture. The method can be applied to the propagation of this rare plant and facilitate its *ex situ* conservation; 4) results of molecular and morphology analyses entitled "Molecular phylogeny and biogeography of the fern genus *Pteris* (Pteridaceae)" has been published by the Taiwanese and Philippines researchers; 5) all researches have been conducted by scientists of both countries to share the experience and results, and thus achieve the goal of collaboration of the both sides.

紅檜人工林不同林分密度生長與材質試驗

邱志明

為反應生態環境保護與自然資源保育之世界潮流，天然林之繼續禁伐仍為必然之趨勢，在此情況下，永續並集約經營現有人工林，使之成為林產物供應之主要來源，已成為林業經營上一項主要課題。紅檜為台灣最重要之造林樹種，目前林分大部分都已成林，均面臨隨著林木之生長，不同林齡林分最適密度之決定。因此，本試驗以棲蘭山紅檜人工林不同林分密度之永久樣區為試驗地，造林時，栽植密度為10,000株，株距為1×1m^2，林齡8年生時，林分已發生嚴重自我疏伐現象，因此進行5種密度調整，分別為保留10,000株（對照區，未疏伐8,608）、5,000、2,500、1,600及1,100株/ha。除每木各項生長性狀調查外，並利用歷年生長資料，求算不同林齡之競爭密度效果、收穫密度效果實驗式，並藉發生自我疏伐之樣區求出林分最大密度曲線或自我疏伐曲線，同時，為避免干擾永久樣區，選取樣木以非破壞檢測方式，進行每一樣區3株近似中央木樣木之音速及動彈性係數、立木硬度測試、生長錐木軸取樣，進行微破壞儀縱向壓縮強度及soft-x-ray年輪構造解析，本年度計畫重點為每一樣區砍伐樣木1株，依CNS標準製成小試材，進行靜曲強度性質施測，以便和非破壞檢測結果進行實際比對分析，求出各性質之相關性，同時進行樹幹解析及生物量調查，以評估不同林齡、不同林分密度之碳吸存效應。結果發現以非破壞檢測法評估立木、原木、小試材其關係顯著，且各性質間之關係，部分關係顯著，但亦有些受限無法顯示其關係，年輪特徵質之關鍵指標為年輪寬、早材密度、晚材密度和最大密度。邊材寬、EFa、枝、葉比率、林分密度小者比林分密度大者，有較大之勢，樹幹形狀比相反。生物量和材積之擴張及轉換係數為411.7 kg/m^3，不同林分密度以每公頃2,500株，其CO_2吸存最大達268.6 Mg/ha，平均每年淨吸存量10.2 Mg。結果可做為台灣紅檜人工林決定不同林齡，林分密度控制，以生產質與量俱佳林分，提升林地生產力、碳貯存量及生物多樣性之重要參據。

關鍵詞：紅檜人工林、競爭密度之效果、自我疏伐曲線、非破壞試驗、碳吸存

紅檜人工林不同林分密度各性質之相關係數

Correlation coefficients among wood properties for different stand densities of *Chamaecyparis formosensis* plantations.

	胸徑 DBH (cm)	微破壞儀 Fractometer (kgf/cm^2)	音速 ultrasonic velocity (m/s)	硬度計 pilodyn (cm)	生材含水率 M.C. in green (%)	容積密度 Bulk density (g/cm^3)	動彈性係數 MOEd (kgf/cm^2)	早材寬 EW (mm)	晚材寬 LD (g/cm^3)	年輪平均密度 RD (g/cm^3)	年輪最大密度 MaxD (g/cm^3)
DBH	1										
Fractometer	0.3654 *	1									
ultrasonic velocity	0.0663	0.4626 **	1								
ultrasonic MSR	0.7465 **	0.3339 *	0.1849								
pilodyn	0.0985	0.0412	0.2728	1							
M.C. in green	0.0000	0.2458	0.2977 *	0.0949	1						
Bulk density	0.3905 **	0.7820 **	0.2548	0.0671	0.2126	1					
MOEd	0.0728	0.6505 **	0.9469 **	0.2977 *	0.3291 *	0.5388 **	1				
EW	0.6025 **	0.1513	0.1187	0.4538	0.0583	0.3464 *	0.0173	1			
LD	0.0917	0.4636 **	0.3991 **	0.1170	0.2330	0.3401 *	0.4652 **	0.1105	1		
RD	0.4110 *	0.6085 **	0.2140	0.7212 **	0.2394	0.7135 **	0.4153 **	0.5456 **	0.4932 **	1	
MaxD	0.0707	0.5615 **	0.4778 **	0.1170	0.2236	0.4589 **	0.5660 **	0.1400	0.7108 **	0.3486 *	1

**：P≦0.01；*：P≦0.05

Studies on the growth and wood properties of stand density for red cypress plantations

Chin-Ming Chiu

Protection of ecological environments and conservation of natural resources are the current worldwide trends. Therefore, the ban on cutting of natural forests is likely to continue. Under the circumstances, it is important that sustainable and intensive management of man-made forests through silvicultural and genetic manipulations should render them to be the main emerging providers of forest products. Red cypress (*Chamaecyparis formosensis*) is the most valuable species in Taiwan and presently, the canopies of its plantations have already closed which leads to some concerns and problems, such as with the increasing stand age, how to determine the optimum stand densities per unit area and how to improve the wood quality of plantation trees are troubling the forestry agencies. Therefore, we've selected experimental sites in permanent plots of different stand densities in red cypress plantations at Chilan Mountain area of northern Taiwan. The original planting space was 1×1 m^2 in 1980. The stand had undergone severe self-thinning at 8 yrs of age, so the stand densities were adjusted to 5,000, 2,500, 1,600 and 1,100 tree/ha, while the control plot had 8608 tree/ha. In order to avoid disturbing the permanent plots, we applied some non-destructive techniques to sample 3 trees of close to the average characteristics from each plot. Then one of the sampled trees of each plot was cut for doing stem and growth analyses, biomass, wood strength and carbon sequestration estimations. Base on the experimental results, we concluded that the non-destructive techniques can be used to successfully evaluate the ultrasonic velocities? and mechanical properties of the standing trees, logs and clear specimens of red cypress. In addition, the average ultrasonic velocity of clean specimens was about 8.8% higher than the logs; and that of the logs was about 6.3% higher than the standing trees. However, certain nondestructive techniques were limited in their capacities to evaluate some wood properties. The ring width, earlywood ratio, ring density, and the maximum ring density are key factors affecting wood mechanical properties. For sapwood thickness, and the branch to foliage ratio of the red cypress trees, the lower stand densities have the larger values than the higher stand density ones, but for taper of stem ratio, the opposite are true. The best regression equation for biomass conversion and expansion factor of the above ground parts? (BCEFa) to the stem volumes indicated that M (kg) = 411.7V(m^3). urthermore, the optimum CO_2 sequestration was found in stand with 2,500 stem/ha density, reaching 268.6 Mg/ha at 30-yr-old and the average annual net CO_2 sequestration was 10.2 Mg/ha/yr. The results could be a useful reference for the tending practices of red cypress plantations; to control stand density at various age; and to produce both good qualitative and quantitative growths, while maintaining bio-diversity and keeping the plantations sustainably producing.

Key words: Red cypress plantations, competition density effect, self-thinning curve, non-destructive test, carbon sequestration

科普活動：教學型蕨類培養套組之研發

黃曜謀

雖然植物的生命週期較動物複雜，卻相當穩定及多樣性，相當適合做為認識生命週期多樣性的入門教材。在植物界中，蕨類植物具有獨立的孢子體世代與配子體世代，不僅適合用於植物生命週期觀察，且可進行其他操作性實驗，這些特性是其他植物類群所難匹敵的。可惜，在臺灣未有任何有關蕨類培養教材可供教學使用；國外雖有類似的套組販售，但價格昂貴且有外來物種汙染的問題存在。

本計畫所研發之蕨類培養套組，包括塑膠杯、培養介質並以宜蘭地區水蕨(*Ceratopteris thalictroides* (Linn.) Brongn)為栽培對象。在適當培養條件下，水蕨孢子於1週內發芽，第2週產生藏精器及藏卵器，第4週幼孢子體產生；植株從幼孢子體出現至植株成熟，約7週。水蕨完成整個生活史約12週，在一個學期內即可完成整個生活史觀察。

為推廣本蕨類培養套組使用說明，自2013年7月20日起至11月10日分別在台北植物園及6所學校，共舉辦12場次蕨類培育研習營，參加的教師及學生人數分別達到117及481位，他們不僅學習到如何栽培蕨類也懂得觀察蕨類的生活史。相較於開花植物從種子發芽到植株成長過程，蕨類生長速度通常較為緩慢及需要較高的空氣濕度，造成一般大眾對蕨類很難培養照顧的誤解，唯有透過不斷的解說教育及從錯誤中學習經驗，方能打破此一存之已久的誤解。

本蕨類培養套組具有價格便宜、容易操作、培養時間短等優點，適合當作國小及國高中自然課實驗教材，且使用臺灣原生蕨類，避免外來物種生物汙染的疑慮。

學生正學習如何用蕨類培養套組培養蕨類。
Students are learning how to culture ferns with fern culture kit.

Popular science activities: development of a fern culture kit for the teaching purposes

Huang Yao Moan

Life cycles of plants are more complex than those of animals, but are quite stable and variable Ferns have independent gametophyte and sporophyte generations. These characteristics are rarely seen in other plant taxa. Thus ferns not only offer a suitable material for observing the life cycle of the plant, but also for conducting other experiments. Unfortunately, no fern culture kit for teaching has been developed in Taiwan. Commercial fern culture kits were available in foreign markets. However, high cost of these kits and the potential of biological pollution from foreign fern species are important concerns and need to be addressed before applying these commercial kits for educational purpose.

A newly developed fern culture kit in this study contains plastic cups, culture medium, and spores of native aquatic fern (*Ceratopteris thalictroides* (Linn.) Brongn) grown in Ilan area. Under suitable cultural condition, spores initiate germination within one week. In the 2nd week, gametophyte produces antheridia and archegonia. Young sporophyte develops from gametophyte in the 4th week, and develops into mature sporophyte 7 weeks later. The complete life cycle of the aquatic fern is ca. 12 weeks which is within one semester.

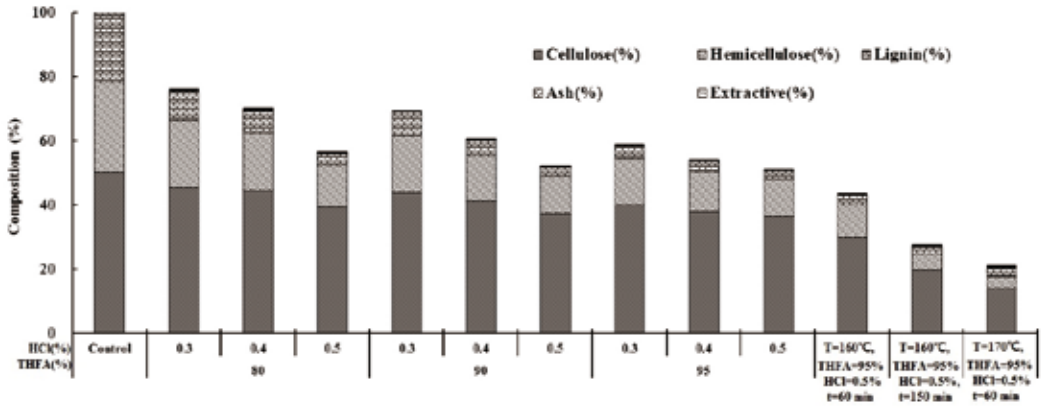
Twelve seminars/workshops were hold in Taipei Botanic Garden and 6 schools during July 20th to November 10th 2013, to demonstrate how to culture ferns by using this kit. A total of 117 teachers and 481 students participated in these workshops. They learned not only how to culture ferns but also how to observe the fern life cycle. Comparing to seed germination and plant growth of flowering plant, the growth of gametophyte generation of fern is relatively slow and needs high air humidity. People need to have more patience to culture ferns. This also reflects the general misunderstanding that ferns are difficult to plant and care. Continuous education and experiences from mistakes will break the long-standing misconceptions.

The fern culture kit has several advantages, including cheap price, easy operation and short culture period. It is a suitable teaching material for biological experiment in elementary and high schools. Meanwhile, the deployment of native ferns will avoid the biological pollution of exotic species.

多種高沸點醇製備銀合歡漿料、動力學推導及廢液回收應用之研究

何振隆

隨著全球木材資源日趨枯竭及台灣林業政策禁止砍伐，使得台灣漿紙業界尋求料原壓力愈大，故對於木質廢棄物的有效利用愈重視。銀合歡為外來入侵種，其造成台灣南部海岸林相當嚴重之生態環境危害，必須進行伐除。因此利用砍伐後之銀合歡(*Leucaena leucocephala*)做為製漿原料，始可減低料原供給壓力。現今製漿方法大都為化學製漿法，此等製漿方法，易造成廢液回收、收率低等問題，因此開發新型且較低污染製漿方法，在實現木質廢棄物完全利用為及環境保護上均具重要意義。近年來，有機溶劑製漿法之應用已屢被學者研究，並發表於世界重要學術期刊，均顯示此種製漿法可取代傳統製漿法，且已具高度開發潛力。依據目前學者已發表的相關文獻顯示，高沸點醇製漿具蒸煮壓力低、安全性及收率高等特性，故具有極佳工業化潛能。但相對於銀合歡之高沸點醇製漿而言，卻無類似文獻。因此本論文為利用砍伐後之銀合歡做為製漿原料，分別以四種高沸點醇類溶劑製漿，即為乙二醇(ethylene glycol)、1,3-丙二醇(1,3-propanediol)、1,4-丁二醇(1,4-butanediol)及四氫呋喃醇(tetrahydrofurfurylalcohol, thfa)等有機溶劑予以製漿。所得四種高沸點溶劑漿料中，為以四氫　喃醇溶劑製漿方法所得漿料卡巴值可達最低，且收率為最高，較一般傳統鹼性製漿法高出5%或以上，因此此方法之製漿適性為最佳。此四氫呋喃醇製漿方法於蒸煮初期之脫木質素效率較高，且此法主要為攻擊木質素及半纖維素，但纖維素溶出較少。再者，於手抄紙物理性質較傳統硫酸鹽法之性質為差，其原因為紙漿中之單纖維強度在酸性蒸解下，導致強度較弱所造成。



以各種不同條件進行四氫呋喃醇製漿法蒸煮銀合歡漿料之化學組成分分析
The compositions of THFA pulped *L. leucocephala* under different pulping conditions.

