

出國報告（出國類別：其他）

台日韓舉辦
「世界快速變遷下之森林永續經營」

服務機關：行政院農業委員會林業試驗所

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派赴國家：韓國

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I、 目的

台灣、日本、韓國三國環境極為類似，林地面積森林覆蓋率皆超過 50%以上，林業經營發展亦面臨許多相同之衝擊。因此，藉此這定期舉辦之研討會，可供相關研究人員能和世界快速變化環境下之林業經營科學研究接軌，分享見解和構建一網路，使三國林業經營專家和研究人員共同承擔，腦力激盪，尋求因應解決快速變遷下林業經營相關問題。由於環境快速變化，啟動了對社會各種多樣之威脅，但也提供我們一個巨大的挑戰，以達成森林資源永續利用之目標。這需要比以前更細緻之規劃和執行森林經營作業，以確保人類經濟需求和森林生態環境健康之兩全其美，雙贏之策略與方法。目前森林經營領域之研究人員，已經發展和使用現代化工具去監測和因應森林生態系之動態變化，此架構幫助解決複雜之森林經營決策。因此，希望藉由此研討會將三國林業經營專家和研究人員齊聚於一堂，集思廣益，創造一有效率之平台，做為交換見解、作業經驗和彼此合作，以達成森林資源多目標利用之間有更好之平衡發展。

II、 行程

行程	事由
5 月 26 日	往程
5 月 27 日	首爾大學參訪報到
5 月 28 日	研討會
5 月 29 日	研討會、野外參訪、韓國人工林及休養林經營
5 月 30 日	研討會、野外參訪、韓國都市林管理及植栽綠化狀況
5 月 31 日	回程

III、 過程

1.研討會

本屆研討會在韓國首爾大學之 Hoam Faculty house 舉行，首先由大會召集人韓國首爾大學教授，森林先進技術研究中心主任 Joosang chung 開場，介紹召開研討會之緣起及目的，台日韓三國輪流舉辦之「世界快速變遷下之森林生態永續經營研討會」(Sustainable Forest Ecosystem Management in Rapidly Changing World)，相關研討會之召開始於 2006 年 8 月由日本 chiba 東京大學森林計畫協會 Japanese Society of Forest Planning(JSFP)主任 yamamoto 召集舉行；2007 年於台灣中興大學于蕙蓀林場舉行，由馮豐隆教授主辦，本所森林經營組協辦；2010 年，因第 13 屆 IUFRO 會議於韓國首爾舉行，會議主題森林之未來，永續社會與環境，與會者大家共識建議加入韓國，促成 2012 年之台日韓三國以森林經營為主題相關研討會。第一屆於 2012 年宜蘭大學森經營研究室王兆桓教授主辦，本

所協辦，第二屆於 2013 年日本九州鹿兒島大學數理統計研究室， Atsushi Yoshimoto 教授主辦。

本次（第三屆，2014 年）會議共有來自美國、不丹、菲律賓、馬來西亞、台灣、日本及韓國一百餘位林業專家和研究學者，共發表口頭報告 18 篇，壁報 54 篇，台灣參與者除本所外，台灣大學及實驗林，中興大學、宜蘭大學、嘉義大學森林經營領域教授與學者共 7 位參與。

