Professional Articles

Some Observations on Forestry in China, 1983

by

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Abstract

Based on a one-month trip to northeast China in June of 1983 and on recent articles by returned travellers, a brief survey of afforestation, reforestation and amenity plantings is presented. The diversity of trees and of the flora in general far exceeds that of Canada and the United States, though several thousand years of use has drastically reduced the native cover. China's problems of forest reconstitution and forest management are formidable compared with those of North America. Nevertheless, the drive and determination of the people to green up the country again with trees is an inspiration to all who value forests.

Key Words: Reforestation, afforestation, amenity planting, forest geography, forest ecology, People's Republic of China, Manchuria, Jilin Province.

Résumé

A la suite d'un voyage d'un mois effectué au Nord-Est de la Chine en juin 1983 et des articles récents écrits par les visiteurs à leur retour, un bref aperçu du système de plantation des sites forestiers, non-forestiers et urbains est discuté. La diversité des essences d'arbres et de la flore en général dépasse largement celle du Canada et des États-Unis même si plusieurs milliers d'années d'utilisation ont grandement diminué la couverture végétale indigène. Les problèmes de la Chine en terme de reconstitution et d'aménagement des forêts sont impressionnants comparés à ceux des nord-américains. Néanmoins, l'énergie et la détermination de ce peuple pour reverdir leur pays par la plantation d'arbres est une source d'inspiration pour tous ceux qui estiment le milieu forestier.

In his book "Forestry in Communist China", Dennis Richardson (1966) referred to five "memorial trees" that have influenced Chinese art and literature: Chinese pine (*Pinus tabulaeformis*) for emperors, Chinese scholar tree (*Sophora japonica*) for high officials, arborvitae (*Thuja orientalis*) for princes, golden-rain tree (*Koelreuteria* spp.) for scholars, and poplar (*Populus* spp.) for commoners. Clear evidence was seen while visiting northeast China in 1983 that the common people at last are getting just recognition, for poplars have been planted everywhere, fringing roads, canals, railways, fields and villages. Even in the large cities of Changchun and Beijing the poplars (such as *Populus simonii* and *P. tomentosa*) are planted as shade trees. Of the other four memorial trees, only the regal *Pinus tabulaeformis* — semitolerant and able to survive in the shade of broadleaf trees — appears frequently on boulevards and reputedly is used in the reforestation of denuded mountains. The others are mostly confined

to parks, temple grounds and gardens, appropriate places to commemorate princes, mandarins and scholars.

A team of four from Saskatoon travelled to Changchun in Jilin province, central Manchuria, in June of 1983 to arrange an exchange of biologists and ecologists between Northeast Normal University and the University of Saskatchewan. Our mission was oriented to problems of grassland deterioration in the steppe country of the northeast and not to forestry, and therefore afforded only a few opportunities to see beyond the ubiquitous shelterbelts and amenity plantings. Nevertheless, the following observations may be of interest, for although Canada established diplomatic relations with the Peoples Republic of China in 1970, few foresters have made the trip to old Cathay. Information from several periodicals and from the writings of other recent visitors from North America is included. Forest statistics should be taken as approximations, for variability shows up in the reports of returned travellers.

Forest Geography

The land area of the People's Republic of China is slightly smaller than that of Canada but the population — in excess of

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one billion, 40 times as large as Canada's — indicates an environment much more favourable for the production of food. Seventy percent of the terrain is hilly, dissected, or mountainous, and only about 15% is arable cropland (still well beyond Canada's 4%). The good agricultural lands are mainly in eastern China, occupying broad alluvial and loessal plains that extend inland from the Pacific shore. Here a monsoon climate with sea-to-land air mass movement in the summer brings rain at the time most opportune for plant growth. Eastward flowing rivers that rise in the mountains of the north and west carry water for irrigation to the lowlands, further ensuring good crop production in most years.