Preparation, kinetics, waste liquor recovery and utilization of *Leucaena leucocephala* pulps using several high-boiling-point alcohols

Chen-Lung Ho

Diminishing global wood resources coupled with a policy of moratorium on log harvesting in Taiwan have led to tremendous pressure for the pulping industry there. This also led to a greater stress on the effective utilization of woody wastes. *Leucaena leucocephala* is an alien invasive species causing extensive ecological harms along the southern coastal forests of Taiwan. Removal of the species is desirable and pulping of the harvested materials might provide alternative supplies. At present, chemical pulping is largely dominated by the kraft process which has certain shortcomings. Thus, novel and low polluting pulping processes have significance in total utilization of woody wastes and environmental protection. Organosolv processes have been examined by researchers and their applications reported in important global journals. These processes are shown to have potential of substituting the traditional methods. According to the reports, high-boiling-point alcohols have low cooking pressures, thus with higher safety and recoverability, which are prerequisites for industrialization. There is no pertinent report on the high-boiling-point alcohols pulping of *Leucaena leucocephala,* however. Thus, four kinds of high boiling point alcohols as pulping agents were used. These were ethylene glycol, 1,3-propanediol, 1,4-butanediol, and tetrahydrofurfuryl alcohol (THFA). Among the pulping chemicals, THFA produced pulp of the lowest kappa number while gave the highest pulp yield; more than 5% higher than the yields of conventional alkaline pulping processes. Thus THFA pulping of *Leucaena leucocephala* is deemed optimal among the organosolv pulping processes. THFA has higher delignification rate at the initial pulping stage. The chemical mainly attacks lignin and hemicellulose with minimal dissolution of cellulose. In addition, all organosolv pulps had poorer strength properties than traditional kraft pulp. This is probable caused by the presence of acid in the cooking liquor leading to overall weaker fibers.

台灣穗花杉花粉儲藏、控制授粉與胚胎發育之研究

Studies on the pollen storage, controlled pollination and embryo development of *Amentotaxus formosana*

鍾振德

Jeng-Der Chung

台灣穗花杉僅分布於台灣本島南端，由於族群稀少，被列為積極保育之本土樹種。台灣穗花杉由於有性生殖能力薄弱，使得種子產生不易，為其族群拓展最大限制因子。研究探討台灣穗花杉生殖生物學，解決台灣穗花杉生殖之困境，增加飽滿種子之生產。台灣穗花杉為雌雄異株，種子被假種皮所包覆，生殖週期與其它穗花杉屬相似，從授粉到種子成熟需要15個月。試驗材料取栽植於福山之49株15年生扦插苗，利用枝條高壓處理，獲得高壓發根苗，高壓方法為環狀剝皮1.5cm寬，包覆水草後以黑色塑膠布包裹。高壓過程中的環狀剝皮處理，可以誘導台灣穗花杉花芽分化。試驗處理結果以六月初高壓處理效果最佳。以高壓處理所獲得之發根苗栽植於盆缽，進行有性生殖觀察。雄毬在3月中旬結束休眠，小孢子形成於3月底漸漸發育成熟。成熟花粉大小約25μm。雌毬2014年在3月底結束休眠，胚珠裸露後不久即分泌授粉滴。約在4月初開始授粉，授粉期約1~2星期。大孢子於3月底開始逐漸發育，此時雌配子體尚未成熟，直到6月初成熟時才完成授精。從授粉到授精大約需2個月。台灣穗花杉有2個藏卵器，而種子成熟於隔年之5到6月。

台灣穗花杉具紅色假種皮之種子

A. formosana seed cone containing a single seed surrounded by an aril.

Amentotaxus formosana is an indigenous tree found only in the southern parts of Taiwan. These trees have already been listed as one of the conservation tree species and protected by the government due to scarcity of its population. However, a major limitation of the species is poor seed production in Taiwan due to its weak reproducibility. The goal of this project is to provide information about the reproductive biology of *A. formosana* growing in seed orchards and in natural stands. The information should make it possible to determine its reproductive potential, reproductive success rate, and provide methods to increase cone and filled seed production. *A. formosana* is dioecious and its seed cones are highly modified, each cone containing a single seed surrounded by an aril. Its reproductive cycle is similar to other *Amentotaxus* and spanned 15 months from pollination to seed maturity. In this study, 49 cuttings of 15-year-old *A. formosana* in Fushan Botanical Garden were air layered as a propagation method that allowed us to root branches. The method was girdling the stem, removing a band of bark 1.5 cm wide all around the stem, cover the cut with a ball of moist moss and wrap moss ball with a piece of black plastic. Band girdling is a way to stimulate *A. formosana* cuttings into producing more flower buds. Early June is an ideal time to begin air layering. Then the sexual reproduction of *A. formosana* was described for the container-grown clones. Pollen cones ended dormancy in middle-March, and microsporogenesis occurred in late March. Mature dry pollen was about 25 μm in diameter. The seed cones ended dormancy at the end of March 2014; cone opened to expose the ovules, and soon afterward pollination drops were secreted. Pollination occurred about 1~2 week in early April. Megasporogenesis occurred in late March but female gametophytes did not mature and the fertilization did not take place until early June. The interval between pollination and fertilization was about two months. An archegonial complex formed containing 2 archegonia. Seed maturity was in May and June of the next year.

以天敵昆蟲控制入侵中歐的台灣植物-臭椿

Regulation of invasive *Ailanthus altissima* in Middle Europe by its Taiwanese native pests

董景生

Gene-Sheng Tung

臭椿（*Ailanthus altissima* (Mill.) Swingle）被引入歐洲當作行道樹約有200年的歷史，原做為觀賞樹種，但近數十年來由於原生生態系的破壞與人為活動干擾，在歐洲地區造成嚴重的入侵現象。傳統抑制方式，如植株伐除，除草劑或其他整合應用，僅有暫時效果而整體成效不佳，成本相對高昂，並且無法於保護區內施用。尋求專一性高且有效的生物防治物種因此成為當務之急。臭椿原產於自中國大陸和台灣，其原生分布地有許多病蟲害曾被描述。但在台灣，臭椿是一種侷限分布的高海拔植物，其族群數量受限與稀有的原因值得探索和應用。本計畫採集並選取台灣臭椿上的天敵昆蟲，在斯洛伐克實驗室內建立族群，經過寄主植物偏好性測試，了解對臭椿的抑制機制。繪製台灣臭椿的天然分布圖，探討自然條件下，天敵昆蟲的基礎生物學以及昆蟲對植物健康的影響。後期斯洛伐克方若取得歐盟輸出許可，預期將天敵昆蟲釋放到野外進行試驗。

The tree-of-heaven (*Ailanthus altissima* (Mill.) Swingle) has been introduced as an ornamental plant to Europe for almost 200 years. In the past decades it has become one of the worst alien plant species which cause significant damage to ecosystems and human activities. For its classical regulation methods, such as removal of the plants, herbicide application or their combinations, these have low and temporary effect but entail a high cost. Moreover, their application is limited especially in protected areas. Therefore, there is an urgent needs to search for high specificity and effective bio-agents to eliminate the target trees. In China and Taiwan, the original habitats of the tree-of-heaven, many native pests and diseases have been described. But the tree is distributed only on high elevation areas in Taiwan. The reason for the phenomenon is worthy of farther investigation. In this project, we've collected the most harmful pests of the tree-of-heaven found in Taiwan. Then one of the pests will be established in a laboratory culture in Slovakia to evaluate its trophic affinity to native economically important tree species and its destructive effects on this alien tree. We've also mapped the health conditions of tree-of-heaven population in Taiwan, to study the biology of the pests in their natural conditions and tree-pest interactions. Upon approval of the EU import permit of this pest, it will be released into the natural environment.

臭椿在斯洛伐克的入侵現況
Invasive Tree-of-heaven population grew in Slovakia.

在台灣採集臭椿的植食性昆蟲
Herbivorous insects of tree-of-heaven were collected in Taiwan.

提高國產木竹材資源多元化利用之創新研究

林裕仁

本計畫依據工作內容執行完成計有: 1.召開「2013竹精品產業發展論壇」一場次，邀集國內從事竹類研究與竹材加工利用之相關學者與專家，分享工作經驗、設計理念與未來展望。2.建置「台灣竹資源交流網」資訊平台一式，延續竹精品產業發展論壇所彙集竹相關產業多元領域成果能量，擴大交流空間，讓關心臺灣竹資源利用與發展的各方學者、專家、業者與民眾有持續性之討論平台。3.辦理木材小型機械採運技術訓練課程一場次，培育年輕學子林業採集技術專業智識與技能之講習活動，以期漸趨斷層之林木採集技術得以傳承給年輕世代。4.執行赴日本參訪竹林經營與竹材採運技術及經驗交流行程，借鏡學習其良善之林木經營管理模式與採運技術。5.執行赴歐盟參訪奧地利木質顆粒生質能源之推廣政策與經驗，瞭解木質顆粒已成為歐盟國家間生質能源未來發展的重要趨勢與重要選項，且已被大量使用於火力發電廠燃燒轉化能源，未來全球木質顆粒消費市場呈現持續增長之趨勢。及6.草擬「利用生質能源推廣辦法」草案。諸等工作均按照計畫期程順利執行，具有提高木、竹材收獲作業效益與綠色生質能源應用，提昇木、竹材產品創新，與國內生質能源利用比例，及健全國內林業經營管理，並建立與國際林業研究機構接軌管道，研究結果可提供能源與林業主管機關作為政策擬訂之參考，以期國內木、竹材產業得以有振興之機會。

拜會奧地利木質顆粒協會(proPellets Austria Association)，由協會理事長Dr. Christian Rakos (右二)親自接待
Delegation visited the “proPellets Austria Association” in Austria and Dr. Christian Rakos (the second one from right), the President of the Association, hosted in person.

Study on promoting innovations in multifaceted utilization of domestic wood and bamboo resources

Yu-Jen Lin

According to the initial project outlines, we've implemented the following works: 1) held a forum of "2013 Developmental Forum for Excellent Bamboo Products Industry in Taiwan," invited researchers and experts on bamboo process utilization to share their work experiences, design ideas, and future prospects; 2) established a website "Taiwan Bamboo Resources Communication Platform" to foster the spirit of the Forum and to extend related information exchange to academics, experts, businesspersons, and the general public, who care about the domestic bamboo resources utilization and development; 3) held a training course for timber logging operation with small machines to train young people on the specialized knowledge and skills of timber harvest without knowledge gap; 4) visited a bamboo forest in Kyushu, Japan to learn their management and mechanical harvesting technologies; 5) visited the "proPellets Austria Association" in Austria to explore their extension policies and experiences of biomass handling, knowing that wood pellets have become an important alterative to develop bioenergy in Europe and will see continuously growth in global consumption markets; and 6) drew up a draft on the promotional measures for biomass utilization. All these works were smoothly implemented according to the project procedures and reached expected results. The results can provide references to energy development and for strategy modulations of the forestry authority, as the results provided helpful information and feasible advices to promote efficiency of forest management, to increase green bioenergy utilization, to enhance the wood and bamboo product innovations, to build supply chain of wood and bamboo processing industry, to revitalize the forestry industry in Taiwan, and to strengthen international cooperation with related research institutes abroad.

2014

Annual Report

參

附錄

Appendix

103年度 1月—12月

1 JAN

- 本所與臺中市政府文化局、臺中市葫蘆墩文化中心及野桐工坊於1月15日在台北植物園欽差行臺，合辦「植物・纏繞—走進纖維植物的世界特展」開幕記者會，展示構樹、大甲藺、月桃、香蕉絲、苧麻等編織纖維的栽培、選用與產業變遷等主題，展期至6月29日止。

2 FEB

- 臺北市景觀工程商業同業公會人員暨大陸地區廈門市市政園林局蔡允嘉局長等7人，於2月13日拜會本所並參訪台北植物園。

- 黃裕星所長率領同仁於2月24日在恆春研究中心接待監察院財政及經濟委員會一行20餘人，並向渠等簡報及導覽恆春熱帶植物園業務。

3 MAR

- 國立臺南藝術大學陳建北老師於3月間至本所，指導臺北植物園志工有關植物科學的繪圖技巧，藉以提升志工們的解說品質與繪製教具能力。

- 技術服務組於3月5日、10日及13日在總所舉辦「103年度個人資料保護之教育訓練與內部稽核」講習，共有259人參加。

- 黃裕星所長及森林保護組吳孟玲組長於3月6日出席新北市政府「啄木鳥護樹計畫」培訓之樹木修剪技術合格人員及護樹志工暨樹木醫療顧問團成員之授證典禮，黃所長並榮膺該市「樹木醫療顧問團」團長。

- 木材纖維組何振隆副研究員為執行「多種高沸點醇製備銀合歡漿料、動力學推導及廢液回收應用之研究」計畫，於3月12日至16日赴日本松山參加「第64回日本木材學會大會（The 64th Annual Meeting of the Japan Wood Research Society in Matsuyama）」並發表論文。

- 蓮華池研究中心於3月14日至15日假埤子頭植物園、嘉義樹木園、阿里山森林遊樂區等地舉辦「蓮華池志工團103年移地研習」，共有26人參加。

- 世界竹會理事長蘇珊・盧卡斯（Susanne Lucas）女士與美國哈佛大學植物標本館分類學者茱莉・麥肯塔斯・莎媲柔（Julie McIntosh Shapiro）女士於3月16日參訪臺北植物園及植物標本館，由植物園組邱文良組長、育林組陳財輝研究員及竹類專家呂錦明博士陪同參觀。雙方並就臺灣竹種、竹類資源以及本所標本館之標本數位化等議題進行交流。

- 植物園組陳建帆助理研究員為執行「索羅門群島資源植物調查暨植物誌編纂」計畫，於3月22日至5月6日赴斐濟及索羅門群島採集研究材料。

- 本所與國立苗栗高級農工職業學校於3月26日至27日合辦「林木採集技術訓練講習」，共有該校森林科學生34人參加。

4 APR

- 本所於4月1日至2日在恆春研究中心舉辦「103年度森林護管人員教育訓練及檢討會」，共有25人參加。
- 植物園組邱文良組長及鐘詩文助理研究員為執行「臺菲國合計畫－全球氣候變遷下菲律賓受威脅之經濟蕨類植物保育」計畫，分別於4月1日至14日及4月5日至14日赴菲律賓蒐集研究材料。邱組長並赴菲國宿霧（Cebu）參加「第23屆菲律賓生物多樣性研討會（The 23rd Philippine Biodiversity Symposium）」發表論文。
- 本所與雪霸國家公園管理處、國立臺灣大學實驗林管理處等單位於4月18日假國立臺灣大學合辦「2014森林樹冠層生態保育國際研討會（2014 International Symposium of Canopy Ecology Conservation）」。

5 MAY

- 技術服務組王瀛生研究員，林業經濟組林俊成組長、王培蓉副研究員等人，於5月18日以「樹木枝條的生活化與花果種子工藝展示」為主題，參加由國立歷史博物館等單位主辦的「518博物館文創園遊會」，展出利用人工林修枝疏伐後的枝葉花果所製成的工藝品與DIY組裝玩具，藉以宣揚森林之可再生利用與碳匯功能。
- 本所與臺北市政府、臺灣都市林健康美化協會等團體於5月19日在國立臺灣大學舉辦「2014樹木保護國際研討會—以大安森林公園為例探討預防天災作為」。另於5月20日在本所舉辦「2014樹木醫/樹藝師工作實務國際研討會」，邀請美國、新加玻、日本等地的樹醫專家講授都市林維護管理之概念與實務，提供國內制訂樹木健康管理規範之參考。
- 木材纖維組葉若鋆助理研究員為執行「森林精油生產與永續森林經營」計畫，於5月19日至11月21日赴美國奧勒岡州波特蘭市世界林業中心（World Forestry Center）進行研習。
- 本所與中華製漿造紙技術協會於5月21日至23日在總所舉辦「2014泛太平洋漿紙技術國際研討會—基於可永續森林生質之世界前景」，邀請美國、加拿大、日本、韓國、印尼、臺灣等地區代表報告紙業現況，並安排臺灣永豐餘集團何壽川總裁、瑞典皇家科技院教授暨國際木材科學院理事長Lennart Salmén先生，及美國北卡州立大學森林生質材料系Hasan Jameel教授進行專題演講。
- 福山研究中心與桃園縣蘆竹鄉公所等單位，於5月22日至23日合辦「103年度香花生態導覽與應用之解說員訓練」課程，講授如何利用香花植物推動地方特色農業與社區發展。
- 植物園組董景生副研究員、林奐宇助理研究員、張德斌約用助理等3人為執行「以天敵昆蟲控制入侵中歐的臺灣植物－臭椿」國際合作人員交流計畫，於5月22日至31日赴斯洛伐克進行研究交流。

