TAIWAN RED- AND YELLOW-CYPRESS AND THEIR CONSERVATION

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ABSTRACT

The Taiwan Red- and Yellow-Cypress are the most important coniferous trees of Taiwan and producing ideal construction timbers of particular usefulness in subtropical countries for anti-termites. Unfortunately these valuable trees, for some reasons or the others to be studied, are now tending to be exterminating. Hence the following problems call for a critical study;

1. Why is Taiwan Cypress endemic to Taiwan and not occurred in any other part of the world?
2. Why are they now exterminating?
3. How to maintain proper forest management and adequate silivicultural method to reserve these valuable species?

The summaries and conclusions of the ecological and silvicultural studies of the above problems are as follows:

1. Peculiar climatic conditions occurred in this particular region having a combination effects of high relative humidity, cool temperature, moderate high annual precipitation, and the influence of prevailing typhoons, are the factors controlling the distribution area of these species.
2. Taiwan Red- and Yellow-Cypress are light demanding species. The thick and luxurious undergrowths of the forest floor impeding the fallen seeds in germination and growth and the cutting away of Taiwan Cypress in all the accessible regions and leaving too many over-matured trees bearing no more seeds for natural regeneration in all the accessible places cause a tendency of extermination.
3. The over-matured stands of forest should be cut off in a period of 120 years instead of 40 of the present management plan and to regulate the age classes to the "Normal Forest", so that the rate of growth and drain shall be balanced and matched up with the 120–year rotation.
4. Artificial reforestation with seedlings raised from seeds of selected mother-seed trees is the only measure of conserving these valuable species from extinction.

GENERAL CHARACTERS OF THE TAIWAN RED- AND YELLOW-CYPRESS

1. The scientific names of the two cypresses.

The scientific name of the Taiwan Red-cypress is *Chamaecyparis formosensis* Mastu. and that of the yellow-cypress is *Chamaecyparis taiwanensis,* Masam. & Suz. and both belong to the family Cupressaceae, Because both species having similar wood property and the same commercial value in their economic uses they are called "Taiwan Cypress" collectively.

2. The botanical differences between the two Taiwan cypresses.

Growing along with the species *Chamaecyparis formosensis* Mats., there is a close related Japanese species, *Chamaecyparis obtusa* Sieb. & Zucc. which in Taiwan was a variety of the species *C. formosensis* Mats. and hence it has been called *Chamaecyparis obtusa* Sieb. & Zucc. var. *formosena* by A. Rehder, and later on it has been changed to *Chamaecyparis taiwanensis* Masamune & Suzuki[5]. Although both *C. formosensis* Mats. and *C. taiwanensis* Masamune & Suzuki being called "The Taiwan Red- and Taiwan Yellow-Cypress", except that *C. taiwanensis* Masa. et Suzuki has its altitudinal distribution 2–3 hundreds meters higher than that of *C. formosensis* Matsu., they are quite similar in their ecological growing habitat, in growth habit, and in their characteristics of wood properties. The only botanical differences between the two species are that the leaves of *C. formosensis* is triangular with sharp apex, and dark green in color; the cone is oblong-ovate, smaller; and the wood is reddish, and that of *taiwanensis* the leaves with obtuse apex and light green in color; the cone is round and larger, and the wood is brownish.

3. The economic value of the trees.

They are the most important and the largest coniferous trees of Taiwan and producing ideal construction timbers, especially useful in tropical and subtropical countries, as the wood possesses anti-termites and anti-humid-decaying-fungi porperties. The wood is light, durable, with very fine texture and straight grains, and also having high commercial value in its derived products, exporting to Korea, Japan, Liukyu and the southern islands, which offer opportunities for expanding industrial activities.

The height growth of the tree can reach 50–60 meters and its diameter 15–20 meters in circumference. Two of the largest living trees are found in Taiwan, one of which is in Mt. Ali, at an altitude of 2,200 m. above the sea level, with a height growth of 53 m. a D. B. H. of 34 m. in circumference, having a timber volume content of about 500 cub., m. and the estimated age is of about 3,000 years (see fig. no. 1); the other is in the Experimantal Forest of the National Taiwan University at Chi-tou, Tsu-shan, at an altitude of 1,350 m. above the sea level, with a height growth of 46 m. a D. B. H. of 16.8 m. in circumference, having a timber volume content of 460 cub m., and the estimated age is about 2,800 years. Both trees are

also called "The tree of God" by the natives. Most of the rest of the matured trees in the forests have a height growth of about 30 m. a D. B. H. of 2–3 meters in circumference, and an age of 3–5 hundreds of years. Each tree has a timber volume content of 20–30 cubic meters.