From the Manchurian Plain in the northeast through the North China Plain and southward to the fertile lands surrounding the Yangtze and Pearl Rivers, the character of the vegetation changes from boreal to temperate to subtropical and tropical, similar to a transect from Quebec to Florida and on to southern Mexico. This wide range of climates plus the variety of mountainous terrain in the hinterland has encouraged great evolutionary diversity in the flora of 30 000 species. Three thousand different kinds of trees, many of them endemics, are known in China; that is, four to five times as many as occur in the entire United States and Canada. There are for example, 16 species of poplar, 19 spruces, 20 true firs, 27 pines, and 60 oaks (Hsiung 1980).

During 4000 years of civilization, man's impact on the native plant cover has been so drastic that a reconstruction of the potential vegetation is difficult. A recent map by Hou (1979) at the scale 1:4 000 000 provides the best current overview. He has recognized in eastern China, from north to south, the following six major vegetation zones:

- 1 — Cold-temperate deciduous needleleaf forest.
- 2 — Temperate mixedwoods (broadleaf deciduous & needleleaf evergreen forest).
- 3 — Temperate steppe and forest-steppe (in the rainshadow of Korean mountains).
- 4 — Temperate deciduous broadleaf forest.
- 5 — Subtropical evergreen broadleaf forest.
- 6 — Tropical seasonal rain forest.

The first four zones bear marked similarities to Canada's vegetation, although larch is far more important and spruce far less in the cool north than in our boreal forests. The following trees chiefly comprise the native forests of Heilongjiang Province in northernmost Manchuria: *Larix gmelini* (syn. *L. dahurica* and *L. kamtschatica*), plus an ecotype *L. olgensis* that grows in valley swamps, is accompanied by several birches (*Betula platyphylla*, *B. ermani*, *B. albo-sinensis*) with *Populus davidiana* (a close relative of *P. tremula*) and Scots pine, *Pinus sylvestris*. According to Dickerman *et al.* (1981), Heilongjiang is the premier forestry province, possessing one third of China's total forested area and producing about 40% of the nation's industrial timber. Harvesting here is reported to be 20% by clear felling and 80% tree-by-tree selection (Devitt in Fullerton, 1981).

Southward through the mountainous eastern part of Heilongjiang to Jilin and Liaoning Provinces, the forest character changes to temperate mixedwoods. According to Wang (1961), no less than 50 northern hardwoods are constituents of the broadleaf component: nine birch species, eight maples, five basswoods, five elms, and many others. Common examples are *Betula platyphylla*, *Acer mandshurica*, *Tilia amurensis*, *Quercus mongolica*, *Fraxinus mandshurica*, *Juglans mandshurica*, and *Ulmus pumila*. These trees intermixed with some pine grade at lower elevations and westward into a savanna or forest-steppe, while merging with pure stands of needleleaf evergreens on podzolic soils at higher elevations and eastward, especially toward the Korean border. Fir and

spruce behave as in western Canada, the latter (*Picea obovata* and *P. jezoensis*) more prominent on cooler and drier sites, while the firs (chiefly *Abies nephrolepis* but with some *A. holophylla*) increase to the east where precipitation is greater. The yew (*Taxus cuspidata*) is an occasional tree here. At low altitudes, on dry slopes and rocky terrain with brown calcareous soils, oak and pine species such as *Quercus mongolica* and *Pinus koraiensis* are usual. Still farther south where summers are sometimes droughty the forest character is broadleaf deciduous, composed primarily of oaks (*Quercus liaotungensis*, *Q. dentata*, *Q. aliena*) in the province of Shandong and the province of Hebei, within which the capital city of Beijing is located.

Jilin Province in Central Manchuria

We travelled briefly in central Manchuria, traversing forest and grassland both east and west of Changchun at the edge of the forest-steppe. Eastward on the hilly steep terrain around Jilin City and the great Songari River reservoir, extensive stands of maple-basswood-ash characterize an environment similar to the southeastern townships of Quebec. An unusual local harvest near Jilin City is dead leaves of the oak, *Quercus mongolica*, gathered from the ground in the fall and stored as winter provender for the famous spotted deer whose thinly sliced antlers are reputed to work medicinal wonders. Ginseng root is another forest product from the same area, and its potent restorative virtues are also legendary. In the predominantly agricultural landscape we saw only occasional plantations of conifers: *Larix olgensis* and *Pinus sylvestris* var. *mongolica*.