- 森林經營組邱志明組長為執行「紅檜人工林不同林分密度生長與材質試驗」計畫，於5月25日至31日赴韓國首爾大學參加「世界快速變遷下之森林永續經營研討會（Joint International Symposium by Korea, Japan and Taiwan - Sustainable Forest Ecosystem Management in Rapidly Changing World）」發表論文，並參觀韓國人工林之經營試驗地。

- 本所於5月29日在總所舉辦「2014森林集水區經營研討會」，共有103人參加。

6 JUNE

- 本所樹木醫學中心與新北市政府於6月20日假淡水忠烈祠園區共同執行「啄木鳥護樹計畫」，本所提供「樹木健康檢查」與「樹木腐朽診療—樹木注射」二項專業技術，為該市珍貴老樹進行健康檢查與病蟲害防治。

7 JULY

- 福山研究中心與新北市永續環教中心於7月1日至3日在福山合辦「昆蟲專業教師研習」課程，共有國中、國小教師近20人參加。

- 本所與中央研究院生物多樣性研究中心、東海大學生命科學系等單位，於7月1日至11日在蓮華池研究中心合辦「中部田野技術課程」，針對亞熱帶地區之氣候形態、動植物相及人文發展等議題，培訓研究人才之現地調查與分析實力。

- 根據考古學家推測，嘉義市山仔頂疑有距今約2,000年至400年前的金屬器時代遺址，主要集中於本所嘉義樹木園棕櫚植物區。本所同意嘉義市政府申請於7月14日以機械及人工方式並行挖掘，展開嘉義建城300年來首次的試挖遺址考古工作。

- 本所與中央研究院生物多樣性研究中心、東海大學生命科學系等單位，於7月15日至26日在蓮華池研究中心合辦「第五屆臺灣田野生物研習會（Taiwan Field Biology Course Workshop）」，共有來自16所大學的30位學員參加。

- 森林保護組王豫煌特聘研究員於7月16日至19日赴日本筑波，參加「全球生物多樣性資訊機構（The Global Biodiversity Information Facility, GBIF）第五屆亞洲節點會議（The fifth GBIF Asian Nodes Meeting）」。

- 植物園組邱文良組長及鐘詩文助理研究員為執行「索羅門群島植物種源蒐集」計畫，於7月19日至8月2日赴索羅門群島採集研究材料。

- 森林保護組吳孟玲組長，育林組簡慶德研究員、黃怡菁副研究員於7月24日至27日赴臺北世界貿易中心南港展覽館，參加「2014臺灣國際生物科技大展」，展出「樹木褐根病LAMP檢測技術之建立」、「臺灣原生優良檫樹（諾麗果樹）品系、栽培技術及其保健產品」與「珍稀懸垂觀賞植物—垂枝石松之體外人工繁殖技術」等研發成果並開拓商機。

- 植物園組陳建文聘用助理研究員及吳維修聘用助理研究員為執行「索羅門群島資源植物調查暨植物誌編纂」計畫，於7月28日至8月20日赴索羅門群島採集研究材料。

8 AUG

- 植物園組朱麗萍助理研究員於8月1日至6日赴日本福島縣出席「只見町地區登錄為聯合國教科文組織人類與生物圈保留區紀念研討會（Symposium for the Tadami Biosphere Reserve, UNESCO MAB Plan-Ecology, Conservation and Sustainable Management of Beech Forests）」並發表簡報。
- 蓮華池研究中心許原瑞主任率領同仁於8月13日至14日在該中心接待中國電視公司生態旅遊節目「MIT台灣誌」製作團隊，並協助拍攝生態專輯。
- 本所與苗栗縣政府於8月14日在南庄鄉公所合辦「平地造林撫育作業講習會暨傾聽人民心聲」活動，為參與林務局獎勵造林或租地造林之林農提供相關經營技術。
- 技術服務組張勵婉助理研究員及恆春研究中心伍淑惠助理研究員於8月16日至22日赴大陸地區瀋陽市及哈爾濱市，參加「第8屆海峽兩岸森林動態樣區研討會」並分別發表簡報。
- 森林經營組邱志明組長為執行「臺灣杉人工林不同林分密度生長與材質研究」計畫，於8月16日至24日赴大陸地區北京市參加「第七屆海峽兩岸森林經營研討會」發表簡報，並參訪北京大學實驗林及相關人工林經營試驗地。
- 黃裕星所長率領同仁於8月20日、21日、22日分別前往臺東縣頂岩灣釋迦專區、嘉義縣梅嶺果樹專區、臺中市摩天嶺甜柿專區，勘查針對林務局租地造林地所規劃的農業專區。
- 植物園組朱麗萍助理研究員於8月26日至9月2日赴荷蘭參加「橡樹開放日研討會（Program of the Oak Open Days at Trompenburg Gardens and Arboretum, Rotterdam, The Netherlands）」並發表簡報。

9 SEP

- 本所為辦理臺北植物園整建工程，特別將昔日大池塘角落的休憩飲茶空間恢復為日式建築風貌，並於9月2日以日據時期舊地號「南門町三二三」之名揭幕並開放參觀，同時推出「臺北植物園志工繪圖展」做為開幕首展。
- 本所與臺灣藍染學會自103年9月2日起至104年1月4日止，於臺北植物園欽差行臺合辦「染料植物特展」，內容介紹常見的染料植物、染布流程、使用工具及精美作品等。
- 森林保護組王豫煌特聘研究員於9月14日至19日赴印度新德里，參加「全球生物多樣性資訊機構（The Global Biodiversity Information Facility, GBIF）第21屆理事會（The 21st Meeting of the GBIF Governing Board）」。
- 臺灣森林休憩保育協會人員暨大陸地區廣東省林學會林業專家譚天泳等15人，於9月15日拜會本所並進行座談交流。
- 本所於9月17日在總所舉辦「2014平地造林試驗研究監測研討會」，共有99人參加。

- 黃裕星所長率領同仁於9月17日假苗栗縣南庄鄉公所，舉辦「平地造林撫育作業講習會暨傾聽人民心聲座談會」，共有140人參加。

10 OCT

- 本所與林務局、特有生物研究保育中心、營建署等單位合作，於10月6日共同舉辦「臺灣生態資訊入口網」及「社區生態雲」開站啟動儀式。這不但是臺灣生態資訊服務的新紀元，更是行銷臺灣生態之美及接軌國際生態趨勢的重要一步。

11 NOV

- 本所與臺灣森林認證發展協會共同輔導之新竹縣竹東鎮正昌製材廠，於11月4日正式通過國際FSC™森林經營標準認證，成為臺灣第一個通過相關認證的林地，代表國內人工林朝向負責任永續經營邁入新的里程碑。

- 植物園組董景生代理組長及陳廷科約聘職務代理人為執行「原住民與社區保育區（Indigenous & Community Conserved Area, ICCA）在臺灣的發展及建構—傳統生態智慧對民族生物的運用與管理—ICCA在蘭嶼社區保育」計畫，於11月8日至19日赴澳洲雪梨進行原住民部落研究參訪，並於「2014年IUCN世界公園大會（The 2014 IUCN World Parks Congress）」中宣讀論文。

- 育林組何政坤組長當選第38屆全國十大傑出農業專家，於11月12日至16日赴大陸地區天津市進行農業專家參訪交流。

- 蓮華池研究中心於11月20日接待新竹縣政府「103年度森林觀摩研習會」一行37人並安排試驗林導覽。

- 本所於11月21日與26日在總所及中埔研究中心各舉辦一場「2014臺灣竹構造建築研討會」，分別約有150人及140人參加。

12 DEC

- 森林保護組趙榮台研究員及陸聲山副研究員於12月1日至5日接待日本森林總合研究所（Forestry and Forest Products Research Institute）塔村真一郎博士（Dr. Shin-ichiro Tohmura），並協助其採集虎頭蜂蜂窩等材料。塔村博士為分享其研究專長，特別於12月5日在總所以「交錯層積材（cross laminated timber, CLT）的現今及未來發展（Current and future development of CLT）」為題發表演講。

- 蓮華池研究中心於12月2日在該中心舉辦「2014年第4季志工研習暨員工在職教育講習」，約有20人參加。

- 技術服務組於12月6日以「樹木的永生—林業古籍之典藏與修復」為主題，參加中華民國圖書館學會舉辦的「2014年專門圖書館海報展」榮獲第1名，並獲推薦於2015年至美國圖書館學會（American Library Association）展出。

- 蓮華池研究中心於12月21日在該中心舉辦「志工團年會暨聯誼活動」，共有28人參加。
- 蓮華池研究中心於12月21日接待雲林縣莿桐鄉樂齡學習中心一行約200人並安排試驗林導覽。

Major events

JANUARY–DECEMBER 2014

JANUARY

- The TFRI together with the Cultural Bureau of Taichung City Government, the Huluduen Cultural Center of Taichung City and the Wild-Tong Trees Workshop held an opening media session at the Guest House of Imperial Envoys, Taipei Botanical Garden on Jan. 15 to co-host "Plants•tangled—World premiere of fiber plants special exhibition." The exhibition displayed themes of cultivation, selection, and industrial shifts of fibers for weaving such as from paper mulberry, bulrush, beautiful galangal, banana fiber, ramie etc. The exhibition expired on June 29.

FEBRUARY

- Representatives of Taipei Landscape Engineering Association and Chinese Mainland Xiameng City Municipal Garden and Forest Bureau Chief Mr. Yin-Jia Tsai for a total of 7 persons visited TFRI and Taipei Botanical Garden on Feb. 13.
- On Feb. 24, The Director General Dr. Star YS Huang led colleagues at the Hengchuen Research Center to meet visitors of a group of 20 plus from the Committee on Financial and Economic Affairs of the Control Yuan. After briefing the guests on the missions of Hengchuan Tropical Botanical Garden, a guided tour was provided.

MARCH

- Mr. Chien-bei Chen of National Tainan Arts University came to TFRI in March and instructed the art of botanical drawing to volunteers of Taipei Botanical Garden so as to improve their interpretive quality and drawing capacity of the props.
- On March 5th, 10th, and 13th, the Division of Technical Services held ttree training and internal audit sessions of "2014 Protection of Personal Information Course." A total of 259 persons partook in the events.
- Director General Dr. Huang and Division Chief of Forest Protection, Dr. Mong-lin Wu took parts in a "Woodpecker Tree Protection Project" of New Taipei City which purports to train qualified tree pruning technicians, tree protection volunteers and a council of advisors for tree medical service members on March 6th on the occasion of certificate issuing ceremony. Dr. Huang was accorded with the title of Chief Councilor of the tree medical advisory council.
- Associate Researcher Dr. Cheng-long Ho of the Division of Wood Cellulose in due course of researching on "A study of pulping, kinetics derivation and waste liquor recovery of *Leucaena leucocephla* wood using several high boiling-points alcohols," has submitted a paper to the 6th Annual Meeting of the Japan Wood Research Society at Matsuyama, Japan and was invited to present on March 12 to 16.
- The Lienhwachih Research Center hosted a 2014 Translocation Study Tour of the Volunteer Corp of Lienhwachih on March 14 and 15 by visiting the Pitsutou Botanical Garden, Chiayi Arboretum and Alishan Forest Recreational Area in Chiayi County. A total of 26 persons participated.
- The President of World Bamboo Association Ms. Susanne Lucas accompanied by a Harvard University plant taxonomist Ms. Julie McIntosh Shapiro visited the herbarium of Taipei Botanical Garden on March 16. They were hosted by Dr. Wen-liang Chiou, Chief of Division of Botanical Garden, Dr. Tsai-hui Chen, Senior Researcher of Division of Silviculture, and Dr. Jin-ming Lu, an emeritus bamboo specialist. Bilateral discussion on Taiwan bamboo species, bamboo resources, and digitalization of the herbarium collections were held.
- Mr. Jian-fan Chen, Assistant Researcher of the Division of Botanical Garden, in the course of executing "Resource plants survey and compilation of the flora of Solomon Islands," visited Fiji and the Solomon Islands during March 22 to May 6.

- TFRI in conjunction with the National Miaoli Agriculture and Industry Professional High School held a "Forest harvesting technique training course" on March 26 and 27. A total of 34 Forestry Department student of the school took parts.

APRIL

- TFRI held a "2014 forest protection and management personnel education, training and performance review session" on April 1 and 2 at the Hengchuan Research Center. A total of 25 persons participated.
- Drs. Wen-liang Chiou, Chief and She-wen Chung, Assistant Researcher of the Division of Botanical Garden in the course of executing a "Taiwan-the Philippines cooperative project—conservation of economical ferns threatened by global climate change" visited the Philippines on April 1 to 14, and April 5 to 14, respectively, to collect research materials. Dr. Chiou also visited Cebu to take part in the "23rd Philippine Biodiversity Symposium" and presented a paper there.
- TFRI in conjunctions with Shei-pa National Park Administration, and the Experimental Forest Administration of the National Taiwan University held a "2014 International Symposium of Canopy Ecology Conservation" on April 18 on the campus of National Taiwan University.

MAY

- Drs. Yin-sheng Wang, Senior Researcher, Division of Technical Services, Dr. Jun-chen Lin, Chief of Division of Forest Economics, and Pei-jung Wang, Associated Researcher, Division of Forest Economics took parts in a "518 Cultural Innovation Fair of Museums" hosted by the National History Museum with a theme of "Display of artifacts made from tree branches, flowers, fruits and seeds as decorative items." The display utilized materials gathered from pruning or thinning of plantation to make artifacts and DIY toys, and was meant to promote the renewable and carbon sink function of the forests.
- TFRI together with Taipei Municipal Government, Taiwan Urban Forest Health and Beautification Association etc. held a "2014 International Symposium on Tree Protection—using Daan Forest Park as an example of natural disaster prevention practices," on May 19 on the campus of National Taiwan University. And the next day, on May 20, a "2014 International Symposium of Tree Medical/Tree Art in Practice" was held at TFRI. Tree medical specialists from the US, Singapore, and Japan were invited to lecture on concepts and practices of urban forest maintenance and management. The session provided important guidelines for setting the domestic tree health management regulations.
- Ms. Ruo-yun Yeh, Assistant Researcher of Division of Wood Cellulose, in order to further her study on production of forest essential oils and sustainable forest management, flew to Portland, Oregon, USA from May 19 to November 21 as a visiting scientist at the World Forestry Center there.
- TFRI and Taiwan Technical Association of the Pulp and Paper Industry (Taiwan TAPPI) cohosted on May 21 to 23 the "2014 Pan Pacific Conference of the Pulp and Paper Industries—a future of the world based on sustainable forest biomass." Representative of the US, Canada, Japan, Korea, Indonesia and Taiwan reported on the status of their paper industry. Then the President of the YFY Group, Mr. Shou-chuan Ho, Prof. Lennart Salmén of Royal Swedish Academy of Science and Technology, also President of International Association of Wood Science (IAWS), and Prof. Hasan Jameel, Dept. of Forest Biomaterials, North Carolina State University were the illustrious keynote speakers.
- Fushan Research Center and Luzhu Township Administration, Taoyuan County teamed up and held on May 22 and 23 a "2014 Interpreter Training of Fragrant Flowers Ecosystem Guiding and Applications" course. Wherein how to use fragrant flowers to promote local specialty agriculture and community development were taught.