4. The character and composition of the Red- and Yellow-Cypress forest association.

The character and composition of the virgin stand of both species are very similar. Each one of the two species may form a pure stand, (see fig. no. 2.) two species may form a mixed stand (see fig. no. 3), and sometimes they may mix with hardwoods in their lower part belt of distribution. The two species form the climax formation of the region. The most common associated hardwoods found in their lower part belt are;

Lagerstroemia subcostata, Koe.
Beilschmiedia erythrophloia, Hayata.
Slonea dasycarpa, Benth.
Cinnamomum comphora, Sieb.
Ardisia Sieboldii, Miq.
Symplocos theophrastaefolia, B. & Z.

The most important undergrowths are;

Eurya glaberima, Hayata,
Eurya leptophylla, Hayata,
Eurya japonica, Thunb.
Plagiogyria adnata, Bedd.
Illicium leucanthum, Hayata.
Gilibertia pellucid-punctata, Hayata.

The most important herbaceous plants are;

Geranium nepalence, Sweet.
Skimmia arisanensis, Hayata.
Senecio taiwanensis, Hayata.
Lycopodium cernunm, Linn.
Impatiens uniflora, Hayata.
Veronica anagalis, Linn.

The altitudinal belt of distribution of *Chamaecyparis formosensis* Mats. is 1,200–2,400 m. above the sea level and that of *C. taiwanensis* Matsamu. & Suzuk, is 1,800–2,400 m and usually 500–600 meters higher than *C. formosensis*. Below the lower limit of their natural distribution, if you have planted them artificially, they would have grown bushy and their central stems begin to fork immediately above the ground at a point of 3–5 feet above the basal end the stem is deviating from the coniferous habit of growth of a central axis of a single leading shoot (see fig. 4 & 5).

The present growth conditions of the virgin forest stands of the Taiwan Cypresses are appearing to be declining toward extinction and calling for a critical study in

order to save these exceptional valuable species from extinguishing. The number of matured trees in the virgin stands occurred very unevenly, ranging from 4 or 5 to 120 trees per hectare and averaging about 40 trees. No matter in dense by or in sparcely populated virgin stand there is not a single seedling of natural reporduction ever found in the forests. The reckless cutting of the virgin forests of the conifers without considering the regenerations, the forest floors would naturally be taken up by the vigorous development of undegrowths of which especially *Indocalamus niitakayamensis* Nakai being most vigorous (see fig. 6 & 7) the Taiwan Cypress will be in danger to become extinct, and these coniferous forests of the region shall be eventually substituded and succeded by the above mentioned hardwoods and *Indocalamus niitakayamensis* Nakai.

THE INTERESTING PROBLEMS AROUSED

According to the above descriptions the Taiwan Cypresses have aroused the following very interesting problems for studying as;

(1) Why are these Taiwan Cypresses endemic to Taiwan and not occurred in any other part of the world?

(2) Why do they not reporduce themselves naturally in the forests, no seedlings, saplings and pole wood trees ever found in the forests and are extinguishing now?

(3) How to maintain an adequate forest management to secure a perpetual regeneration and a sustained yield and how to conserve these exceptional valuable species from extinction?

The first two problems are the studies of Ecology and the third one is the study of silviculture and forest management.

A. The ecological studies.

In order to find out the reasons why *Chamaecyparis formosensis* Mats. being endemic to Taiwan there are two main aspects to be considered;

(a) The origin of its distribution.

The genus *Chamaecyparis,* constituting 6 species, has been distributing in Eastern Asia and North America, but the species *formosensis* is found in Taiwan only. Though this species is endemic to Taiwan, but its origin of distribution must be the mainland of China. This may be proved by the parallel distributions of the other conifers, which have their origins in the southwest China and their endemic species are also occurred in Taiwan, such as;

1. Pinus taiwanensis, Hayata,
2. Cunninghamia Konishii, Hayata.
3. Libocedrus formosana, Florin.
4. Juniperus formosana, var. conclor, Hayata and others.

It can further be proved by the continuous distributed conifers of the same species from the south-western China to Taiwan, such as;

1. Pseudotsuga Wilsoniana, Hayata.
2. Taiwania cryptomerioides, Hayata.
3. Juniperus formosana, Hayata.
4. Pinus Armandii, Franch. and others.