At the Academy of Forestry in Beijing, Professor Wu Chun Lung, an alumnus of Yale and Duke Universities (1945-1950) commented on some of the forestry problems in northeastern China. All wood is in demand for fuel, he said, and the basswood and ash are used for plywood and for furniture. Nevertheless, softwoods are valued more than hardwoods, so clearcut areas are being replanted mostly with pine and larch. In the face of competition from resprouting broadleaf trees and bushes, the regeneration of native pine, spruce and fir is difficult. Birch and poplar often takes over logged areas. *Pinus koraiensis*, a five-needle pine resembling *P. strobus*, is a favoured species but it does not readily reproduce itself. Factors contributing to regeneration failure, in addition to competition, are very cold winters followed by drought in the windy spring. Nevertheless, successful reforestation projects utilizing the Korean pine are underway in the mountainous parts of Heilongjiang, Jilin and Liaoning provinces. As with our white pine, *P. koraiensis* is attacked by the rust *Cronartium* whose alternate host, however, is the herbaceous lousewort (*Pedicularis*) rather than shrubby currants (*Ribes*).

Westward from Changchun, toward Inner Mongolia, the climate is drier and the prevalent vegetation on plains and lowlands is grassland (steppe). Loess uplands that are too sandy or hilly to cultivate are used as rangeland; they still carry a native savanna of Siberian elm or white elm (*Ulmus pumila*) and large-seeded elm (*U. macrocarpa*). In contrast to its healthy state in western Canada where it does well as a small tree and in hedge rows, the Siberian elm suffers from insect defoliators on this part of its home ground. As is usual, therefore, the poplars (especially *Populus pseudosimonii*) have been selected to shelter croplands against the severe winds of March and April. The widely planted "Canada poplar" (*P. canadensis* = *P. euramericana*) — a fast-growing hybrid of the North American cottonwood (*P. deltoides*) and European black poplar (*P. nigra*) — has proved susceptible to wood-boring insects, as well as to rust and a leaf spot (Wortman, 1975), and so it is no longer favoured.

Table 1. Comparative Forest Data (approximate): China and Canada.

	China*	Canada**
Area	9 600 000 km ² ***	9 900 000 km ²
Population	1 billion plus	25 million
Forested area (current)	1 200 000 km ² (13%)	total 4 400 000 km ² (44%) productive 2 200 000 km ²
Potential forest area (F.A.)	2 880 000 km ² (30%)	
Current per capita F.A.	0.13 ha	9 ha
Standing timber volume (T.V.)	9 500 000 000 m ³	total 23 000 000 000 m ³ prod. 19 500 000 000 m ³ 780 m ³ (on productive F.A.) 250 000 000 m ³ 1.1 m ³ ha ⁻¹ yr ⁻¹ 152 000 000 m ³ (av. '76-'80)
Current per capita T.V.	9.5 m ³	
Yearly increment	250 000 000 m ³	
Increment per unit area	2 m ³ ha ⁻¹ yr ⁻¹	
Annual harvest (A.H.)	250 000 000 m ³	
Percent A.H. as industrial wood	20	90
Yearly loss to fire, insects & disease	?	90 000 000 m ³
Currently replanted yearly	3 000 000 ha	400 000 ha
Replanted or treated since 1949	30 000 000 ha	?
Backlog of forest land needing treatment	168 000 000 ha	30 000 000 ha
Reforestation goals	3 500 000 ha yr ⁻¹ for next 20 years	650 000 ha yr ⁻¹
Number of tree species	3000, many endemic	140 (31 conifers)
Nature reserves	57, in area	28 National Parks & 1700 Provincial = 25 000 000 ha
Forestry colleges	1 620 000 ha 11	6

*Sources are the referenced papers of this article.