口頭報告分四大部分：

第一部份：南韓林業之介紹及永續經營森林與人類之多元面向。

第二部份：探討各國溫室氣體減量和碳吸存相關議題。

第三部份：探討各國重要經濟樹種生長收穫相關模式探討與林木擇伐永續收穫。

第四部份：航遙測技術應用。

第五部份：為森林生態服務之定量與生物多樣性保育。

職發表之報告，題目「香杉人工異齡及混合林之構成與經營研究」，摘要如下：

香杉為台灣重要鄉土樹種，其生長快速，材質優良，因此成為台灣重要造林樹種之一。本研究之試驗地位於台灣南部林業試驗所高雄六龜研究中心，1973 年造林香杉，數年後因鼠害及颱風危害因而補植台灣杉，1996 年依香杉受害程度進行伐除，留存香杉上木 200、300、400 株/ha，並栽植 6 種原生樹種潤葉樹，江某、牛樟、印度栲、香楠、烏心石、台灣欒，16 年生時，經裂區試驗變異分析顯示，不同上木留存量、成活率、胸徑、樹高差異皆不顯著，但林下栽植之 6 種樹種成活率、胸徑、樹高差異皆極顯著，而區集效應僅樹高顯著，上木留存量和林下栽植樹種間之交感效應，則僅成活率差異顯著，餘均不顯著。不分上木留存量，平均成活率以印度栲最高 75%，香楠、烏心石、江某其次為 65~68%，牛樟及台灣欒最低 36~37%，平均胸徑以香楠最高 11.6cm，其次為烏心石及印度栲 10.3cm~10.4 cm，江某 9.0cm，牛樟 8.4cm、台灣欒最小 6.2cm，平均樹高以香楠最高 8.9m，烏心石 8.2m，印度栲 7.9m，江某 7.2m，牛樟 6.4m，台灣欒 5.8m 最低。不同上木留存量，不同林齡之生長趨勢，不同樹種各有其生長特性，上木留存最少者，不一定存活率最高，但大致其胸徑生長上木留存量較少者，有較高之趨勢，再者，留存之香杉及台灣杉上木，其生長也會隨著留存木株數之降低而增加。

2. 韓國林業介紹

面積：

平均海拔高 420 m，韓國土地面積 221,000 km²，南韓土地面積 99,660 km²，韓國林地面積占總土地面積 70%，有 154,700 km²，其中南韓林地面積佔 64%，63,782 km²。

氣候：

年平均氣溫南部 12-14°C，中部 10-12°C，北部 5-10°C。平均年雨量 600-1,800

mm，平均 60 % 集中在夏季。

森林分布：

1. 亞冷寒帶森林(Sub-boreal forest)
平均溫度 5°C 以下，樹種 *Abies*, *Picea*, *Larix*, *Juglans mandshurina*, *Betula platyphylla*。
2. 冷溫帶森林(Cold-temperate forest)
平均溫度 5-14°C，樹種 *Quercua*, *Zelcova*, *Fraxinus*, *Piruns densiflora*, *Piruns koraiensis*。
3. 暖溫帶森林(Warm- temperate forest)
平均溫度高於 14°C，樹種 *Quercua acuta*, *Lastanopsis cuspidate*, *Camelia japonica*。

森林資源：

針葉樹人工林之面積以 red pine (*Pinns densiflora*) 佔 56% 最多，其次為 Japanese larch (*Larix kaempferi*) 佔 16%，Pitch pine (*pinus rigida*) 佔 15%，Korean pine (*Pinus koraiensis*) 佔 8%，其他樹種佔 5%。

1. 每人擁有林地面積約 0.2ha(世界平均 1/4)。
2. 林木總蓄積: 800 萬 m³，平均每公頃 125.6 m³，其中國有林為 148.5 m³/ha，私有林 117.7 m³/ha。
3. 59 % 之人工林，林齡在 30 年生以下。因此，撫育管理、疏伐、工時分析、高效率集運機械之採用，以降低作業成本，是當前努力之目標。
4. 南韓木材之消費 83.8% 由國外進口。

森林所有權屬：

1. 私有林占 68 %，4,337,880ha (82% 林主擁有之林地面積小於 50ha)。
2. 國有林占 24 %，1,543,352ha。
3. 公有林佔 8 %，487,611ha。