Thus the genus *Chamaecyparis* was undoubtedly originated from the mainland of China and distributed similarily with the above mentioned conifers to Taiwan. During a long period of adapting growth to this particular environment of Taiwan it had been transformed as an endemic species as *C. formosensis,* Mats. and its sister species *C. taiwanensis* Masamu. & Suzuki was derived similarily from *C. obtusa* Sieb. & Zuce., from Japan as a variety of the species of *obtusa,* named by A. Rehder and later on it has been changed to *C. taiwanensis* by Masamune and Suzuki[5].

(b) The particular environment of the growth habitat.

Chamaecyparis formosensis and *C. taiwanensis* prefer to grow in habitat of cool and humid climate with moderate high annual precipitation. It is very difficult to find regions possessing such an adequate combination of these three pertinent factors in any other part of the world, whereas Taiwan, which in addition of being surrounded by seas and oceans, lays under the tract of prevailing typhoons that bring abundance of rainfalls during the late summer and fall even in the drier period of the year and is subjecting to the North-Eastern monsoon wind, which usually brings lots of rainfalls, causes a wet season from January to April every year. *C. formosensis* and *C. taiwanensis* require a particular habitat of high relative humidity of at least 80% above and heavy clouds and fogs during the most part of the day (see fig. 8).

Meterorological records of the conifers belt of Mt. Ali.
(taken from Tsou Pao-Chun)[6]

Month.	Jan.	Feb.	March.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Temp.	5.8	6.5	8.3	10.5	12.5	13.7	14.1	13 8	13.3	11.4	9.7	10.6
Precip. mm.	673	1,562	2,485	2,634	5,494	7,293	7,948	8,373	4,423	1,313	441	1,007
R. H. %	80	82	84	85	88	90	90	90	89	86	82	78

(1) The annual average of the temperature is 10.8 centegrade.
(2) The annual average of the precipitations is 4,344.5 mm.
(3) The annual average of relative humidity is 86%

It was very interesting to find out the fact that in regions where the Taiwan Cypress occurred in Mt. Ali having the growing temperature ranging from 5–20 degrees C., the optimum temperature is 8–14 degrees C.; and the relative humidity is of 80–90%. In temperate countries there may be such a cool habitat, but there is no such a high relative humidity, and in tropical countries there may be such a high relative humidity and cool temperature, but no such adequate maintainance of seasonal

distribution of high precipitation, such as on the High-land of East Africa and in many temperate regions you may find cool and humid climate with moderate amount of preripitation, but its winter temperature usually drops so low that *C. formosensis*, Mats. cannot withstand. So Taiwan is probably the only region of the world that possesses such a particular environment of the three conbination pertinent factors, which resulted these species of vuluable trees being endemic to Taiwan.

B. The problem of species-exterminating.

The problem and the development of the forests depends upon its natural reproduction. Under the present forest condition there is practically to find no natural repooduction occurred in the forest floors of all the matured Taiwan cypress stands and even in those of cut-over lands there is hardly to find any young seedling. Moreover from the uneven distribution of the age-classes and from the low percentage of the young stands of below 200 years of age of the existing Taiwan-cypress, one would easily detect that the tendency of the Taiwan Cypresses are exterminating now. Furthermore in September, 1949 The Ta Hsueh Shan Forestry Corporation has made a timber resource inventory and in page 21 of that inventory report stated that among the total conferous timber volume content, those trees with a D. B. H. of above 85 cm. occupy 50%; and those above 70 cm. occupy 60%; and those above 150 cm. occupy 10%. Thus one can radily see that most of the soniferous trees are of old-aged and with large D. B. H. ones; Saplings and pole-wood classes occupy a very small proportion and those of 30–50 cm. class are practically not found in the forests. As a matter of fact that these pole-wood class are not only found in these over-matured forests in very scarcity but also not found any stumps of such sized trees in the old cut-over lands and nor any seedling reproduction. This un-even and deficit of middle-aged classes will give you an astonishing impression that the Taiwan-Cypresses are going to be exterminating. The situation can also be proved by Mr. Paul Zehngraff's work (7) of "Forest conditions of Taiwan" in which he has made three graphical illustrations indicating the percentage of age-class distribution of Taiwan Conifers. Graph A. and B. represent the samples of Surplus and Deficit while C. is the actual conditions of Taiwan coniferous forests. A critical ecological field study on this extinguishing problem obtained as follows:

(1) The effect of light and of undergrowths:

C. formosensis is a light demanding tree, so in the forests, owing to have too dense undergrowths, there is practically not a single specimen of natural reproduetion of Taiwan-cypress ever found in the matured stands. Only scattered young seedlings are occurred along the old logging roads. One instance in a small piece of the old burn stand in Taiping Shan region scattered natural reproductions of 120 young trees of Taiwan-cypress per hectare have been discovered, but no other cutting-over-land or within any matured Taiwan cypress forest such natural regeneration has ever appeared. The discontinuous age-classes of the virgin forests, i.e. lacking of natural

regenerations in the forest stand of below 100 years of age, indicated clearly that under the present conditions the natural regeneration of Taiwan-cypress seems to be hopeless. The Taiwan Forestry Administration has once boldly ordered its Tai-ping shan Logging Station try to practice cuttings of Taiwan-cypress forests with the method of natural regeneration, but they have failed to secure any result.

(2) The reckless cuttings of the aecessible areas of Taiwan-cypress and the favorable environments encourage the development of the thrift and prolific undergrowths, which are so dense that they allow no chance to Taiwan-cypress to regenerate (see figs. 6–7).

(3) The majority of the existing natural stands of Taiwan-cypress growing only in the limited suitable areas is now over-matured and the trees have lost their seed-bearing abilities.

(4) The country of Taiwan is too rugged and suitable areas that possess the combination of the three pertinent factors, the growth area of the Taiwan-cypress is extremely limited. These pertinent habitats occupy about 7.5% of the coniferous land about 50,000 hectars and these mountainous regions are too cloudy and foggy and as a consequence in many places there is not light enough for seed-germination and for young seedlings to develop within the dense forests. (see figs. no. 6 & 7)

From the above stated conditions one would easily see that the light require-ment for seed-germination and the development of young seedlings of Taiwan-cypress is probably is chief factor controlling the natural regeneration; the favorable environmental condition encouraging the fast development of thrift undergrowths; the limiting area of the country having the combination of pertinent factors of growth of Taiwan-cypresses; and the reckless cutting of only accessible areas or the mismanagement of these forests by neglecting the disposal of undergrowths before cutting, leaving too high percentage of over-matured stands having no more seed-bearing abilities, have brought about these Taiwan-cypresses to be exterminating.

C. The problem of silviculture and forest management.

(1) The present forest conditions of these Taiwan-cypresses.

The area of the optimum growth of the Taiwan-cypress is limited only of the regions where are these pertinent combination factors stated above available, so the areas is limited only to the mountains of 1,500–2,200 m. elevation above the sea level. The total area of such optimum habitat, according to the estimation of the aerial survey of J. C. R. E.'s report (1), is not more than 50,000 hectares in the whole island of Taiwan. Within these areas the standing timber volume content has been estinated to be 34,000,000 cub. M. and 95% of that are of over-matured trees. On the average each hectare contains of 40 trees and each tree has an average timber volume content of 17 cub. M.

The estimated pereentage of age-classes of the Taiwan conifers.

Age class years	Hardwood %	Mixed Hardwood and conifers %	Conifers %	Total percentage
100–above	0	5.0	70	7.5
80–100	0	15	10	2.5
60–80	0	0	0	1.5
40–60	10	20	0	14.0
20–40	20	30	10	20.0
Below 20	70	30	10	54.5
Total	100	100	100	100.0

From the above table one can see that over 70% of the Taiwan coniferons forests, in fact most of the matured coniferous forests are Taiwan-cypresses, are above 100 years of age and from 100–years below the percentage is becoming lower and lower. This phenomenon indicates that the natural regeneration of Taiwan-cypress becomes poorer and poorer until the age-class of 40–years below, then the rate of percentage is becoming greater and greater until the age-class of 20–year, and below that it reached the maximum of 54.5%, which was due to the fact that artificial reforestation with conifers, especially *Cryptomeria japonica* D. Don and *Cunninghamia lanceolata*, Hook. have been extensively planted in Taiwan during the recent 50 years. This also indicates that the nature of regeneration of Taiwan-cypresses is declining year after year and a possible extinction of these species will come in the future, if the artificial reforestation and proper management to these Taiwan-cypress forests are not duely maintained.

(2) The annual growth and annual drain of the Taiwan cypress.