- Dr. Jin-sheng Tong, Associate Researcher , Mr. Huan-yu Lin, Assistant Researcher, and Der-bing Chang, Appointed Assistant of Division of Botanical Garden took parts in an international cooperation exchange program studying "Using natural enemy insects to control an invasive plant from Taiwan to mid-Europe—*Ailanthus altissima*" and visited Slovakia for research exchange during May 22 to May 31.
- Dr. Chih-ming Chiou, Chief of Division of Forest Management, in carrying out a study on "Effects of different stand density growth and wood quality of red cypress (*Chamaecyparis formonsensis*)" visited Seoul National University, Seoul, Korea to participate in the Joint International Symposium by Korea, Japan and Taiwan—Sustainable Forest Ecosystem Management in Rapidly changing World, to present a paper and visited the experimental sites of Korean plantation forest management.
- On May 29, the 2014 Forest Watershed Management Symposium was held at the TFRI. A total of 103 persons participated.

JUNE

- The Tree Medical Center of the TFRI and the New Taipei City Government held a "Woodpeckers Tree Protection Program" at the Martyrs' Shrine garden of Tamshui. The TFRI staff provided two professional technologies of "tree health inspection" and "diagnosis on tree decay—tree injection." Precious old trees of the township were given health checkup and the insect and disease prevention measures.

JULY

- On July 1~3, the Fushan Research Center co-hosted a "professional teachers of insects workshop" with the New Taipei City Sustainable Environmental Education Center. Close to 20 persons of elementary and middle school teachers participated.
- The TFRI, together with the Biodiversity Research Center of Acadmia Sinica, and Dept. of Life Science, Donghai University, held a "Central Taiwan Field Techniques Courses" on July 1 to 11 at the Lienhwachih Research Center. The courses focus on the climate type, flora and fauna and cultural development issues of subtropical regions to train researchers on on-site field work and analysis prowess.
- According to an estimate of archeologists, the Shantseding area of Chiayi City was suspected to have a metal age relic site about 2,000 to 400 years before present. The site mainly concentrates at the palm tree zone of the Chiayi Arboretum. TFRI has agreed to the application by the Chiayi Municipal Government to excavate the site using mechanical and manual methods. This endeavor represented the first test excavation of an archeological site 300 years after the founding of Chiayi City.
- TFRI, together with the Biodiversity Research Center of Academia Sinica, and Dept. of Life Science, Donghai University, co-hosted a "Taiwan Field Biology Course Workshop" on July 15~26 at the Lienhwachih Research Center. A total of 30 students from 16 universities participated in the event.
- Dr. Yu-huang Wang, Special Appointed Researcher, Division of Forest Protection, flew to Tsukuba, Japan on July 16 to 19 to take part in the Fifth Global Biodiversity Information Facility (GBIF) Asian Nodes Meeting.
- Dr. Wen-liang Chiou, Chief and Shih-wen Chung, Assistant Researcher of Division of Botanical Garden in the course of studying "Flora Collection of the Solomon Islands" project, went to the Solomon Island during July 19 and August 2, to collect research materials.
- Dr. Mong-lin Wu, Chief of Division of Forest Protection, Dr. Ching-der Chien, Senior Researcher, and Dr. Yi-Ching Huang, Associate Researcher, Division of Silviculture, took parts in the "2014 Taiwan International Biotechnology Exposition" on July 24 to 27 at the Nangang Exhibition Hall, Taipei World Trade Center. They have exhibited their research achievements in "Establishment of a LAMP based inspection technique for detecting brown root rot of trees," "Superior strains of Taiwan indigenous *Morinda citrifolia* (noni)—their cultivation techniques and development of health food," and "The *in vitro* propagation techniques for a rare

pendent decorative fern—*Lycopodium phlegmaria* L." Business opportunities were explored during the exposition.

- Mr. Chien-wen Chen and Wei-show Wu, Appointed Assistant Researchers of Division of Botanical Garden in carrying out the "Resource plant survey and compilation of the flora of the Solomon Islands" project flew to the Solomon Island during July 28 and Aug. 20 to collect research materials.

AUGUST

- Dr. Li-ping Chu, Assistant Researcher, Division of Botanical Garden went to Fukushima, Japan on August 1 to 6 to take part in the "Symposium for the Tadami Biosphere Reserve, UNESCO MAB Plan-Ecology, Conservation and Sustainable Management of Beech Forests" and presented a paper.
- Mr. Yuan-Rui Shu, Head of Lienhwachih Research Center led colleagues to host a production team of China TV Co. filming an ecotourism program "MIT Taiwania" and help with the filming of a special series.
- TFRI, together with the Miaoli County Government, held an activity of "Plain afforestation tending practices course and listening to the voices of the people" at Nanzhuang, which provided forest farmers participating in Taiwan Forestry Bureau's incentive afforestation and rental afforestation programs the pertinent management technologies.
- Ms. Li-wan Chang, Assistant Researcher, Division of Technical Services, and Ms. Shu-hui Wu, Assistant Researcher, Hengchuen Research Center, flew to Shenyang and Harbin Cities in Chinese Mainland on Aug. 16 to 22 to take parts in "The 8th Symposium of Cross-strait Forest Dynamic Plots" and respectively presented papers.
- Dr. Chih-ming Chiou, Chief of Division of Forest Management, in the course of studying "Effects of different stand density growth and wood quality of plantation wood" went to Beijing of Mainland China on Aug. 16 to 24 to take part in "7th Cross-strait Forest Management Symposium" and presented a paper. He also visited the experimental forest of Beijing University and the pertinent plantation management sites.
- Dr. Star YS Huang, Director General, led colleagues and visited the Yendingwan custard apple special zone, Taitong County, the Meilin orchard special zone, Chiayi County, and Motianlin sweet persimmon special zone, Taichung City, respectively on Aug. 20, 21, and 22. The tour inspected planned agricultural special zones under the forest rental program of Taiwan Forestry Bureau.
- Dr. Li-ping Chu, Assistant Researcher of Division of Botanical Garden flew to Rotterdam, the Netherland to take part in the "Program of Oak Open Days at Trompenburg Gardens and Arboretum" and presented a paper.

SEPTEMBER

- The TFRI, in order to renovate the Taipei Botanical Garden, specifically restored a gazebo for resting and drinking tea at the corner of old large pond into a Japanese style building, and on September 2, open the site for visitors with an old address of 323, Nanmengding which harks back to the Japanese occupational period (before 1945). Concurrent with the event, an art exhibition by the volunteers of Taipei Botanical Garden also unfurled at the site.
- TFRI and the Taiwan Indigo Dyeing Association cohosted a "Dyestuff plants special exhibition" from Sept. 2 to Jan. 4 of 2015 at the Guest House of Imperial Envoy site within the Taipei Botanical Garden. The exhibition introduced some common dyeing plants, process of dyeing fabrics, the tools used and some delicate products.
- Dr. Yu-huang Wang, Special Appointed Researcher, Division of Forest Protection, flew to New Delhi, India on September 14 to 19 to take part in the 21st Meeting of Global Biodiversity Information Facility (GBIF) Governing Board.

- The Taiwan Forest Recreation & Conservation Association together with Mr. Tian-yung Tan, Forestry Specialist of Chinese Mainland Cantonese Forestry Association as well as a grouo of 14 persons visited TFRI on Sept. 15 and exchange views.
- On Sept. 17, at TFRI headquarter, a symposium on "2014 Plain afforestation experimental research and monitoring" was held. A total of 99 persons attended.
- The Director General Dr. Star YS Huang led a group of colleagues visited the Nanzhuang Town Hall, Miaoli County on Sept. 17 and held a "Plain afforestation tending practices seminar and listening to the voices of the people discussion session." A total of 140 persons attended.

OCTOBER

- The TFRI, together with Taiwan Forestry Bureau, Taiwan Endemic Species Research Center, and Construction and Planning Agency, Ministry of Interior held an opening ceremony for "Taiwan Ecological Information Portal Website" and "Community Ecology Cloud." These were not only a new era for Taiwan ecological information service, but also an important step toward promoting the beauty of Taiwan ecosystems and connecting with the global ecological trends.

NOVEMBER

- TFRI, together with the Taiwan Forest Certification Development Association assisted the Jang Chang Lumber Industry Ltd. of Zhudong Township, Hsinzhu County, in obtaining an International FSC™ Forest Management Certification attesting to its achieving forest management standard and became the first tract of forest unit to pass the due certification process. This also represented that domestic plantation forests passed a new milestone of responsible management.
- Dr. Jing-sheng Tong, Acting Chief, and Mr. Ting-ker Chen, Appointed Substitute of Division of Botanical Garden in the course of studying "Development and construction of indigenous and community conserved area (ICCA) in Taiwan—application and management of the traditional ecological wisdom to ethnobotany—ICCA in the conservation of Lanyu Community," flew to Sydney, Australia on Nov. 8 to 19 to take parts in an aborigine tribal study and visit and presented a paper at the 2014 IUCN World Parks Congress.
- Dr. Chen-kuen Ho, Chief of Division of Silviculture was elected one of the 38th Ten Outstanding Agricultural Experts, and visited Tianjin City, Mainland China on Nov. 12 to 16 on a visitation and exchange program of the agricultural experts.
- Lienhwachih Research Center hosted a group of 37 visitors from the "2014 Forest Visit Study Tour" of Hsinzhu County Government on Nov. 20. A guided tour of the experimental forest was arranged.
- At TFRI headquarter in Taipei and the Chungpu Research Center, Chiayi the "2014 Taiwan Bamboo Structural Symposium" were held on Nov. 21 and 26, respectively. A total of 150 and 140 persons attended, respectively.

DECEMBER

- Drs. Jung-tai Chao, Researcher and Sheng-shan Lu, Associate Researcher, Division of Forest Protection hosted a visitor, Dr. Shin-ichiro Tohmura, from the Forest and Forest Products Research Institute of Japan on Dec. 1 to 5. They also assisted Dr. Tohmura in collecting wasp nests and other materials. Dr. Tohmura shared his specialty by giving a lecture on the "Current and future development of cross-laminated timber (CLT)".
- On Dec. 2, the Lienhwachih Research Center held the "Fourth quarter 2014 volunteer and staff on-the-duty educational training." About 20 persons attended the event.

- The Division of Technical Services obtained the honor of first place in the "2014 Posters Exhibition of the Specialized Libraries" hosted by the Library Association of the Republic of China with an entry entitled "Perpetual life of trees—the collection and restoration of ancient forestry books." The entry was also recommended to be exhibited at the American Library Association in 2015.
- On Dec. 21, Lienhwachih Research Center held an "Annual meeting and social event of the volunteer corp." A total of 28 persons participated.
- On Dec. 21, Lienhwachih Research Center also hosted a group of 200 with the Elders' Study Center from Tsetong Township, Yunlin County and arranged a guided tour of the experimental forest.

國內外學者專題演講

日期	講　　題	演講者	職稱	服務機關
01/14	Thermal effect of urban green spaces	Dr. Tsuyoshi Honjo	professor	日本千葉大學
05/08	Mitigating the Effects of Climate Change on Lodgepole Pine Height Growth	Gordon D. Nigh	高級研究員	加拿大BC省森林及環境資源部
06/27	林業生涯四十載：漫談中美林業實務	張森 Sun Joseph Chang	教授	美國路易斯安那州立大學
12/05	Current and future development of CLT	塔村真一郎	博士	日本森林總合研究所
06/19	大陸非糧生物質能源原料科技發展	馬履一	研究中心主任暨教授	北京林業大學

科技研究專題演講

日期	講　　題	演講者	職　　稱	服務單位
01/24	植物種原保存與資源調查-索羅門群島植物誌之合作	邱文良	副研究員兼組長	植物園組
02/24	長伐期人工林疏伐作業和疏伐木之選擇	汪大雄	研究員	森林經營組
02/27	國際樹藝研習及交流	吳孟玲	研究員兼組長	森林保護組
02/27	樹木危險性調查及樹木風險管理計畫制訂之研究	林振榮	副研究員	森林利用組
03/28	福山二種大型樹蕨之物候及光合作用特性	王相華	副研究員兼主任	恆春研究中心
03/28	福山試驗林動物群聚之變動	葛兆年	副研究員	森林保護組
04/25	木本植物種實油脂開發高附加價值副產品的研發	馬復京	助理研究員	育林組
04/25	高經濟林木種苗產業之建構與研發(4/4)	陳怡蒨	助理研究員	育林組
05/30	台灣主要竹種生長及碳吸存效應之研究	陳財輝	研究員	育林組
05/30	植林減碳研究	林國銓	副所長	育林組

科技研究專題演講

日期	講　題	演講者	職　稱	服務單位
06/27	原生海岸樹種種子收藏與育苗體系之建立	楊正釧	副研究員	植物園組
07/28	濱海鹽濕地造林樹種選拔之研究	鄧書麟	助理研究員	中埔研究中心
07/28	森林步道視覺數位化技術應用平台之建立	汪大雄	研究員	森林經營組
07/28	木粉-聚乳酸複合材作為護坡植生用材之可行性研究	塗三賢	助理研究員	森林利用組
08/29	應用超高速真空模組增加精油收率及成分之研究	洪昆源	助理研究員	森林化學組
08/29	開發具潛力林木天然成分以提升木材耐久性之研究	許富蘭	副研究員	森林化學組
09/26	油茶品種嫁接技術及活性之探討	許富蘭 許俊凱	副研究員 助理研究員	森林化學組 蓮華池研究中心
09/26	適合樟芝生長發育之牛樟品系選育與栽培	張淑華	研究員	育林組
10/31	台灣產殼斗科重要木材組織構造之研究	王瀛生	研究員	技術服務組
10/31	橫向打音法評估肯氏南洋杉樹幹內部空洞	許富蘭	副研究員	森林化學組
12/01	由館藏標本探討溫度變化對臺灣熱帶及溫帶植物花期之影響	王相華	研究員	恆春研究中心
12/01	昆蟲是五色鳥幼鳥生長的關鍵食物資源	葛兆年	副研究員	森林保護組
12/26	傳統書畫文物裝裱用紙之研製	徐健國	助理研究員	木材纖維組
12/26	筆筒樹枯萎死亡現象之研究	傅春旭	副研究員	森林保護組
12/26	褐根病菌子實體對病害傳播的影響	傅春旭	副研究員	森林保護組