林產物與貿易：

1. 2012 年，林產物需求量 27,819,900 m³。
2. 2012 林產物本身供給量 4,506,000 m³，自給率 16.2 %。

森林生態公共效益(Public benefits of forest)：

據南韓林業機關公布，2012 年總估計約 908 億美金(1us ≡ 1200 韓元(KRW))
≡ 1,090,070 億 KRW

森林一年效益約占 9 % GDP

碳吸存，氧氣生產量及空氣淨化，每年之效益 220,630 億 KRW，佔森林生態公共效益之 20 %

集水區保育效益有 202,100 KRW，佔森林生態公共效益之 19 %

森林地景效益有 151,710 KRW，佔森林生態公共效益之 14 %

森林遊樂效益有 146,070 KRW，佔森林生態公共效益之 13 %

土壤沖蝕防止效益有 143,360 KRW，佔森林生態公共效益之 13 %

邊坡保護效益有 66,930 KRW，佔森林生態公共效益之 6 %

水源淨化效益有 65,470 KRW，佔森林生態公共效益之 6 %

生物多樣性保育效益有 52,750 KRW，佔森林生態公共效益之 5 %

野生動物保育效益有 24,240KRW，佔森林生態公共效益之 2 %

森林療法(Forest therapy) 效益有 16,820 KRW，佔森林生態公共效益之 2 %

韓國政府林業組織 Korea forest service(KFS)：

任務：

1. 促進、保護與永續利用森林資源
2. 提升森林公共利益
3. 保育國家林地

組成：

由 5 個部門組成 25 個單位及 5 個地區管理處及 27 個工作站組成。

林業部：

1. 林業計畫與合作局(Planning and Coordination Bureau)
2. 國際事務局(International affairs Bureau)
3. 森林資源局(Forest resources Bureau)
4. 森林利用局(Forest utilization Bureau)
5. 森林保護局(Forest protection Bureau)

其 5 個部門，共 25 個所屬單位及 5 個地區管理處及 27 個工作站組成

韓國森林研究機構(Korea Forest Research Institute, KFRI)：

屬於政府部門之組織

任務：

1. 聚焦於森林永續經營知識與技術之促進與發展
2. 強化韓國林業科學之競爭力，經林業技術之發展與擴大應用，改善生活品質與創造財富

組織：

1. 森林政策與經濟部門
2. 森林保護部門
3. 森林遺傳資源部門
4. 林產物部門
5. 林業作業研究中心
6. 南方森林研究中心
7. 暖溫帶森林研究中心

野外參訪

野外參訪韓國人工林經營、休養林、民俗文物村、都市林管理及植栽綠化狀況。

IV、心得與建議

1. 木材自給率之提升

南韓土地面積 99,660 km²，林地面積占 64%，約有 63,782 km²，私有林占 68%，國有林占 25%，公有林 8%，木材自給率 16.2%，此情況和台灣相較，台灣土地面積約為南韓的 1/3，但森林林地面積占 59%，國有林占 70% 以上，私有林約 20%，公有林 10%，而木材自給率 1% 不到，由此可知，台灣對森林林產品之生產供給尚存許多努力空間。

2. 人工林之經營

南韓之針葉樹人工林，主要為紅松(Red Pine)，*Pinus densiflora* 佔 56%，其次為日本落羽松 Japanese larch(*Larix kaempferi*)佔 16%。其人工林之經營初期栽植距離為 2×1.5m²，亦即每公頃 3,300 株，因此林齡 15-20 年生左右即進行修枝撫育工作，其對林木質與量的提升甚為重視，但亦碰到工資成本高漲及環境之問題，因此本次研討會，亦有數篇文章探討友善環境之集運作業及成本工時分析。期待降低生產成本，又能對環境之衝擊降低之集運研究，此方面有待我們借鏡學習，有關各種人工林之經營撫育、生長收穫發表之報告最多，超過 10 篇以上。

3. 生態服務功能計量

南韓定量估算其森林生態公眾效益價值達 1,090,070 億韓元，約等於 908 億美金，並分別以水源涵養、空氣品質改善、沖蝕控制、森林遊樂、水質改善、崩塌防止及野生動物保護，分別計畫並估算其效益然後宣傳教育社會大眾，喚起國人對森林之重視，因而充裕資源管理及相關研究經費，而台灣在森林生態服務功能之定量評價之重要性，雖已獲得共識，但其評估計量方式仍有許多學習空間。南韓以森林生態服務功能計量之方式，喚起國人重視森林及保護森林，爭取經費之方式，值得我們借鏡。

4. 都市林之管理

參觀南韓首爾都市林、行道樹之管理維護及前總統李明博清溪整治，由汗水排水溝變成大眾市民喜愛駐足、休憩及可讓市民親水、近水、親身體驗之多樣性生態景觀，讓人覺得南韓處處之努力及用心，對於老樹、珍貴樹木、景觀行道樹之維護管理值得本所樹醫中心及縣市綠化部門學習。