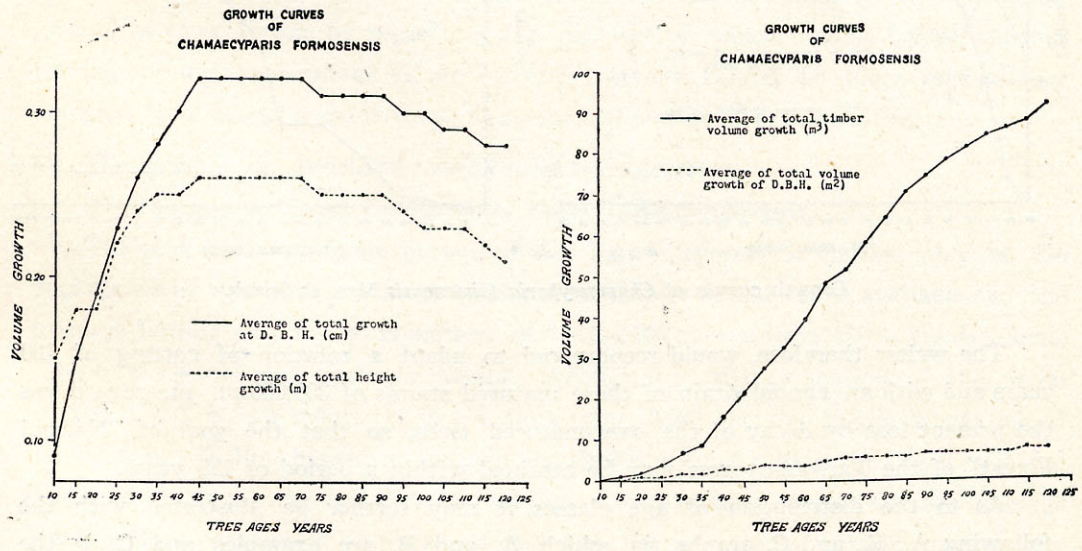
Out of the total standing timber volume content of Taiwan coniferous forests of about 34,000,000 cu. M. Taiwan-cypress occupies 95% or 32,300,000 cu. M. Among which 70% are trees of above 100 years of age. In fact most of them are 3–5 hundreds of years of age and overmatured. The annual growth of the conifers in Taiwan is 1.3% per 1,000 cu. M. of standing timbers. Thus the total annual growth is about 330,000 cu. M. and the total loss of decay due to trees over-matured being estimated is about 400,000 cu. m. In view of the heavy losses in these stands a more rapid liquidation of a cutting period of 40 years was suggested by the Forest Division of J. C. R. R. (2) by saying that "from the view point of salvage provided, of course, that reforestation activities could be correspondingly increased and that sufficient young timbers of suitable size would be available to sustain continuous logging operations—". The most dangerous point is that the rate of artificial reforestation cannot closely follow up the annual amount of area of liquidation and the 40 years period of cutting cannot match with the neccessary length of rotation adequately used for that species of trees, as the slow growing habit of the Taiwan-cypresses

cannot reach the merchantable size below 120 years. This can also be proved by the growth rate of the Taiwan-cypresses indicated by the stem analysis record-table made in Ta Hsueh Shan at an elevation of 2,000–2,300 m. above the sea level and their economic age curves made therefore as in the following.

Table of Stem analysis of *Chamaecyparis formosensis* Matsum.

Tree ages / Growth rate	10	15	20	25	30	35	40	45	50	55	60	65
Ave. of total growth at D. B. H. (cm.)	0.09	0.15	0.19	0.23	0.26	0.28	0.30	0.32	0.32	0.32	0.32	0.32
Ave. of total vol. growth of D.B.H. (m^2)	0	0	1	1	2	2	3	3	4	4	4	5
Ave. of total height growth (m.)	0.15	0.18	0.18	0.22	0.24	0.25	0.25	0.26	0.26	0.26	0.26	0.26
Ave. of total vol. growth (m^3) timber	0	1	2	4	7	9	16	22	28	33	40	49

Tree ages / Growth rate	70	75	80	85	90	95	100	105	110	115	120
Ave. of total growth at D. B. H. (cm.)	0.32	0.31	0.31	0.31	0.31	0.30	0.30	0.29	0.29	0.28	0.28
Ave. of total vol. growth of D.B.H. (m^2)	0	6	6	6	7	7	7	7	7	8	8
Ave. of total height growth (m.)	0.26	0.25	0.25	0.25	0.25	0.24	0.23	0.23	0.23	0.22	0.21
Ave. of total vol. growth (m^3) timber	52	59	65	71	75	79	82	85	87	89	93