**Source the Canadian Forestry Service, Ottawa.

*** 1 km² = 100 ha.

Forestry in China and in Canada Compared

China today has a standing timber inventory of about 9.5 billion cubic metres, a little less than one half that estimated for Canada's productive forestlands. The yearly increment in the two countries is nearly the same: approximately 250 million cubic metres. Where Canada harvests 60% of its increment, China takes close to 100% even though much of it is accumulating in young stands. At the moment, the fuelwood harvest is almost double that of industrial wood, but plans are to reduce the dependency on wood fuel and to dedicate 80% of future harvests to commercial timber. Comparisons between the forestry situations in China and Canada are presented in Table 1, with data drawn from the referenced papers.

According to official estimates, 30% of China's land area ought to be maintained in forests (Anon. 1982), but widespread deforestation in this turbulent century has drastically reduced tree cover. The anarchy of civil war when Chiang Kaishek attempted to annihilate the communists in the late 1920s and early 1930s, coupled with the full-scale Japanese invasion in the latter years, resulted in uncontrolled felling that at the time of liberation in 1949 had reduced forest cover to around 8% (some estimate 5%). Increased food production was the primary concern until the late 50s, leading to widespread deforestation as the agricultural area was expanded. The "Great Leap Forward" program after 1958, initiated with the second five-year plan, sought to reverse the trend but again an emphasis on self-sufficiency by districts encouraged agricultural encroachment on forest land at the same time that much wood was harvested to smelt iron in backyard foundries.

The Cultural Revolution from 1966-76 marked another period of unplanned felling, as well as an interruption in the education of professional foresters (Ching and Ching 1973; Ehrenreich 1980). Pressures on the forest land still continue (Smil 1982) particularly for fuelwood in a country where about 80% of the population lives in a rural setting and relies on burning stalks, straw and wood at a rate of approximately 500 million tonnes a year (Qu and Li 1981). Nevertheless, a recent emphasis on reforestation is believed to have restored cover to nearly 13% of the area, currently giving China 0.13 ha of forest per capita compared with Canada's 9 ha per capita. A

goal of 20% of the country reforested by the end of the century is frequently mentioned.

The scarcity of wood shows up in various ways. Utility poles and railway sleepers are made of concrete. Brick is the chief building material in cities; mud and straw in the rural areas. In some plantations the forest floor is swept clean of twigs and duff, undoubtedly scavenged for fuel.

Shelterbelts and Afforestation

Protection forests are extremely important in a country whose climate is notorious for episodes of damage to the erodible soils by wind and water. The arid lands of Inner Mongolia and the northwest are particularly at risk due to overgrazing. In the entire country, 127 million ha have been classified as desert, an area greater than that under cultivation. Spring dust storms regularly occur on the North China Plain as dry winds from the interior blow oceanward. The loess plateau of the north, a depositional feature 631 000 km² in area, was built up as were parts of the Manchurian Plain by dust carried on continental winds from the great interior Gobi and Taklimakan deserts. Fifty-three percent of this huge expanse of erodible soils used to be forested, but tree cover has now shrunk to about 3%. The enormous silt load of the Yellow River has been increasing, evidence of accelerated erosion at its headwaters. Based on Chinese sources, Smil (1982) paints a gloomy picture of desertification, soil erosion, rapid runoff, reduced water retention and siltation of lakes, attributing much of the damage to deforestation. Indeed, from the air between Changchun and Beijing, dry eroded stream beds resembling winding dusty trails are constantly in view leading back from agricultural areas to deforested watersheds in the hills. Signs of intense soil erosion on slopes are equally common. One ought not to forget, however, the historical antecedents of current problems, nor the major accomplishments of the Chinese people in recent times (Southwick 1983).

Tree planting to counteract desertification is a going concern in China. Over the last 30 years or so, 30 million ha have been forested (Hsiung and Johnson 1981), showing what a dedicated people can do without machine help. The yearly average of 3 billion trees planted is about twice the planting rate in the USA (Duncan and Krugman 1981). Planted wind-

breaks account for some 6% of the area recently forested according to Dickerman *et al.* (1981).