5. 休養林之開發

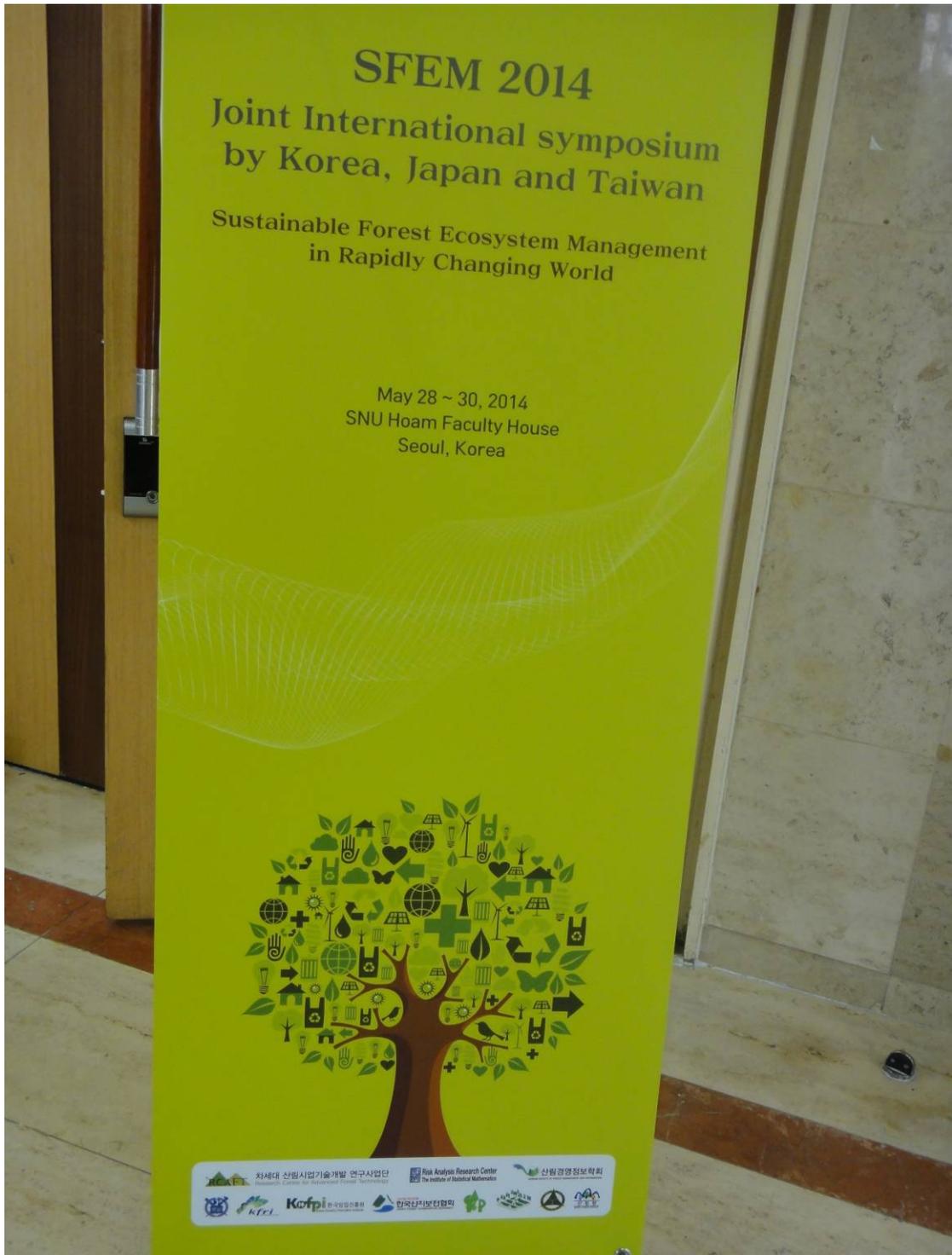
森林具有多功能目的，其能發揮國土保安、水源涵養、淨化空氣、環境生態多樣性、經濟性木材使用及許多森林特產物之保健、經濟價值等各種效能。其中有關森林休養林之開發應用，在南韓蓬勃發展，尤其針對日益老化之社會中老齡層提供森林特殊方便及友善之環境，如芬多精、陰離子、新鮮空氣等紓解身心及身心靈醫療治療效果及無障礙空間，在此次研討會亦有超過 5 篇報告之發表。因此，台灣林業單位應可加強森林療癒之開發應用及研究。

6. 木材利用

此次參訪首爾附近之大關嶺休養林及民俗文物村，發現其對木材之利用，開發的淋漓盡致，尤其對於小徑材、小工藝品及木炭之開發應用，處處可見展

售之場所，其小工藝品之設計，千奇百怪，值得我們開發平地造林木之中小徑木及林地疏伐木利用之參考。

V、 照片





Study on creation and management of uneven-aged and mixed plantations in Luan-tai-fir forest