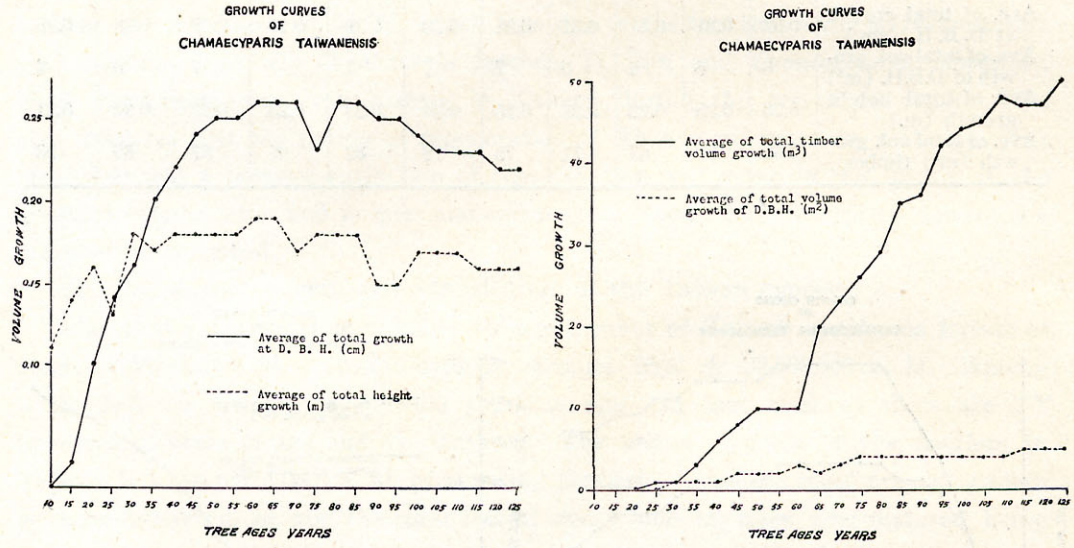


Growth curves of *Chamaecyparis formosensis* Matsum

Tables of stem analysis of *Chamaecyparis taiwanensis* Mas. et Suzuk.

Tree ages / Growth rate	10	15	20	25	30	35	40	45	50	55	60	65
Ave. of total growth at D. B. H. (cm.)	0	0.04	0.10	0.14	0.16	0.20	0.22	0.24	0.25	0.25	0.26	0.26
Ave. of total vol. growth of D.B.H. (m^2)	0	0	0	0	1	1	1	2	2	2	3	2
Ave. of total height growth (m.)	0.11	0.14	0.16	0.13	0.18	0.17	0.18	0.18	0.18	0.18	0.19	0.19
Ave. of total timber vol. growth (m^3)	0	0	0	1	1	3	6	8	10	10	10	20

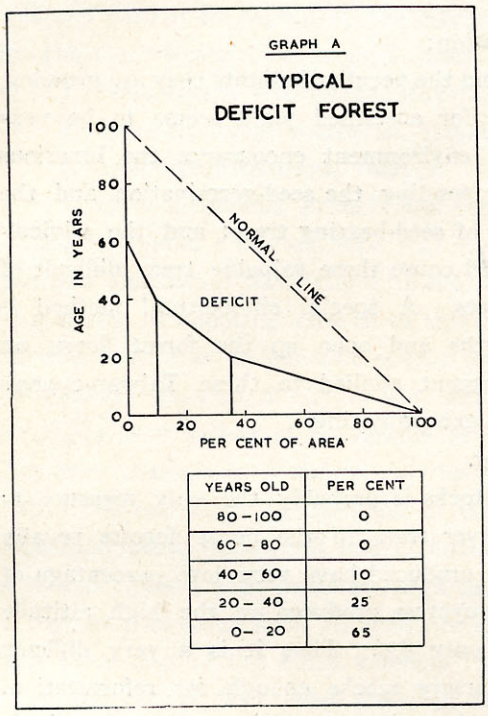
Tree ages / Growth rate	70	75	80	85	90	95	100	105	110	115	120	125
Ave. of total growth at D. B. H. (cm.)	0.26	0.23	0.26	0.26	0.25	0.25	0.24	0.23	0.23	0.23	0.22	0.22
Ave. of total vol. growth of D.B.H. (m^2)	3	4	4	4	4	4	4	4	4	5	5	5
Ave. of total height growth (m.)	0.17	0.18	0.18	0.18	0.15	0.15	0.17	0.17	0.17	0.16	0.16	0.16
Ave. of total timber vol. growth (m^3)	23	26	29	35	36	42	44	45	48	47	47	50