出版品

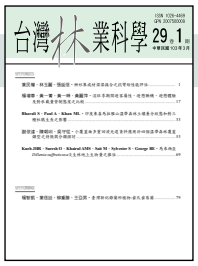
圖書類｜林業叢刊

刊號	題名	作者	出版日
243	樹木風險評估個案調查彙編	林振榮、黃裕星、黃國雄 張東柱、吳孟玲	3月
254	2014年森林集水區研討會論文集	林壯沛、羅方岑	5月
255	2014泛太平洋漿紙技術國際研討會—基於可永續森林生質之世界前景研討會論文集	王溢真、何振隆等	5月
256	行政院農業委員會林業試驗所101-102年度雙年報	林業試驗所年報編輯委員會	6月
257	2014平地造林試驗研究監測研討會論文集	邱志明	9月
258	臺灣主要林產品貿易統計(2003~2013年)	林俊成、陳溢宏、楊素珍	12月
259	臺灣中部地區歸化植物圖鑑	周富三、廖俊奎、王豫煌 林朝欽	12月
260	臺灣常見殼斗科木材圖鑑	李金梅、余欣怡、王瀛生	12月

非圖書類｜推廣摺頁

刊號	題名	作者	出版日
111	台北植物園歷史漫步—考古遺址篇(中文)	吳維修、蔡沛霖、康碩容、董景生	1月
112	台北植物園歷史漫步—考古遺址篇(英文)	吳維修、蔡沛霖、康碩容、董景生	1月
113	纖維植物面面觀	蔡沛霖、尤瑪達陸、董景生 吳維修	5月
114	南門町323(中文)	陳科廷、董景生	8月
115	Nanmen-machi 323(英文)	賴郁雯、陳科廷、董景生	8月
116	蓮華池森林步道景觀視覺之動畫平台	汪大雄	9月
117	欽差行臺(中文)	康碩容	10月
118	欽差行臺(英文)	康碩容	10月
119	欽差行臺(日文)	康碩容	10月
120	扇平森林生態科學園	朱榮三、周富三、李政賢 邱韻璇、林麗華、陳金泉	12月
121	桉樹枝癭釉小蜂的入侵現況與藥劑防治	董景生	11月
122	人工林的另類收穫—樹皮枝幹篇	王瀛生	12月

非圖書類｜期刊



刊名	卷期（總號）	總編輯	出版日
台灣林業科學	29卷1期	吳俊賢	3月
	29卷2期	吳俊賢	6月
	29卷3期	吳俊賢	9月
	29卷4期	吳俊賢	12月
	29卷-專刊	吳俊賢	12月
林業研究專訊	21卷1期(117號)	陳燕章	2月
	21卷2期(118號)	陳燕章	4月
	21卷3期(119號)	陳燕章	6月
	21卷4期(120號)	陳燕章	8月
	21卷5期(121號)	陳燕章	10月
	21卷6期(122號)	陳燕章	12月

技術移轉案件

技術名稱	單位	創作人	件數	授權種類	年限	備註
牛樟種子的生產與發芽技術	植物園組	楊正釧	1	非專屬	3	
牛樟多芽體組織培養、出栽與繁殖技術	育林組	何政坤	2	非專屬	10	
生產10-DAB南洋紅豆杉台紅3號栽培管理技術	育林組	何政坤	1	專　屬	5	
木藝創作組裝材料包及成品	林業經濟組	王培蓉	1	非專屬	2	
高效天然防蚊配方	森林化學組	洪昆源	1	非專屬	5	
「樹木褐根病防治檢驗流程及檢體檢驗標誌之製作」續約案	森林保護組	傅春旭	1	非專屬	5	
筆筒樹孢子繁殖體系的建立	森林保護組	傅春旭	1	非專屬	5	
山葵在植物工廠之種植及栽培技術	育林組	黃怡菁	2	非專屬	3	
山葵健康種子的生產技術	森林保護組	傅春旭	1	非專屬	5	
微波快速萃取精油之裝置及技術	森林化學組	尹華文	1	非專屬	5	
竹稈材之乾燥技術	技術服務組	李銘鐘		非專屬	5	已於103年6月19日公告，惟尚未於103年完成技轉
肉桂醛型土肉桂繁殖與肉桂醛及黃酮類生產利用技術	育林組	何政坤		非專屬	5	已於103年6月19日公告，惟尚未於103年完成技轉
樹木危險性的檢查及診斷技術-應力波2D檢測技術	森林利用組	林振榮			3	已於103年7月14日公告，惟尚未於103年完成技轉
桃花心木果實藝品製作技術	技術服務組	王瀛生			2	已於103年8月15日公告，惟尚未於103年完成技轉
小果油茶種子苗之培育技術	植物園組	楊正釧			3	已於103年8月15日公告，惟尚未於103年完成技轉

專利案件

專利名稱	專利型態	核發國家	單位	發明人	證書號	公告日期
樹木根盤保持力之安全性判定法	發明	中華民國	森林化學組	許富蘭	發明第I457551	2014/10/21

台灣林業科學

作者	英文題目	中文題目	頁數
許天銓、林謙佑 陳正為、邱文良 張藝翰	Confirmation of the Occurrence and Distribution of Three Fern Species in Taiwan	三種蕨類植物在臺灣的分布確認	29(2):157-67
張淑華、陳芬蕙 蔡錦瑩、陳　媜 黃芷雲、呂汶玲 何政坤	Establishment of Hairy Root Cultures of Nothapodytes nimmoniana to Produce Camptothecin	建立青脆枝毛狀根培養以生產喜樹鹼	29(3):193-204
吳俊賢、吳孟珊 陳溢宏	Quantitative Analysis of Traditional Ecological Knowledge: A Case Study of Paiwan People in Jialan Village, Taiwan	傳統生態知識的量化分析：嘉蘭村排灣族人的個案研究	29(3):205-19
汪大雄、林謙佑 陳財輝、湯適謙 鍾智昕、謝漢欽	Comparing the Early Growth of Pure and Mixed Plantations of *Calocedrus formosana* and *Michelia formosana* at Lienhuachih, Central Taiwan	蓮華池地區肖楠、烏心石純林和人工混合林早期生長之研究	29(3):221-37
郭耀綸、王相華 彭世賢、楊雅萍	Composition, Structure, and Preliminary Restoration Efforts of a Tropical Coastal Forest at Siangjiaowan, Southern Taiwan	香蕉灣熱帶海岸林森林組成結構及初步復育工作	29(4):267-84
林朝欽、麥舘碩	Applying Open-Source Software to Update a Taiwanese Forest Fire Database	開源軟體應用在台灣森林火資料庫之更新	29(Supplement): S1-11
廖俊奎、周富三 林朝欽	Succession of a Degraded Low-Elevation Mountain Forest	低海拔山地劣化森林之演替	29(Supplement): S13-26
葛兆年、陳舜英 陳銘瑝	Effects of Fruit Ingestion by Taiwan Barbet (*Megalaima nuchalis*) on Seed Germination of Four Native Tree Species in Taiwan	五色鳥取食4種台灣原生樹種果實對其種子發芽的影響	29(Supplement): S27-39
吳孟玲、許育晏 李芷芸、吳厚德 洪挺軒	Application of Biocontrol Agents to Control *Phellinus noxius*	微生物製劑在褐根病防治管理之應用研究	29(Supplement): S41-53
黃文伯、賴韋翰 葛兆年	The Effect of Ambient Temperature on the Biodiversity of Necrophilous Beetles at Chilanshan, Northeastern Taiwan	棲蘭山環境溫度對親屍性甲蟲多樣性的影響	29(Supplement): S55-64
林雅玲、張德斌 董景生	Susceptibility Tests of Various Eucalyptus Host Species to *Leptocybe* invasa in Taiwan	桉樹枝癭釉小蜂對台灣桉屬植物之造癭偏好性	29(Supplement): S65-71

其他學術期刊

作者	題目	書名期刊	卷(期)、頁碼、審查編號	TSSCI/SCI/EI
洪聖峰、何政坤、林欣德	芳樟醇型土肉桂嫁接及扦插之初步成活表現	台大實驗林研究報告	28(2):109-121	其他
D. R. Hodel, Adam Chi-Tung Hsu, 陳建帆	The Palms of Taiwan	PALMS	58(4)	其他
Zhang WY, Kuo LY, Li FW, Wang CN, 邱文良	The Hybrid Origin of Adiantum meishanianum (Pteridaceae): A Rare and Endemic Species in Taiwan	Systematic Botany	39(4):1034-1041	SCI
林振榮、鍾智昕、林世宗	棲蘭山地區不同生育地台灣扁柏的樹輪特徵研究1	中華林學季刊	46(2):135-150	其他
蔡呈奇、張瑀芳、黃國雄許正一	Impact of Wood Biochar Addition on Nutrient Leaching and Fertility in a Rural Ultisols of Taiwan	台灣農業化學與食品科學	51(2):80-93	其他
黃國雄、李金梅、余欣怡顧文君、夏滄琪	麻竹熱處理材之基本性質1	林產工業	32(3):139146	其他
Lan-Hui Li, Ping Wu, Jen-Yi Lee, Pei-Rong Li, 何振隆	Hinokitiol Induces DNA Damage and Autophagy followed by Cell Cycle Arrest and Senescence in Gefitinib-Resistant Lung Adenocarcinoma Cells	PLOS ONE	9(8):0104203	SCI
洪聖峰、潘富俊	利用逢機擴大多型性去氧核醣核酸標誌鑑定棍棒椰子(*Hyophorbe verschaffeltii*)及酒瓶椰子(*H. lagenicaulis*)之天然雜交種	台大實驗林研究報告	28(2):123-130	其他
楊正釧	Effects of Roasting Camellia tenuifolia Seeds with/without Shells on the Quality of Seed Oil	台灣農業研究	63(1):17-29	其他
謝煥儒、傅春旭、施欣慧	Exobasidium on Ericaceae in Taiwan	Fungal Science	29(1):1-12	其他
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陳財輝、廖天賜、鍾一榮 王　仁	高雄六龜與台南白河兩地麻竹林之林齡結構及生物量比較	林業研究季刊	36(4):263-272	其他
陳財輝、劉瓊霰、鍾一榮 王　仁	南投縣鳳凰山地區孟宗竹產筍林之調查	中華林學季刊	47(2):169-180	其他
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黃裕星	植物園的價值與使命	21(2):1-4
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研討會報告

作者	研討會名稱	論文題目	主辦單位
邱文良	The Society of Plant Reproductive Biologists III Global Congress	Gametophytes play important role in reproduction, speciation and evolution of Pteridophytes	The Society of Plant Reproductive Biologists
陳一銘	2014年動物行為暨生態學研討會	福山試驗林中大型哺乳動物群聚特性與變動	東海大學生命科學系
陳一銘	2014年動物行為暨生態學研討會	大農大富森林平地園區野生動物遷入現況評估	東海大學生命科學系
王豫煌	AP-BON side event in CBD COP 12 and 6th AP BON Workshop	GBIF and data publishing	林業試驗所
王豫煌	PRAGMA 26 Workshop	Mobile Devices Help Collect and Stream Data from Ecological Sensor Network into the Cloud	NAR Labs國家實驗研究院
王豫煌	The 7th GEOSS Asia-Pacific Symposium	Spotlight on TaiBIF National Activities	Group on Earth Observations (GEO)
董景生	Pacific History Association 21st Biennial Conference 2014	The Ocean Current of Taro from the Batanes to Irala	台灣太平洋研究學會
楊正釧	103年森林資源永續發展研討會	暗色隔膜內生菌對牛樟實生苗生長及生理影響	中華林學會
楊正釧	103年森林資源永續發展研討會	台灣野梨種子的發芽與儲藏	中華林學會
楊正釧	第九屆環境保護林經營管理研討會	如何建構穩定的環境保護林	林業試驗所中埔研究中心
陸象豫、黃良鑫	2014森林集水區經營研討會	試驗集水區研究	林業試驗所
林奐宇、林謙佑、葉銘哲	2014臺灣竹構造建築研討會	竹資源知多少？- 台南的竹資源-	林業試驗所
陳永修、何政坤、許原瑞	2014森林資源保存與利用研討會	台灣相思樹育種與育林技術造林試驗	林業試驗所
張東柱	10th International Symposium on Biocatalysis and Agricultural Biotechnology	Quality detection and standard erection of antrodia cinnamomea	義守大學

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作者	研討會名稱	論文題目	主辦單位
張東柱	2014 International Symposium and Workshop on Taiwan Medicial mushrooms:Antrodia cinnamomea	牛樟菇栽培品管及標準制定	中央研究院生物化學研究所
CC Tsai、ZS Chen 杜清澤	第十屆海峽兩岸土壤肥料學術交流研討會/土壤肥料推廣研究成果研討會	利用數位化土壤圖推估臺灣地區亞熱帶森林土壤有機碳的貯存量	中華土壤肥料學會、中華肥料協會、國立中興大學土壤環境科學系、中國土壤學會
加藤詩邦、伍淑惠	第14回漂着物學會-沖繩石垣島大會	台湾と日本におけるムクナ類の分布と種子漂着の記	日本漂着物學會
張俊文、林思民	2014動物行為暨生態學研討會	利用麥克風陣列監測翡翠樹蛙鳴叫行為	東海大學
張勵婉、邱少婷、謝長富	103年森林資源永續發展研討會	棲位分化及散布限制對台灣中部蓮華池闊葉森林木本植物群聚組成與分布的影響	中華林學會
張勵婉、邱少婷、謝長富	第八屆海峽兩案森林動態樣區研討會	臺灣蓮華池常綠闊葉林不同功能群幼樹空間分佈之多樣性研究	中國科學院
何政坤	2014年第六屆熱帶林業研討會森林與生物資源保育產業現況與發展	台灣林業生物技術產業現況與發展趨勢	國立屏東科技大學森林系、生物資源研究所、行政院農業委員會林務局
莊鈴木、趙榮台、葛兆年	2014樹木保護研討會	林木苗圃蟲害	林業試驗所
趙榮台、陳尚遠、陳擎霞 陳一銘	2014樹木保護研討會	四種野外處理對段木中松斑天牛存活率之影響	林業試驗所
邱祈榮、林俊成	2014年第六屆熱帶林業研討會	森林生態系服務價值現況及發展趨勢	國立屏東科技大學
謝漢欽、邱志明、鍾智昕	因應氣候變遷及糧食安全之農業創新研究103年度成果發表暨研討會	氣候變遷人工林生長脆弱度指標及造林策略分析-以蓮華池試驗林人工林生長特性為例	農業試驗所
謝漢欽、林謙佑、黃俊元	103年森林資源永續發展研討會	應用福衛二號SAVI植生指標與地測GLA葉面積指標於平地造林地光蠟樹材積推估之比較	中華林學會