Division of Forest Management, Taiwan Forestry Research Institute
Chih-Ming Chiu*, Wen-Chih Lin, Sheng-Lin Tang,
Chih-Hsin Chung, Fu-Shan Chou

Introduction

Luan-tai-fir is an endemic species in Taiwan. Evidence had shown the Luan-tai-fir growing rapidly with high wood quality, and therefore it was selected as one of the major species for plantation. However, the severe damages from typhoon breakage and squirrel have occurred contiguous after afforesting several years. So we replanted the Taiwan seedling after planting 5 yr. The Luan-tai-fir, the trunk bark were damaged by the squirrel. We found that the parts of the trunk was occlusion for producing heal organism, but the trunk had already been decay owing to fungi, and the appearance of the trunk seemed to occlude, in fact, the trunk inside have been decayed. If those serious decayed trees retained in the forest land, not only hinder replanting Taiwan seedling growth, but also waste land productivity. Therefore, the purpose of this study was to investigate and select cut the damage trees, retained the health Luan-tai-fir and replanting Taiwan and natural regeneration hardwoods. The gap created after select cut damage trees, we planted six hardwood species, in order to establish uneven-aged and mixed species forest.

Materials and Method

Experimental site

Experiment site was located at Liukuei research center, Taiwan Forest Research Institute, in southern Taiwan and the elevation is 1320-1400m. According on neighboring weather station's 1980-1996, the average annual rainfall is 2280 mm and the average annual temperature is 18.6°C. Moreover, the universal obvious rainy season, rainfall concentrate April to September, it is account for 92.5% annual rainfall. The man-made forest, Luan-tai-fir, was established in May of 1973. The planted space is 2 m × 2 m i.e. 2500 stems per hectare. The stands investigated was found that 946 stems per hectare existed in 1995 and that consist of Luan-tai-fir (*Cunninghamia honisii*) 587 stems, average DBH 28.3cm, Taiwan (*Taiwania cryptomeria*) 178 stems, average DBH 14.2 cm, and the others are natural regeneration the hardwood species.

Which an elevation is about 1100 m. The plantation is 30yr's old at present.

The experimental site was split-plot designed

- Main plot, we cut serious damaged Luan-tai-fir then left three levels of upper trees. 200, 300 and 400 trees/ha respectively.
- Subplots: was that six endemics hard-wood species were planted at gaps in 1996 which were *Machilus zuihoensis*, *Michelia compressa*, *Zelkova serrata*, *Coatanopsis indica*, *Cinnamomum micronthum* and *Schefflera octophylla* respectively.

Conclusion

The results by split plot indicated that there were no significant difference for survival rates, DBH and three height among various residual upper trees, however there were very significant difference for survival ratio, DBH and tree height among six for underplanting species. Moreover, the block effect only tree height was significantly different, indicating the tree height was affected by site environment. Moreover, to monitor the changes of growth process with ages, there were obvious differences among three level residual upper trees and underplanting species, indicating those underplanting species had their own optimal growing environments and mechanisms.

Results

Table 1 ANOVA of seedling survival rates for various levels of residual upper trees and underplanting species by split-plot designs at 16-yr-old

Source	DF	Sum of squares	Mean Square	F value
Blocks	3	4990.11	1663.37	3.7
Main plot	2	123.03	61.52	0.14
Error (a)	5	2249.26	449.85	
Sub plot	5	12791.94	2558.39	15.76**
Main plot*	10	4157.31	415.73	2.56*
Sub plot				
Error (b)	38	6167.58	162.30	
Total	63	30479.23		

** statistic: callly very significant (p ≤ 0.01)
* statistic: callly significant (p ≤ 0.05)

Table 2 Duncan's test of survival rates of underplanting species at 16-yr-old

Species	Survive ratio (%)	DBH (cm)	Seedling height (m)
<i>Machilus zuihoensis</i>	67.6 ^{ab}	11.6 ^a	8.9 ^a
<i>Michelia compressa</i>	66.5 ^{ab}	10.4 ^{ab}	8.2 ^a
<i>Coatanopsis indica</i>	74.2 ^{ab}	10.3 ^{ab}	7.8 ^a
<i>Schefflera octophylla</i>	65.4 ^a	9.0 ^{ab}	7.2 ^a
<i>Zelkova serrata</i>	36.4 ^a	6.2 ^a	5.8 ^a
<i>Cinnamomum micronthum</i>	37.3 ^a	8.4 ^a	6.4 ^a

1) Means within a given column with the same letter are not significantly (P ≤ 0.05) different as determined by Duncan's multiple range test.