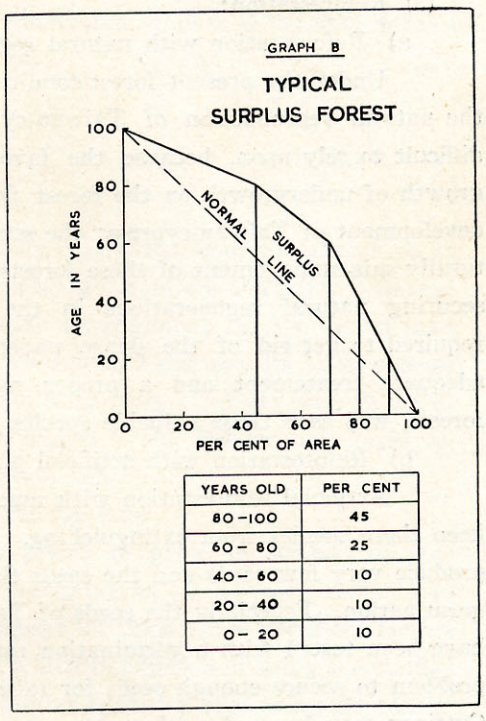
Growth curves of *Chamaecyparia taiwanensis* Mas. et Suzuk.

The writer therefore, would recommend to adapt a rotation of cutting of 120 years and with an annual drain of these matured stands of 300,000 cu. m. regard-less the present lose by decay of the over-matured trees, so that the goal of "Normal Forest" of the Taiwan-cypress may be attained within a period of 120 years.

As to the distribution of age classes it may further be illustrated with the following A., B., and C. graphs, in which A. and B. are examples and C. is the acutual condition of the Taiwan-cypresses.

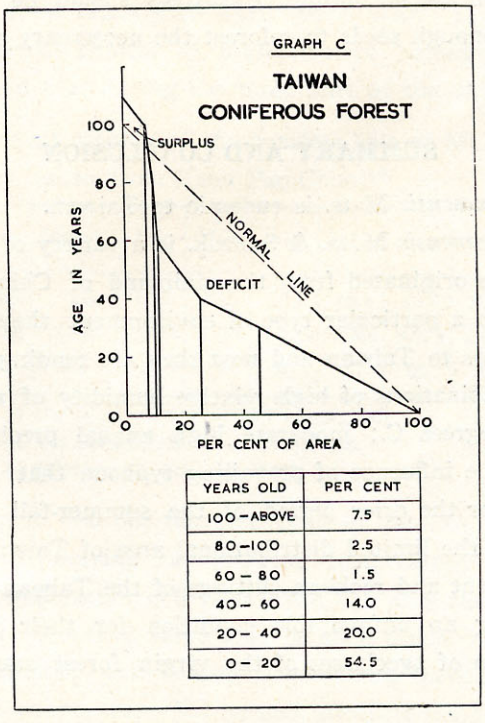


YEARS OLD	PER CENT
80–100	0
60 – 80	0
40 – 60	10
20 – 40	25
0 – 20	65



YEARS OLD	PER CENT
80–100	45
60 – 80	25
40 – 60	10
20 – 40	10
0 – 20	10

Graph A. & B.
Illustrations of Surplus & Deficit.



YEARS OLD	PER CENT
100–ABOVE	7.5
80–100	2.5
60 – 80	1.5
40 – 60	14.0
20 – 40	20.0
0 – 20	54.5

Graph C.
The actual conditions of Taiwan forests

(3) Reforestation:

a) Reforestation with natural regeneration:

Under the present forest conditions and the peculiar habitats they are growing, the natural reproduction of Taiwan-cypress for sustained yiald seems to be very difficult to rely upon, because the favorable environment encourages the luxurious growth of undergrowth on the forest floor impending the seed-germination and the development of Taiwan-cypress; the scarcity of seed-bearing trees; and the silviculturally mis-management of these forests would cause these valuable trees difficult of securing natural regenerations in the forests. A special silvicultural method is required to get rid of the dense undergrowths and open up the forest floors, an adequate treatement and a proper management applied to these Taiwan-cypress forests, will save these valuable species from exterminating.

b) Reforestation with artificial planting.