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作者	研討會名稱	論文題目	主辦單位
邱志明	103年森林資源永續發展研討會	紅檜人工林不同林分密度年輪特徵值之解析	中華林學會
邱志明、鍾智昕	103年森林資源永續發展研討會	雲林杜英塊狀疏伐萌蘗更新試驗	中華林學會
陳明杰、周文進、黃正良	2014森林集水區經營研討會	蓮華池四號集水區微環境及能量收支之探討	林業試驗所
吳孟玲	植醫及樹醫友善用藥與優良處方研討會	樹木病蟲防治健康管理	臺灣植物及樹木醫學學會、行政院農委會林業試驗所、國立台灣大學植物醫學碩士學位學程、國立台灣大學生農學院植物醫學研究中心
吳孟玲	2014年第六屆熱帶林業研討會-森林與生物資源保育產業現況與發展	國內林木疫情現況分析與防治管理	行政院農業委會林務局、行政院農業委員會林務局屏東林區管理處、國立屏東科技大學森林系、生物資源研究所
汪大雄、江昱仁、楊蓓涵	103年森林資源永續發展研討會	步道景觀知覺與景觀偏好之研究-以林業試驗所蓮華池研究中心森林步道為例	中華林學會
王玉婷、王相華	103年森林資源永續發展研討會	由館藏標本看溫度變化對台灣高山植物花期之影響	中華林學會
陳一銘	2014樹木保護研討會	檜木林地型態與野生動物群聚之關係	林業試驗所
葛兆年	2014樹木保護研討會	五色鳥對4種樹木種子發芽的影響	林業試驗所
王豫煌	2014樹木保護研討會	無線自動相機感測網應用於森林動物生態之監測	林業試驗所
林朝欽	2014樹木保護研討會	臺灣森林火資料庫與分析(1963-2013年)	林業試驗所
徐嘉君	2014樹木保護研討會	利用棲地條件的空間自相關性來推測稀有蘭科植物的潛在分布	林業試驗所

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作者	研討會名稱	論文題目	主辦單位
陸聲山、林朝欽、王豫煌	2014樹木保護研討會	生態資訊學發展與應用	林業試驗所
汪澤宏、張耿衡、戴廷恩 周廷威、李勇毅	2014樹木保護研討會	DNA生命條碼在蘭科植物上的應用	林業試驗所
吳孟玲	2014樹木保護研討會	褐根病檢驗商品化套組開發	林業試驗所
汪澤宏、黃裕星、陳芬蕙 張永仁	2014樹木保護研討會	牛樟昆蟲相初探	林業試驗所
鍾智昕、張鈞媛、黃志堅 湯適謙、邱志明	103年森林資源永續發展研討會	應用光譜混合分析於Landsat 8 衛星影像推估蓮華池研究中心造林地蓄積量	中華林學會
洪州玄、王相華	103年森林資源永續發展研討會	結合切蔓及藥劑局部施用應用於小花蔓澤蘭防治之效果初探	中華林學會
吳孟玲、莊鈐木	103年森林資源永續發展研討會	台灣地區農林互通性新外來入侵種調查研究	中華林學會
許淯淳、張坤城、鄧書麟	103年森林資源永續發展研討會	臺灣印尼肉桂歸化族群分布與種源推估之研究	中華林學會
何雅齡、廖宇賡	103年森林資源永續發展研討會	櫸櫟橡實發芽之促進	中華林學會
鄧書麟、黃正良、王志斌 徐浚騰、楊亞蒨	103年森林資源永續發展研討會	四湖海岸木麻黃林天然下種更新之研究	中華林學會
曾于庭、吳家禎、何政坤	103年森林資源永續發展研討會	細葉山茶微衛星體分子標記分析	中華林學會
李金梅、顏亦晞、王瀛生	103年森林資源永續發展研討會	六種青剛櫟屬木材組織構造之研究	中華林學會
劉一新	2014 森林集水區經營研討會	太麻里研究中心之生態育林與效益監測	林業試驗所
林振榮、黃裕星、黃國雄 吳孟玲	103年森林資源永續發展研討會	無損檢測技術應用於都市樹木健全性的調查	中華林學會
楊德新、林振榮、趙偉成 鍾智昕	103年森林資源永續發展研討會	運用光譜無損檢測技術評估木材塑膠複合材經加速劣化後之性質	中華林學會

研討會報告

作者	研討會名稱	論文題目	主辦單位
林振榮、黃裕星、黃國雄 吳孟玲	103年森林資源永續發展研討會	無損檢測技術應用於白蟻危害肯氏南洋杉樹木的調查	中華林學會
羅立偉、林振榮、楊德新	103年森林資源永續發展研討會	應力波斷面影像技術及打音法應用於評估香杉立木之健全性研究	中華林學會
吳孟玲、林振榮	103年森林資源永續發展研討會	台南老樹褐根病健康管理研究	中華林學會
吳孟玲、林振榮	103年森林資源永續發展研討會	樹木注射新技術的試驗與發表	中華林學會
陳昀芝、林振榮、鍾智昕	103年森林資源永續發展研討會	創傷開窗法應用於五種闊葉樹年輪特徵之研究	中華林學會
何振隆、徐光平	103年森林資源永續發展研討會	棕櫚葉桿纖維性質及其製漿適性之評估	中華林學會
何振隆、Yu-Chang Su Yueh-Hsiung Kuo Yu-Ting Yuan、Louis Kuo-Ping ChaoPei-Chun Liao	103年森林資源永續發展研討會	Whitening vs. exfoliating or harming of skin by honokiol and magnolol	中華林學會
何振隆、徐光平 Kuo-Feng Hua Yu-Chang Su	103年森林資源永續發展研討會	Essential Oil from the Heartwood of Taiwan fir Ameliorates LPS-induced Inflammatory Response by Inhibiting the Activation of Mitogen-activated Protein Kinase	中華林學會
吳家禎、許俊凱、何政坤	103年森林資源永續發展研討會	小果油茶與大果油茶之轉錄組分析及其分子應用	中華林學會
胡正恆、呂傑霖、張舜閔 王星哲、王家惠、何可蕙 陳芬蕙	103年森林資源永續發展研討會	烏來大葉種生態茶與共伴野生動物	中華林學會
林裕仁、潘薇如	103年森林資源永續發展研討會	木質能源於國內能源利用之評估分析	中華林學會
林裕仁、陳威廷、莊媛卉	103年森林資源永續發展研討會	FSC FM森林驗證原則第四版與第五版在森林經營計畫制訂內容之差異比較	中華林學會
趙榮台、陳一銘、葉文琪 楊瑞瑜、吳玟欣、黃郁真 蕭育婷	第35屆臺灣昆蟲學會年會"外來入侵昆蟲專題討論會"	台東蘇鐵自然保留區白輪盾蚧之危害監測	臺灣昆蟲學會

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作者	研討會名稱	論文題目	主辦單位
吳孟玲	2014真菌資源及其永續利用研討會	牛樟芝與香杉芝PCR鑑別技術建立	行政院農業委員會動植物防疫檢疫局、中華民國植物病理學會、中華民國真菌學會、國立臺灣大學植物病理與微生物學系
鄭森松、林群雅、張上鎮 陳盈如、張繼元、張惠婷	103年森林資源永續發展研討會	肉桂醛衍生物抑制褐根病菌生長之效果	中華林學會
陳啟予、黃尹則、李涵筠 施欣慧、林俞廷	2014真菌資源及其永續利用研討會	臺灣之長喙殼菌類真菌	行政院農業委員會動植物防疫檢疫局、中華民國植物病理學會、中華民國真菌學會、國立臺灣大學植物病理與微生物學系
董景生、Chen Ke-Ting Chao Chih-Liang Lu Dau-Jye	IUCN World Parks Congress 2014 Secretariat	Autotrophic Indigenous Botanical Garden in Tao Community in Taiwan	IUCN
董景生	第35屆台灣昆蟲學會年會	桉樹枝癭釉小蜂在台灣的入侵現況與防治	台灣昆蟲學會
林奐宇	2014年創新林產加值推廣研討會	台南市的竹資源調查-以竹鄉龍崎為例	林務局
王培蓉、王相華、蘇文清 林金虎	2014年中華民國環境教育學術暨實務交流國際研討會 暨第五屆兩岸四地可持續發展教育論壇	環境保育結合社區產業發展之永續進程－以社頂部落開發銀合歡小徑材環境商品為例	中華民國環境教育學會
謝漢欽、汪大雄、黃俊元 楊蒼叡	2014平地造林試驗研究監測研討會	鰲鼓溼地平地森林園區道路景觀視覺偏好分析	林業試驗所
張延信、許富蘭、顏才博 李鴻麟	103年森林資源永續發展研討會	柳杉與相思樹木焦油處理材之耐候性	中華林學會
邱志明、鍾智昕、唐盛林 湯適謙	2014平地造林試驗研究監測研討會	疏伐對平地造林光蠟樹與苦楝生長效應之研究	林業試驗所
盧惠生、林壯沛、林介龍 王秋嫻	2014平地造林試驗研究監測研討會	屏東平地造林地表逕流與地下水特性	林業試驗所
黃俊元、謝漢欽	第九屆環境保護林經營管理研討會	木麻黃於東部海岸梅雨季節期間直播造林之可行性探討	林業試驗所中埔研究中心
張怡萱、吳進益、黃正良 鄧書麟、劉癸君	第九屆環境保護林經營管理研討會	濱海工業區的綠化巧手	林業試驗所中埔研究中心

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作者	研討會名稱	論文題目	主辦單位
鄧書麟、黃正良、劉癸君 徐浚騰、楊亞箐	第九屆環境保護林經營管理研討會	木麻黃林下以銀葉樹、瓊崖海棠及海檬果種子直撥造林之探討	林業試驗所中埔研究中心
蔡景株、王靖堯、林渡真 李欣怡、曾紹君、黃正良	第九屆環境保護林經營管理研討會	雲林縣平地造林與補植之探討	林業試驗所中埔研究中心
吳孟珊、林俊成、王培蓉	2014平地造林試驗研究監測研討會	應用效益移轉法評估森林生態系服務價值之可行性分析	林業試驗所
徐嘉君	2014森林樹冠層生態保育國際研討會	臺灣維管束附生植物的垂直與區域分布型式	雪霸國家公園管理處
王培蓉、孫銘源、林俊成 陳溢宏、吳孟珊	2014平地造林試驗研究監測研討會	平地造林中間產物產業化之市場潛力評估	林業試驗所
湯適謙、邱志明、汪大雄	2014平地造林試驗研究監測研討會	平地造林新植造林混農林業經營效益評估	林業試驗所
許富蘭、李羿萱、張益誠 姚忠廷、李鴻麟、黃旌集 陳盈如	103年森林資源永續發展研討會	樟樹材部精油之抗病媒蚊幼蟲活性及對成蚊忌避效果之研究	中華林學會
葛兆年、陳一銘	2014平地造林試驗研究監測研討會	大農大富地區造林對鳥類危害水稻及鼠類危害鳳梨的影響評估	林業試驗所
吳孟玲、莊鈐木	2014平地造林試驗研究監測研討會	平地造林病蟲害監測研究	林業試驗所
Chen CW、Ebihara A、 Luu HT、Park CW、 He ZR、Li CW、 Kuo LY、邱文良	The 6th Asian Fern Symposium	A molecular phylogeny of eastern Asian vittarioid ferns (Pteridaceae)	Bali Botanic Garden, Indonesia
Chen CW、Hsu TC、Li CW Yang TY、邱文良	The 6th Asian Fern Symposium	An insight into lycophytes and fern diversity of Solomon Islands	Bali Botanic Garden, Indonesia
王瀛生、張乃航、徐露玉	2014平地造林試驗研究監測研討會	平地造林木之文創產品開發	林業試驗所
許原瑞、鍾振德、蔡佳彬	2014平地造林試驗研究監測研討會	速生桉樹類在台灣東西部的早期生長表現	林業試驗所
陳芬蕙、王相華	第九屆環境保護林經營管理研討會	墾丁海岸林二階段復育造林之研究成果	林業試驗林中埔研究中心
陳財輝	第九屆環境保護林經營管理研討會	日本311海嘯災後海岸林之復舊做法	林業試驗林中埔研究中心

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作者	研討會名稱	論文題目	主辦單位
蘇聲欣、劉逸民	103年森林資源永續發展研討會	臺灣樹種木材比重特性之種間變異與資料庫之建立	中華林學會
伍淑惠、陳可芳	第8屆海峽兩岸森林動態樣區研討會	臺灣墾丁高位珊瑚礁森林雌雄異株植物組成與生態之關聯	中國科學院生物多樣性委員會
邱文良、黃曜謀 Ho Ming Chang	The 6th Asian Fern Symposium	Evaluation and ex-situ conservation of rare endemic lycophytes and ferns in Taiwan	Bali Botanic Garden, Indonesia
Li Yaung Kuo、De Yen Tang 黃曜謀、Cheng Wei Chen Su Wei Fan、Chun Neng Wang、邱文良	The 6th Asian Fern Symposium	Cryptic species diversity of field fern gametophytes flora in Fushan	Bali Botanic Garden, Indonesia
Tzu Yun Chiu、王相華 Kume Tomonori 李沛軒、邱文良、黃曜謀	The 6th Asian Fern Symposium	Phenology of two giant tree ferns Cyathea lepifera and Cyathea spinulosa in northeastern Taiwan	Bali Botanic Garden, Indonesia
黃曜謀、傅春旭 Yu Ming Ju、Yea Chen Liu	The 6th Asian Fern Symposium	Cyathea lepifera wilt, a serious disease of tree fern in Taiwan	Bali Botanic Garden, Indonesia
黃曜謀、Wei Jhong Chen	The 6th Asia Fern Symposium	Maturity of strongly affects spore viability in tree ferns	Bali Botanic Garden, Indonesia
黃怡菁、邱文良	2014森林資源保存與利用研討會	垂枝石松體外孢子發芽及配子體增殖培養系統	林業試驗所
陳舜英、簡慶德、林秀珍	2014森林資源保存與利用研討會	假繡球(忍冬科)種子發育不完全胚與上胚軸休眠性	林業試驗所
張淑華、徐嘉君、陳　媜 蔡錦瑩、侯懿人欣	2014森林資源保存與利用研討會	小喜普鞋蘭與櫻石斛無菌發芽之研究	林業試驗所
簡慶德、陳舜英	2014森林資源保存與利用研討會	灰木與佐佐木氏灰木種子發芽與休眠	林業試驗所
杜清澤、黃菊美、蘇德忠	2014森林資源保存與利用研討會	台灣地區國有林土壤碳庫之推估	林業試驗所
馬復京、林元祥、游漢明 楊登發	2014森林資源保存與利用研討會	福山天然闊葉林枯落物長期監測	林業試驗所
王巧萍、洪裕淵、蘇德忠 杜清澤	2014森林資源保存與利用研討會	大富六種平地造林樹種之枯落物動態與氮利用效率	林業試驗所