Table 3 ANOVA of seedling DBH for various levels of residual upper trees and underplanting species by split-plot designs at 16-yr-old

Source	DF	Sum of squares	Mean Square	F value
Blocks	3	58.4664	19.4888	3.2
Main plot	2	9.4888	4.7444	0.8
Error (a)	5	30.4397	6.0879	
Sub plot	5	194.6791	38.9358	13.78**
Main plot*	10	11.4014	1.1401	0.4
Sub plot				
Error (b)	38	107.3845	2.8259	
Total	63	411.8598		

Table 4 ANOVA of seedling height for various levels of residual upper trees and underplanting species by split-plot designs at 16-yr-old

Source	DF	Sum of squares	Mean Square	F value
Blocks	3	259090.9	96907.0	8.11*
Main plot	2	43504.5	21752.2	1.77
Error (a)	5	61469.6	12293.9	
Sub plot	5	74320.5	14864.1	23.21**
Main plot*	10	36769.6	3677.0	0.7
Sub plot				
Error (b)	38	300031.6	5263.5	
Total	63	1881167.0		



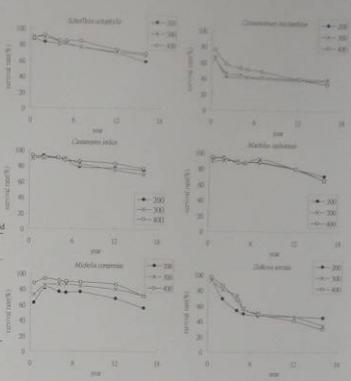



Fig. 1 Changes on survival rate of underplanted species with ages for various levels of residual upper trees

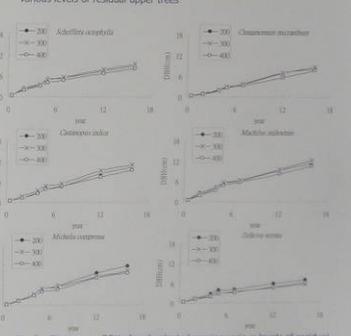


Fig. 2 Changes on DBH of underplanted species various levels of residual upper trees

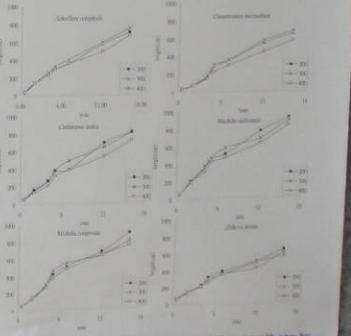


Fig. 3 Changes on seedling height of underplanted species with ages for various levels of residual upper trees

A new method to quantify temporal validity of thinning in the Japan Cedar plantation

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Introduction

- The temporal validity of thinning for improving tree growth is an important key for silvicultural operations schedule.
- The Japan Cedar (*Cryptomeria japonica*) plantation make up over 36,000 ha in Taiwan.
- Thinning is one of silvicultural management methods that reduce stand density during stand development stages and leads to improve residual tree growth. To determine optimal thinning time conventionally estimated by using mathematical or model approach. But those are complex and difficult for silviculture practices.
- The goal of this study is to quantify plantation temporal validity of thinning by means of theory of survival analysis.

Methods

Study area and data

Study area

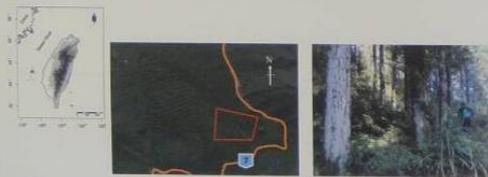


Fig. 1 The study site was located in the Chilanshan area.