Artificial reforestation with nursery stocks is probably the only measure to keep these species from extinguishing. However trees in the dense forests usually produce very few seeds and the seeds though produced have very low percentage of germination. Especially the seeds of Taiwan-cypress produced on the high altitude have been tested with a germination rate of only 8%. Thus it is a very difficult problem to secure enough seeds for raising nursery stocks enough for reforestation. Cuttings may be used, with treatment of I. A. A. auxine, for reforestation, but it is still too slow to get enough cuttings for large scale reforestation needs, Before the practice of reforestation special mother seed-trees should be selected and specially nursed for producing enough seeds to reforest the neceeseary amount of forest areas every year.

SUMMARY AND CONCLUSION

1. *Chamaecyparis formosensis* Mats. is endemic to Taiwan.
2. *Chamaecyparis taiwanensis* Masa. & Sunzuk. is a variety of *C. obtusa* S. & Z.
3. Both of them were originated from the mainland of China and due to a long adapting growth in a particular type of environment they have been developed into endemic species to Taiwan and now they are tending to be extinguishing.
4. The pertinent combinations of high relative humidity of above 80%; cool temperature of 5–20 degrees C.; moderate high annual precipitation of about 4,000. mm.; and under the influence of prevailing typhoon that brings rainfalls maintaining moisture for the drier period of the summer-fall seasons, are the chief factors controlling the limited distributional area of Taiwan-cypresses.
5. The mis-management and reckless cuttings of the Taiwan-cypress only in accessible ares resulting an unfavorable condition for their regeneration and the un-even distribution of ageclasses of the virgin forest stands cause their being extinguishing.

6. Under the present forest conditions natural reforestation method seems to be very difficult to secure perpetual regeneration of these species on these limited habitat-areas.
7. Artificial reforestation is the measure for keeping these species from extinction.
8. Before practicing the artificial reforestation mother seed-trees must be selected and specialllly nursed for producing proper amount of seeds for reforestation needs.
9. The over-matured stands of Taiwan-cypress are recommended to be cut off in a period of 120 years instead of 40, so that the growth and drain of the Taiwan-cypress will be balanced and matched up with the 120 year rotation suggested by the writer in order to reach the goal of a "Normal Forest".

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Fig. No. 1. Chamaecyparis formosensis Mast. The largest living tree of Taiwan, Ht. 53 m. B. H. C. 34 m. (in ciroum) Estimated age about 3,000 years.

Fig. No. 2. Chamaecyparis formosensis Mast. Natural pure stand. Ma An Shan, 2,200 m. above sea level.

Fig. No. 3. Red- and Yellow-Taiwan cypress and Hemlock, forming mixed stand Near Hsio-Hsuh-Shan Elevation 2,200 m.

Fig. No. 4. Yellow Taiwan Cypress planted below its lower distributional limit forming a forked and bushy stems. At Chu-Shan, Elev. 1'300 m.

Fig. No. 5. Yellow Taiwan Cypress, Natural growth in forked stems, in place near its lower limit of natural distribution, elev. 1,700 m.

Fig. No. 6. Prolific development of undergrowth of Indocalamus niitakayamensi in cut-over land of Taiwan cypress, Ta Hsueh Shan, elev. 2,200-2,300 m.

Fig. No. 7. Vigorous development of undergrowth impending the germination and growth of Taiwan Cypresses, Ta Hsueh Shan, elev. 2,200-2,300 m.

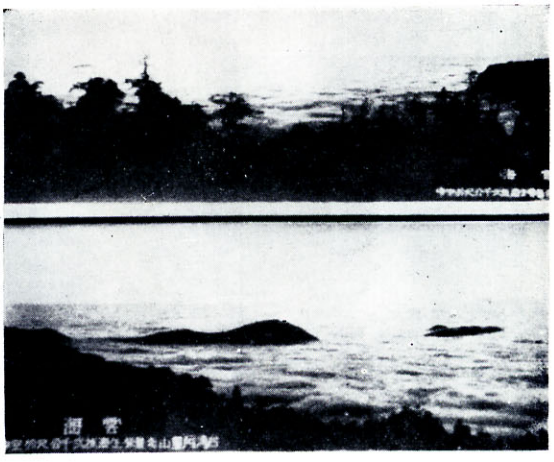

Fig. No. 8. High relative humidity and the dense clouds forming "Sea Clouds" every day. Mt. Ali, elev. 2,200-2,300 m.