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作者	研討會名稱	論文題目	主辦單位
林國銓、黃菊美、杜清澤	2014森林資源保存與利用研討會	台灣地區不同樹種葉片之分解及其影響因素	林業試驗所
顏士雄、陳芬蕙	2014森林資源保存與利用研討會	混農林經營者之非正規農業知識傳播方式初探	林業試驗所
李金梅、黃彥三、黃國雄	2014森林資源保存與利用研討會	以橫向打音法評估麻竹材質	林業試驗所
陳芬蕙、何政坤、林欣德 黃芷雲	2014森林資源保存與利用研討會	混植林木茶園茶葉性質之初探	林業試驗所
鍾俊名、張乃航、黃中宜	2014森林資源保存與利用研討會	台灣地區殼斗科種仁的開發與利用—以青剛櫟種仁製備抗解澱粉	林業試驗所
陳財輝、劉瓊霰、鍾一榮 王　仁	2014森林資源保存與利用研討會	南投縣蕉林地區孟宗竹產筍林之調查	林業試驗所
王升陽、Senthil Kumar 謝瑀心、楊正釧	2014森林資源保存與利用研討會	紅果釣樟果實成分Lucidone之醫療保健活性	林業試驗所
陳怡蒨、陳永修	2014森林資源保存與利用研討會	台灣相思樹族群之遺傳變異研究	林業試驗所
吳家禎、張淑華、何政坤	2014森林資源保存與利用研討會	Development of microsatellite markers in *Cinnamomum kanehirae* using next generation sequencing	林業試驗所
黃曜謀、李沛軒	2014森林資源保存與利用研討會	水蕨親緣關係及栽培利用	林業試驗所
胡正恆、陳芬蕙	2014森林資源保存與利用研討會	恆春海岸林復育過程中第五年的松鼠危害活動與天然更新林(2013-2014)	林業試驗所
洪聖峰、陳右人	2014森林資源保存與利用研討會	毛柿物候觀察及生長量測	林業試驗所
張乃航、杜清澤、馬復京 陳國章、林元祥、游漢明	2014森林資源保存與利用研討會	桉樹人工二代林的萌芽更新	林業試驗所
何政坤、張淑華、林世宗	2014森林資源保存與利用研討會	牛樟不同來源苗木育苗與造林表現	林業試驗所

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作者	研討會名稱	論文題目	主辦單位
邱志明、蘇聲欣、鍾智昕 唐盛林、林謙佑	第七屆海峽兩岸森林經理學術研討會	柳杉人工林行列疏伐異齡混合林經營研究	北京林業大學
朱麗萍	Symposium for the Tadami Biosphere Reserve, UNESCO MAB Plan-Ecology, conservation and sustainable management of beech forests	The ceology and conservation of Fagus hayatae	Tadami Beech and River Museum
邱志明、唐盛林、蘇聲欣 鍾智昕	森林保育經營學術研討會	棲蘭山檜木林永續經營之研究-吉林	吉林省科協
蘇聲欣、邱志明、唐盛林 鍾智昕	第五屆海峽兩岸森林保育經營學術論壇	棲蘭山檜木林永續經營之研究	台灣森林休憩保育協會
邱志明、鍾智昕	台日韓舉辦「世界快速變遷下之森林永續經營」	A new method to quantify temporal validity of thinning in the Japan Cedar plantation	韓國首爾大學
林振榮	第三屆茶葉研討會	茶葉/塑膠廢棄物應用於綠色複材之開發與性能探討	茶葉改良場
李素芬、林俊成、李俊彥	The 2014 International Conference on Business and Information (BAI2014)	The Risk-Alert Index Analysis for Suspicious Illegal Wood Products imported in Taiwan	International Business Academics Consortium (iBAC)
陳惠芳、林俊成、李俊彥	The 2014 International Conference on Business and Information (BAI2014)	Bamboo carbon sequestration of indigenous reserved land in Taiwan	International Business Academics Consortium (iBAC)
林朝欽、陸聲山	2014 ILTER East Asia Pacific 10th biennial meeting	Big data and ecology applications of sensor networks	PhiLTERnet
謝漢欽、黃俊元、李沛軒	台灣地理資訊學會年會暨學術研討會	整合航照立體判釋與地面樣區調查資料於人工造林地蓄積量推估	台灣地理資訊學會、國際華人地理信息科學協會
吳孟玲	2014樹木保護與樹藝制度國際研討會	台灣樹木保護與預防作為	臺南市政府工務局、臺南市政府農業局
吳孟玲	2014樹木保護與天災預防國際研討會	臺灣樹木保護與天災預防作為	臺中市政府研考會、農業局、建設局

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作者	研討會名稱	論文題目	主辦單位
徐健國, Yuan-hsing Perng, Wen-chuan Changc, Hsing-tai Chend, Shu-Yu Swan Wange, Lan-Sheng Kuof	2014 泛太平洋漿紙技術國際研討會	Evaluating the Coloring Strength of Chinese Painting Papers with Cobb tester & CIEL*a*b Color System-A New Approach	林業試驗所、台灣TAPPI
Yuan-hsing Perng, 王益真, Shin-Wen Tsai	2014 泛太平洋漿紙技術國際研討會	Refining Effects of Adding CMC to Coniferous Pulps of Various Lignin Content and Fiber Morphology	林業試驗所、台灣TAPPI
Chih-Ping Chang, 王益真, I-Chun Lin, Yuan-hsing Perng	2014 泛太平洋漿紙技術國際研討會	Feasibility of Using Nano-Sericite in a Dual-chemical Retention System to Substitute Colloidal Silica	林業試驗所、台灣TAPPI
彭元興、王益真	2014中華林產事業協會學術論文暨研究成果研討會	不同型態單一及複合塗料對熱昇華噴墨轉印紙印刷品質的影響	中華林產事業協會
何振隆、Keng-Tong Wu 王益真、Yu-Chang Su	2014 泛太平洋漿紙技術國際研討會	Empirical Model Study of Delignification and Carbohydrate Dissolution on Tetrahydrofurfuryl Alcohol/HCl Pulping of Rice Straw	林業試驗所
簡子超、羅盛峰、何振隆	2014中華林產事業協會學術論文暨研究成果研討會	臺灣針五木香氣成分鑑定與分析	中華林產事業協會
何振隆、Yu-Chang Su	第64回日本木材學會大會	Tetrahydrofurfuryl Alcohol (THFA) Pulping of Leucaena leucocephala	日本木材學會
邱志明、唐盛林、鍾智昕	台日韓舉辦 「世界快速變遷下之森林永續經營	Study on creation and management of uneven-aged and mixed plantations in Luanta-fir forest	韓國首爾大學
吳孟珊、林俊成	2014中華林產事業協會學術論文暨研究成果研討會	台灣民營林業木材伐採量與生產量結構之研究	中華林產事業協會
盧惠生、林壯沛、林介龍	2014森林集水區經營研討會	屏東3 年生無患子平地造林調節溫度特性	林業試驗所
黃瓊璐、劉一新	2014森林集水區經營研討會	原住民部落生態產業與森林生態保育關聯性之研究	林業試驗所
黃瓊璐、謝漢欽、林照松	2014森林集水區經營研討會	試驗林集水區之崩塌潛勢評估模式應用之初步架構	林業試驗所
林壯沛、林介龍、王秋嫻	2014森林集水區經營研討會	檳榔園混農林栽植之水土流失探討	林業試驗所

研討會報告

作者	研討會名稱	論文題目	主辦單位
賴昭尹、黃名媛、王培蓉	海峽兩岸森林經營研討會	台灣社區林業與社區培力發展之分析	北京林業大學
林振榮	2014日本木材學會國際研討會	Evaluation on the selected properties of ACQ treated wood cellular retaining wall elements	日本木材學會
湯適謙	2014中華林產事業協會學術論文暨研究成果研討會	我國林業生產體系研析及日本、加拿大生產體系簡介	中華林產事業協會
林育群、林振榮、李佳如楊德新	2014中華林產事業協會研討會	生態工法木構造物防腐處理藥劑留存與耐久性評估	中華林產事業協會
鍾智昕、林振榮	2014中華林產事業協會研討會	光譜無損檢測技術應用於木材塑膠複合材劣化性質評估	中華林產事業協會
林振榮、黃裕星、黃國雄吳孟玲	2014中華林產事業協會研討會	無損檢查技術應用於樹木危險性的個案調查	林產事業協會
林振榮、黃裕星、鍾智昕	2014中華林產事業協會研討會	無損技術應用於柑橘樹的樹齡檢測及評估	中華林產事業協會
何政坤、陳永修、張淑華陳芬蕙、林欣德、吳濟琛	第五屆「海峽兩岸森林保育經營學術論壇」	短伐期樹種在農地示範造林試驗研究	臺灣森林休憩保育協會、中興大學實驗林管理處、吉林省林學會、福建省林學會、黑龍江省林學會、臺灣全球交流發展協會
陳盈如、葉若鋆 Huai-Wen Hsu Shang-Tzen Chang	XXIV IUFRO World Congress	Antifungal potential and chemical composition of Chamaecyparis formosensis and Chamaecyparis obtusa var. formosana essential oils in liquid and vapor phase against plant pathogenic fungi	International Union of Forest Research Organizations
余欣怡、李金梅、夏滄琪黃國雄	2014中華林產事業協會學術論文暨研究成果研討會	麻竹熱處理材之基本性質	中華林產事業協會
顧文君、朱紀實、夏滄琪馬復京、陳衣秀、黃崇睿	第五屆海峽兩岸森林保育經營學術論壇	不同加工處理對台灣瓊崖海棠種仁油之顏色變化	臺灣森林休憩保育協會、中興大學實驗林管理處、吉林省林學會、福建省林學會、黑龍江省林學會、臺灣全球交流發展協會
馬復京、顧文君、陳衣秀夏滄琪	2014中華林產事業協會學術論文暨研究成果研討會	不同加工處理對瓊崖海棠樹種仁油之顏色變化	中華林產事業協會

研討會報告

作者	研討會名稱	論文題目	主辦單位
陳家慧、吳雅筑、張延信 許富蘭、李鴻麟	2014中華林產事業協會學術論文暨研究成果研討會	國內常用家具用材抗白蟻性之研究	中華林產事業協會
張延信、許富蘭、顏才博 李鴻麟	2014中華林產事業協會學術論文暨研究成果研討會	柳杉與相思樹木焦油處理材之耐久性	中華林產事業協會
范義彬	第五屆台灣溼地生態系研討會	福和溼地生態監測之建立	台灣濕地學會、經濟部水利署
范義彬、劉明昇、楊玉葉	第五屆台灣濕地生態系研討會	華江雁鴨自然公園植物開花物候監測	台灣濕地學會、國立台灣大學
陸聲山、王豫煌、林朝欽	The 6th EAFES International Congress-Ecosystem dynamics in changing environment	Big data and ecology-a case of bee camera system	East Asian Federation of Ecological Society (EAFES)
邱文良、黃曜謀 Amoroso VB Paraguas KGS、Critico F	23rd Annual Philippine Biodiversity Symposium	Exploring ex situ conservation of Aglaomorpha cornucopia (Copel.) M.C. Roos: A rare and endemic fern from the Philippines	Wildlife Conservation Society of the Philippines (WCSP) and the Association of Systematic Biologists of the Philippines (ASBP)
陳建文、邱文良	植物多樣性與系統分類研討會	索羅門群島資源植物調查暨植物誌編纂計畫成果網站建置	台灣植物分類學會
Chen CW、Hsu TC Li CW、Yang TY、邱文良	植物多樣性與系統分類研討會	Sol amazing: Lycophyte and Fern diversity of Solomon Islands	台灣植物分類學會
許天銓、張藝翰、邱文良	植物多樣性與系統分類研討會	台灣產禾葉蕨類群（水龍骨科）之分類訂正	台灣植物分類學會
Kuo LY、Ebihara、Kato E Wang CN、邱文良	植物多樣性與系統分類研討會	Phylogeny and Systematics of Deparia (Athyriaceae)	台灣植物分類學會
林奐宇、胡哲明	植物多樣性與系統分類研討會	紅皮書植物地理分布與受保護現狀之初探	台灣植物分類學會
洪昆源、蔡景株、沈勇強 吳芯慧、邱秀芸	第二十九屆生物醫學聯合學術年會	Whitening and anti-inflammatory activity of mahogany	中國生理學會、台灣藥理學會、中華民國解剖學學會、台灣生物化學及分子生物學學會中華民國細胞及分子生物學學會、中華民國臨床生化學會、中華民國毒物學學會

研討會報告

作者	研討會名稱	論文題目	主辦單位
洪昆源、楊蒼叡、洪州玄 朱木生、莊瓊昌、吳芯慧 邱秀芸	第二十九屆生物醫學聯合學術年會	Bioactivities of Extracts From Magnolia Kachirachirae of Taiwan Endemic Plant	中國生理學會、台灣藥理學會、中華民國解剖學學會、台灣生物化學及分子生物學學會中華民國細胞及分子生物學學會、中華民國臨床生化學會、中華民國毒物學學會
王奉典、張坤城、鄧書麟 呂福原	植物多樣性與系統分類研討會	台灣產越橘屬(杜鵑花科)植物之分類研究	台灣植物分類學會
林　融、張坤城、鄧書麟 呂福原	植物多樣性與系統分類研討會	台灣產雞屎藤屬(茜草科)之分類研究	社台灣植物分類學會
潘學儀、朱汶偵、邱玉娟 徐翰慈、方懷聖、黃志堅 陳一菁	2014動物行為暨生態學研討會	台灣蝶類群聚的時空特性	東海大學生命科學系
施鈞瀚、呂學宇、郭柏宇 林暄翊、林宗岐、黃志堅	2014動物行為暨生態學研討會	蓮華池不同樹上螞蟻相時空的比較	東海大學生命科學系
陸聲山、林朝欽	2014年台灣長期生態研究網年會	從台灣到亞太地區的生態資訊管理發展與回顧	台灣長期生態研究網
江智民、Yiching Lin I-Fang Sun、蘇聲欣 Helene C. Muller-Landau Ryan A. Chisholm Zueng-Sang Chen Chien-Te Chen Nathan G. Swenson Ryan W. McEwan	2014年台灣長期生態研究網年會	Mass ratio effects, not niche complementarity, explain the biodiversity-ecosystem function relationship in a broadleaved subtropical forest	台灣長期生態研究網

其他推廣刊物

作者	題目	書名期刊	卷(期)、頁碼、審查編號
黃俊元	心林歲月：臺東林區管理處第四次森林資源調查工作回顧	同左	1-160
林振榮	樹藝師應具備的都市樹木健康照護概念	林產工業	32(2):111-121
趙榮台	社會生態的生產地景-里山	自然保育季刊	88:4-13
楊玉葉、劉明昇、黃馨蔥翁億齡、范義彬	華江雁鴨自然公園草本單子葉植物圖鑑	同左	全冊
汪大雄	日本之屋久杉(Yaku Sugi)	環境綠化	58:65-71
邱志明	樹木風險評估管理與檢測案介紹	環境綠化	58:24-43
王瀛生	竹材替代傳統木質材料展現竹之美	家具公會特刊	P32-39
陸聲山	蜂群溫度調控與監測應用	苗栗區農業專訊	67:13-16
汪大雄	2010年全球森林資源狀況與變遷之簡介	台灣林業	40(4):60-70
林振榮	樹藝師應具備之樹木風險評估及管理	林產工業	32(1):49-61
洪昆源、吳芯慧、邱秀芸	芳香萬壽菊精油抽出物的利用和安全性	豐年雜誌	64(21):34-35
何振隆	漿料化學組成分析利器—熱裂解氣相層析質譜儀(Py-GC-MS)之介紹與應用	漿紙技術	18(3)49-66
陳建帆	*Fagus hayatae* Palib.	Important Plants of East Asia: Plants Tell stories	96-97
陳建帆	*Abies kawakamii* (Hayata) Ito	Important Plants of East Asia: Plants Tell stories	20-21
陳建帆	*Taiwania cryptomerioides* Hayata	Important Plants of East Asia: Plants Tell stories	204-205
陳建帆	*Sinopanax formosanus* (Hayata) H.L. Li	Important Plants of East Asia: Plants Tell stories	202-203
陳建帆	*Rhododendron pseudochrysanthum* Hayata	Important Plants of East Asia: Plants Tell stories	188-189
陳建帆	*Castanopsis carlesii* (Hemsl.) Hayata	Important Plants of East Asia: Plants Tell stories	60-61
黃曜謀	*Isoetes taiwanensis*	Important Plants of East Asia: Plants tell stories	124-125
黃曜謀	*Pentarhizidium orientalis*	Important Plants of East Asia: Plants tell stories	156-157