Row thinning trial

The experimental plantation stand is located in compartment 20, Taipingshan working cycle, Chilanshan (24°37'4.60" N, 121°29'23.37" E), Ilan County, Northeastern Taiwan (Fig. 1), and the elevation is 1100 m. The Japan Cedar plantation was planted in 1966 after clear-cutting of Temperate conifer-broadleaf mixed forest. The strips thinning experiment established in 1990. Four strip width thinning (by cutting different row) treatments:

cutting of 2 rows (T2), 3 rows (T3), 4 rows (T4) and 5 rows (T5) respectively, were applied; and 6 rows were retained on both sides of the thinned strips.

There were cored 21 cores from each treatment (at each plot 4-6 cores), and total taken about 105 increment cores from 4 thinned gap edge sample trees and one control treatments (unthinning sites near the thinning experiment plots) in summer, 2011.

Statistical analyses:

Relative growth rate (RGR) represents the percent gain of a base period (1988-1990) mean width per 3 years before thinning. The tree-ring width sequence data set is needed to be converted become survival data, as following two steps:

- 3 yrs moving average
 - converted become survival data
- If
- $$mRW \geq \text{threshold} = 1 \text{ (alive)}$$
- $$< \text{threshold} = 0 \text{ (Failure)}$$

The statistical analyses were used the Kaplan-Meyer method (Kaplan and Meyer, 1958) for estimating nonparametric survival function.

Results

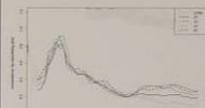


Fig. 2. The smooth out of the annual growth variation by using three-year moving

Table 1. The values of the thresholds for (1) before thinning (1966-1990) and (2) after thinning (1991-2011)

period	Ring width of threshold (mm)	
	mean	std
before thinning*	0.42	0.21
after thinning**	0.22	0.11

*The thresholds are use of cores control average tree ring increment during 1988-1990 period.

**The year average tree-ring increment at 1990.



Fig. 3. The relative growth of ring width per 3-yr of different treatments based on 1988-1990 before thinning.

Table 2. The summary of stand characteristics by survey data

treatments	DBH of stand*		stem base height		Tree height		DBH of sample tree	
	mean (cm)	std (cm)	mean (m)	std (m)	mean (m)	std (m)	mean (cm)	std (cm)
T2	29.8	9.9	7.8	2.7	18.8	2.0	29.3	8.4
T3	31.5	8.6	8.1	3.2	18.5	2.4	26.8	7.4
T4	30.4	12.3	8.8	3.9	18.2	4.5	30.2	9.8
T5	31.0	10.4	7.8	3.3	18.9	4.0	30.8	8.4
CTRL	27.2	8.7	10.4	2.9	18.2	2.8	27.5	8.7

*DBH of survey data. † include bark at 2011.

Table 3. The summary of statistics of Kaplan-Meyer method before and after thinning period.

Treatment	Before thinning				After thinning			
	n	median	0.95L	0.95UL	n	median	0.95L	0.95UL
CTRL	21	16	14	18	21	16	14	18
T2	20	15	14	16	27	20	17.5	8
T3	20	15	12	16	21	14	11	-
T4	21	13	10	16	47	27	15	19
T5	21	14	11	17	27	21	18	29

*n by lost of log-rank

**p<0.0001

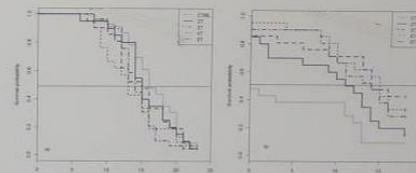


Fig. 4. Estimated survival curves by Kaplan-Meyer method for control and thinning treatments at (a) before thinning (1966-1990) and (b) after thinning (1991-2010).

Summary

The results were inconsistent performance of relative growth for strip thinned width. T2 maintained tree-ring width growth as the same as before thinning. The effects on accelerating growth of tree-ring width, which appears in earlier periods for wider of thinning strip (4T and 5T). Then, the relative growth of 3T-5T sites were apparent declined 14th yr after thinning, and comparatively, a decreasing trend straightly in the control sites. However, the radial increment percent varied by different growth rate with tree growth stage so that were difficult to ensure end time point of thinning effects.

As results of Kaplan-Meyer method, those estimated T50 values were similar (log-rank test, $p=0.797$), ranged from 13 to 16yrs for all treatment and control group that suggested the time of early thinning in the Japan cedar plantation. 21 years after thinning, there were significantly difference between treatments and control group (log-rank test, $p=0.002$), and the T50 values were ranged from 11.5 to 15 yrs for thinning treatment. As this study results, the methods by applying survival analysis through setting tree-ring growth threshold to assess temporal validity of thinning effects, could be a useful tool for decision making of thinning time and detecting temporal validity of canopy space release in silvicultural and ecological studies.