Ever since the 1949 liberation, China's leaders have stressed the importance of forestry. "Cover the hills of the motherland with trees", said Mao. Slogans such as "Three Deep" (deep site preparation, deep planting, deep cultivation) and "Five Timely" (timely planting, weeding, insect control, thinning, and cultivation) have raised awareness and taught basic forestry skills to vast numbers of people (Reidel 1981). Throughout the country afforestation committees have been organized at the provincial level, and in agricultural areas "Four Sides" planting — on waterside, hillside, roadside and homestead — is advocated. Everyone older than 11 years is supposed to plant and tend at least five trees annually (Anon. 1982). In the spring of 1982, 70 000 young people in east Henan province (central China) planted a shelterbelt 50 m wide and 200 km long in an old channel of the Yellow River.

The most grandiose project is creation of a Green Great Wall, planned to be 1 km wide and eventually 6000 km long to shelter lands from desert winds in the north. Another sector of the Green Great Wall is appearing along the southern coast, where 3000 km of windbreak — mostly *Casuarina* trees from Australia — will protect agricultural lands from the typhoon and from drifting beach sand (Zhu 1981; Qu 1982).

Estimates are that 4 billion trees of *Populus* species have been planted along and around roads, canals, railways, utility lines, farmsteads and villages in northern China (Kellison *et al.* 1982). The shelterbelts are said to be highly beneficial to neighboring crop yields, whereas North American experience has indicated that the major benefit is protection rather than enhancement of yield (Dickerman *et al.* 1981). To an outsider's eye, the reliance in the north on a few poplar species for planting very large areas appears to be unnecessarily risky. Interplantings of slower-growing species such as ash, maple, pine and spruce, along with such shrubs as native caragana, would seem a prudent hedge against the vagaries of climatic fluctuations, diseases, and insects.

Forest Management and Reforestation

A new forest policy was promulgated in 1981 by the CPP Central Committee, designed to base forestry on sound principles of development. The important components include stabilizing rights of ownership (large areas to communes, trees around living quarters to individuals), unified timber management (coordinating activities of autonomous regions, provinces and municipalities with state planning), integrated multipurpose use of timber, economic support, party and government leadership in implementing the policy, emphasis on science, technology, education, and restoration of forest zones. This latter is of course to be accomplished by greater efforts in planting and caring for trees (Fullerton 1981).

A strong start toward the goal of reforesting 70 million ha over the next 20 years was made with the establishment of 240 000 ha of forest seedling nurseries in the 18 provinces and autonomous regions in 1983. In the latter year, the planted area was 2.66 million ha. Principally planted for timber in the Manchurian provinces are *Pinus koraiensis*, *P. sylvestris* var. *mongolica*, *Larix gmelinii*, *Picea jezoensis*, and *Fraxinus mandshurica*. On the North China Plain, *Pinus tabulaeformis* is planted on dry sites, while elsewhere the broadleaf species *Populus simonii*, *Salix matsudana*, the introduced black locust (*Robinia pseudoacacia*) and eastern plane tree (*Platanus orientalis*) are favoured.

The problems in such a massive reforestation effort are predictable. The tendency, as elsewhere in the world, is to select a few hardy fast-growing species, using them on all sites and making them serve all purposes. The wealth of

potential plantation species in China could employ countless forest geneticists and ecologists to guide the selection of suitable trees for particular sites. Based on the Daily Forest in Heilongjiang province, Devitt (in Fullerton 1981) saw a need for forest site mapping, to assist matching trees to terrain. A related problem is plantation maintenance, and the fallacy of counting numbers of trees planted and calculating areas reforested without attention to survival rates. Eroded sites present special problems, particularly in mountainous terrain where soils have been washed away, and survival rates of only 25% have been mentioned². The goal for 1985 is to ensure that survival of planted seedlings is 65% (Sun 1983).