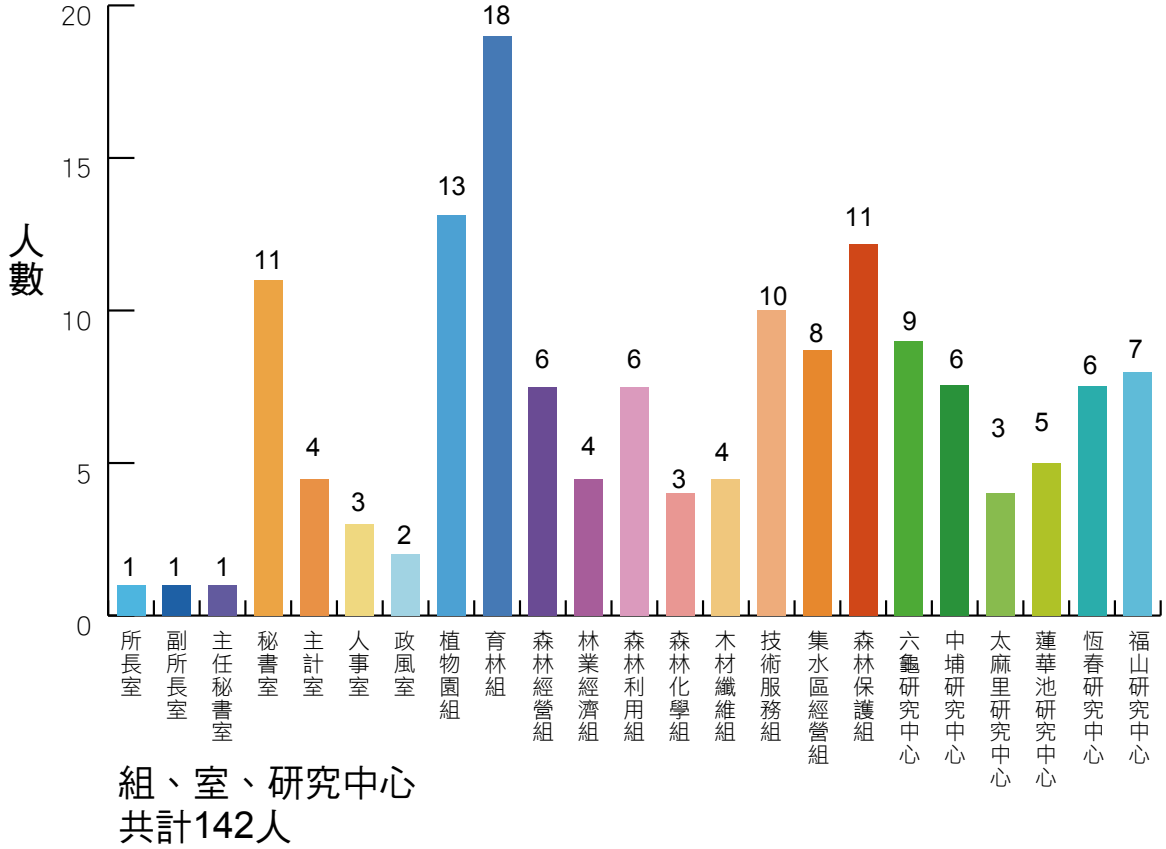
其他推廣刊物

作者	題目	書名期刊	卷(期)、頁碼、審查編號
黃曜謀	*Osmundastrum cinnamomeum*	Important Plants of East Asia: Plants tell stories	148-149
黃曜謀	*Cyathea lepifera*	Important Plants of East Asia: Plants tell stories	74-75
林奐宇、李祈德	森林植物資料庫－談植物標本及其資訊效益之運用	台灣林業	40(4):35-40
趙榮台、李玲玲	英格蘭最北的國家公園: 諾森伯蘭國家公園	大自然季刊	125:54-59
葛兆年	臺灣藍鵲首次在臺北植物園繁殖育雛	冠羽	243:50-51
范義彬	農林作物上重要的蛾類害蟲	農業世界雜誌	373:90-98
李祈德、黃俊元、黃俊銘葉清旺	關鍵時刻－山區意外發生與危機意識的建立	台灣林業	40(6):8-18
趙榮台、李玲玲	負責任的旅遊	大自然季刊	124:82-87
何振隆	有機溶劑製漿之回顧與展望	漿紙技術	18(2):31-43
范義彬	白天活動的美麗蛾類	農業世界雜誌	372:62-68
李金梅、許富蘭、黃國雄黃彥三	以橫向打音頻譜分析法檢測樹幹腐朽之可行性評估	台灣林業	40(4):41-44
蔡景株、范義彬、黃正良李欣怡、陳其緯、林渡真王靖堯、曾紹君	綠美化樹種常見害蟲管理手冊	同左	1-191
陳燕章	植林減碳救地球	農政與農情	263:69-72
吳家禎	夏威夷群島中的茂宜島與歐胡島	國家公園季刊	2014.6:68-78
吳家禎	在崩壞的世代興起美德-談美德的經濟學讀後感	102年度公務人員專書閱讀心得寫作得獎作品集	298-318
簡慶德、許文瑜	臺灣林木與種子的區外保育	台灣花卉園藝	321:30-35
簡慶德	種子的儲藏(二)	豐年雜誌	64(7):31-35
簡慶德	種子的儲藏(一)	豐年雜誌	64(6):30-33
邱志明、唐盛林	重要經濟造林木修枝作業手冊	同左	1-77

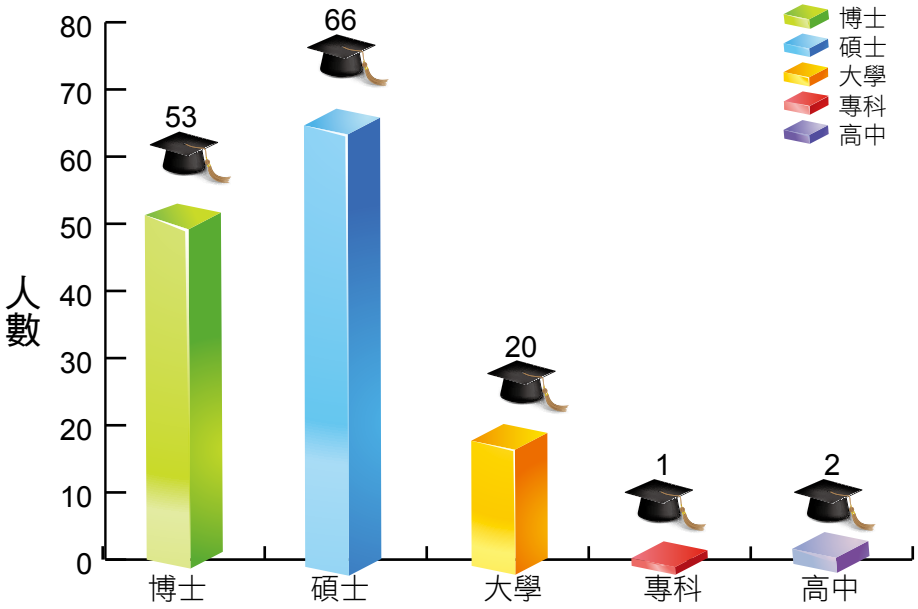
其他推廣刊物

作者	題目	書名期刊	卷(期)、頁碼、審查編號
王瀛生	平地造林木利用之我見	台灣林業	40(1):50-54
趙榮台	談農業生物多樣性麻雀每天來上班	T&D農訓雜誌	291:10-11
趙榮台	泱泱大湖洞里薩	大自然季刊	123:68-73
范義彬	不美麗但是有毒的枯葉蛾	農業世界雜誌	370:90-97
彭元興、王益真	生命週期評估簡介及在紙類產品的應用	漿紙技術	18(1):33-48
彭元興、王益真	化學木漿、機械木漿及脫墨漿的生命週期評估比較	漿紙技術	18(1):7-20
蔡景株、范義彬、黃正良 李欣怡、林渡真、陳其緯 王靖堯、曾紹君	綠美化樹種常見害蟲管理手冊	同左	1-192
簡慶德、陳舜英	殼斗科堅果處理、種子發芽與育苗	台灣林業	40(1):22-25
塗三賢	框組壁式木構造房屋耐久性壁體設計技術	農政與農情	259:100-103
陳財輝	藉溫故知新獲致吉野林業的再生	台灣林業	40(1):43-49
范義彬	要敬而遠之的毒蛾	農業世界雜誌	366:62-70
范義彬	小巧奇特的鉤蛾	農業世界雜誌	367:62-68
伍淑惠、陳可芳	種子的旅程	台灣花卉園藝	318:24-27
邱志明	經濟造林木修枝之觀念與技術	台灣林業	40(1):32-42

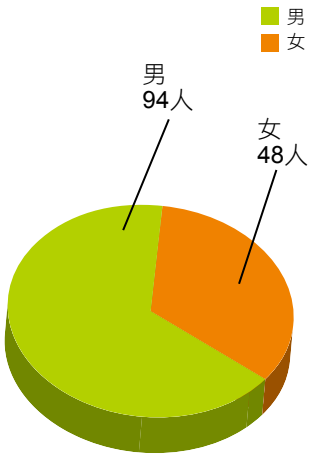
人力資源



組、室、研究中心
共計142人



教育程度



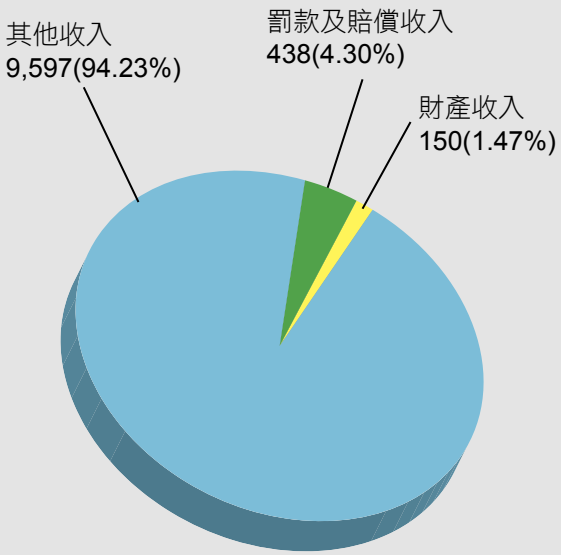
男女人數

財務預決算

(一)103年度預算

1.歲入：本年度歲入預算數10,185千元，較上年度6,897千元增列3,288千元，其主要內容如圖1。

2.歲出：本年度歲出預算數601,545千元，較上年度740,403千元減列138,858千元，其主要內容如圖2。

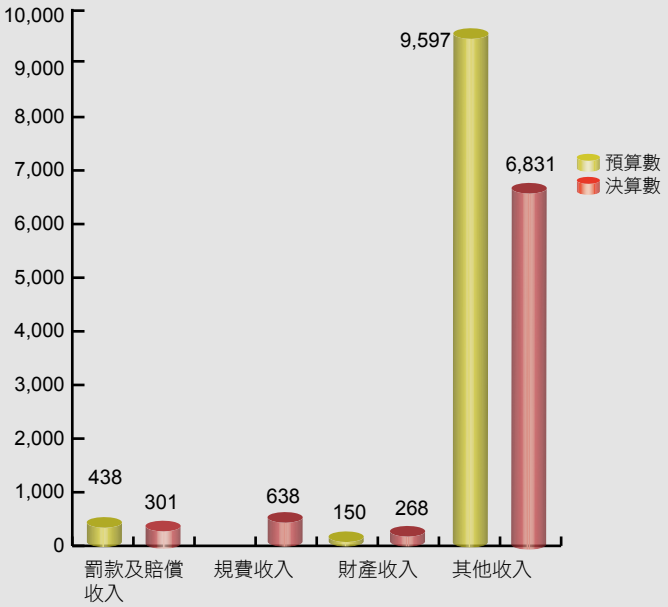


▲ 圖1. 103年度歲入預算主要內容（單位：千元）

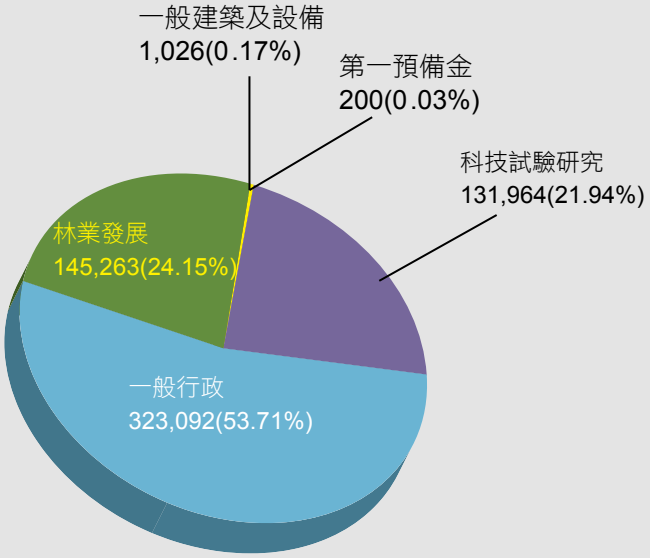
(二)103年度決算

1.歲入：本年度歲入預算數10,185千元，決算數8,038千元，執行率78.92%，其主要內容如圖3。

2.歲出：本年度可支用預算數601,545千元，決算數596,766千元，執行率99.21%，其主要內容如圖4。



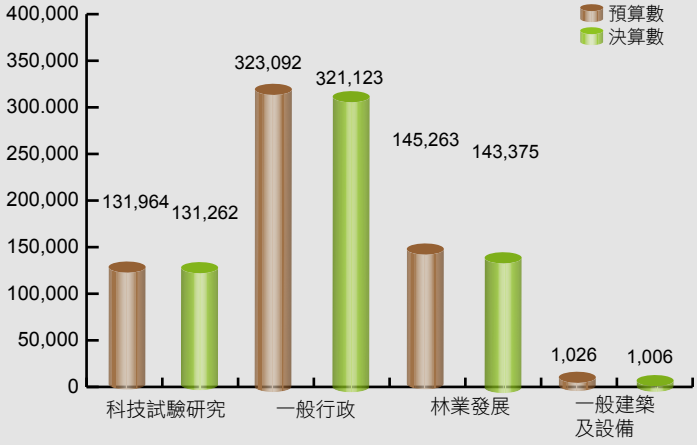
▲ 圖3. 103年度歲入預算執行情形（單位：千元）



▲ 圖2. 103年度歲出預算主要內容（單位：千元）

(三)103年度科技部補助計畫經費

本年度辦理科技部補助計畫經費9,177千元，執行數8,912千元，執行率97.11%。



▲ 圖4. 103年度歲出預算執行情形（單位：千元）

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行政院農業委員會
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