森林經營組鍾智昕、職和宜蘭大學林世宗合作發表之壁報



研討會會場



參訪大關嶺休養林之經營措施



不同樹種之木炭分析展示



木材工藝品展示



參訪南韓民俗村



南韓民俗村小工藝品展示及販售情形



南韓民俗村木藝品展示及販售情形



南韓民俗村木材工藝品展示及販售情形



韓國人工林



韓國紅松人工林



紅松人工林經營作業解說



紅松人工林不同經營狀況介紹



紅松解説牌



紅松人工林



紅松人工林之疏伐



紅松之針潤葉混合林



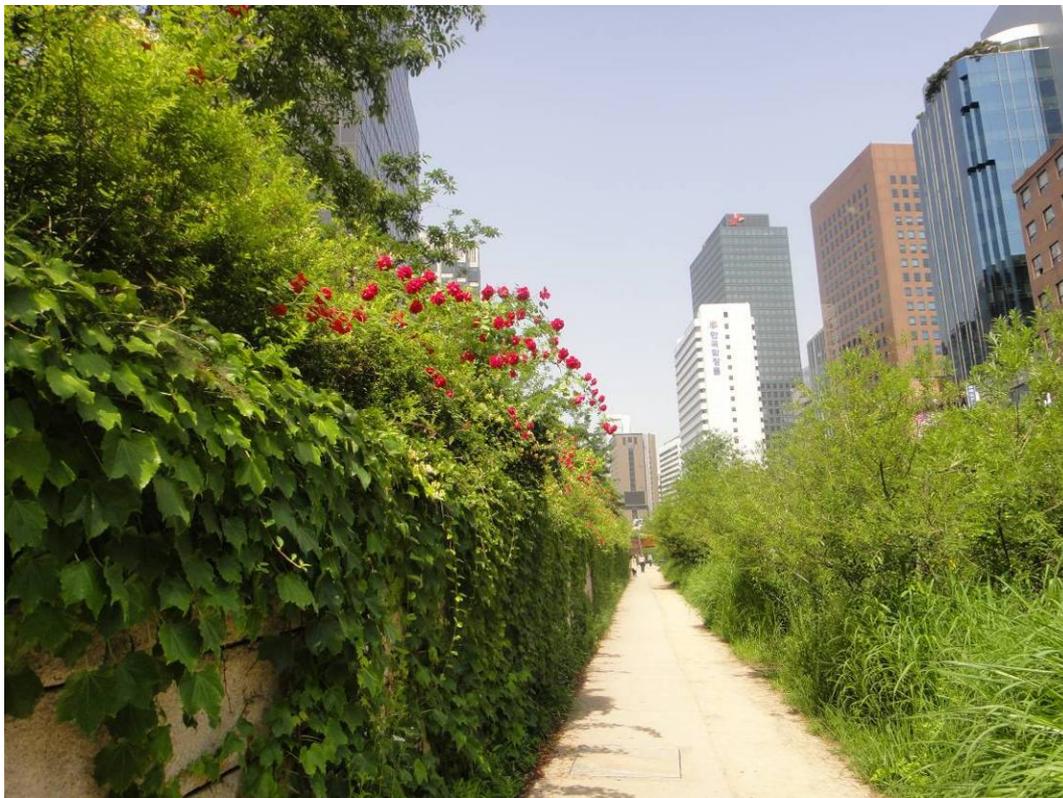
人工針葉混合林



針潤葉人工混合林



南韓首爾清溪整治，將溪水排水溝，進行廢水處理、淨化，並將沿溪兩側生態美化，創造人們親水近水、休憩，人們喜愛之場所（一）



南韓首爾清溪整治，將溪水排水溝，進行廢水處理、淨化，並將沿溪兩側生態美化，創造人們親水近水、休憩，人們喜愛之場所（二）



於整治後清溪舉辦活動



都市林老樹之外科手術（一）



都市林老樹之外科手術（二）



都市林不同支撐保護



都市林林木美化支撐維護



貴重樹之支架維護



行道樹之基盤保護（一）



行道樹之基盤保護（二）