Effective methods of biological control that use parasitic wasps and microbials against insects have frequently been reported³, most recently by Wu (1981) and McFadden *et al.* (1981), the latter authors pointing out that many contemporary pest problems are related to the massive afforestation efforts of recent decades. On the other hand, Lortie (in Fullerton, 1981) expressed a more skeptical view that biological control and integrated control methods are as elusive in China as in North America.

Most important is the question whether the rural people can be convinced that the future health of the country, from building and maintaining forest cover, is worth privation today. As we know in Canada, it is difficult to convince even prosperous people to invest in the forestry future. Perhaps the Chinese people will show the world what can be done, for their ability to mobilize human power in pursuit of goals declared to be in the best interests of the "motherland" is awesome. Certainly the accomplishments of the last 30 years support optimism (Southwick 1983).

Amenity Plantings

Urban forestry is a prominent interest of the Chinese people. The capital city Beijing was shorn of trees by 1949 but today some 60 million grace its environs. Three million people took part in tree planting in and around the city in 1983 (Anon. 1983).

Common trees planted by cities and regions are listed by Wortman (1975), Kellison *et al.* (1982), and others (see first footnote). Prominent trees that we saw on Changchun streets were *Pinus tabulaeformis*, *Populus simonii*, and *Fraxinus mandshurica*. In Shanghai the eastern plane tree (*Platanus orientalis*) shaded many avenues. In Beijing were many young trees of poplars and pines, with occasional maidenhair tree (*Ginkgo biloba*) (the latter also flourishing in Tokyo).

From an evolutionary viewpoint, it is interesting that the *Ginkgo*, once a rare endemic of southern China, has proved to be tough and tolerant of the urban environment. The fossil record shows that for several hundred million years it survived while the world around it changed and its near relatives succumbed. Pre-adapted, it waited for the development (perhaps the return?) of a smoggy environment. Then, with the industrial revolution it came into its own, and where other later-evolved trees fail it flourishes disease-free and resistant to pollution in temperate cities around the world. Another of China's rare trees, the dawn redwood (*Metasequoia glyptostroboides*) has also proved adaptable to city planting. Its deciduous habit, with development of new needles each spring, may be an advantage over conifers whose persistent leaves are perforce subjected to years of industrial insults. We saw handsome groups of these trees in Beijing and in Shanghai.

²Unpublished Report of the Canadian Forestry Mission to the People's Republic of China, October, 1984. Environment Canada, Ottawa. 46 p.

³Unpublished Report on Scientific Exchange in Forestry with People's Republic of China, 1975. D.R. Macdonald and D.F. Pollard, 1976. Canadian Forestry Service, Environment Canada, Victoria, BC. 32 p.

A third amenity tree of note is *Acer negundo*, the box elder or, chauvinistically, Manitoba maple. Originally introduced from North America for shelterbelts, it thrives in northern China as indeed it does elsewhere in the world. This remarkable tree is also tolerant of tropical conditions and is said to be the only tree growing in Canada that will survive near the equator.

The botanist traveller to northeast Asia cannot fail to be impressed with the variety of plants that have evolved in environmental conditions not greatly dissimilar to those in parts of Canada. Such beauties as pink begonias in the sandhills, purple irises and lemon yellow lilies in saline meadows, suggest that our flora is relatively impoverished. As for shrubs and trees, numerous variations on the generic conifer and hardwood themes arouse curiosity concerning adaptability to North American sites. For example, China is rich in nut trees and has in the northeast a walnut tolerant to winter temperatures of -40°C ; would it prosper in Winnipeg, Saskatoon, and Edmonton? Again, pines of eye-catching beauty abound, and one imagines parks adorned with the white-bark pine that, unlike ours, lives up to its name, or boulevards embellished with the strikingly mottled red, green and grey trunks of the lacebark pine.

In Canada we have usually tried to acclimate plants at second hand, hoping to find hardy varieties in material originally collected for introduction into climates of the United States or Europe. Foresters and horticulturists would do better to mount their own expeditions, seeking new genetic material at first hand from climates similar to our own. China has long been a source of plant enrichment for the rest of the world and according to Wu (1981) there may still be undiscovered new species and even new genera back in the mountains.

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