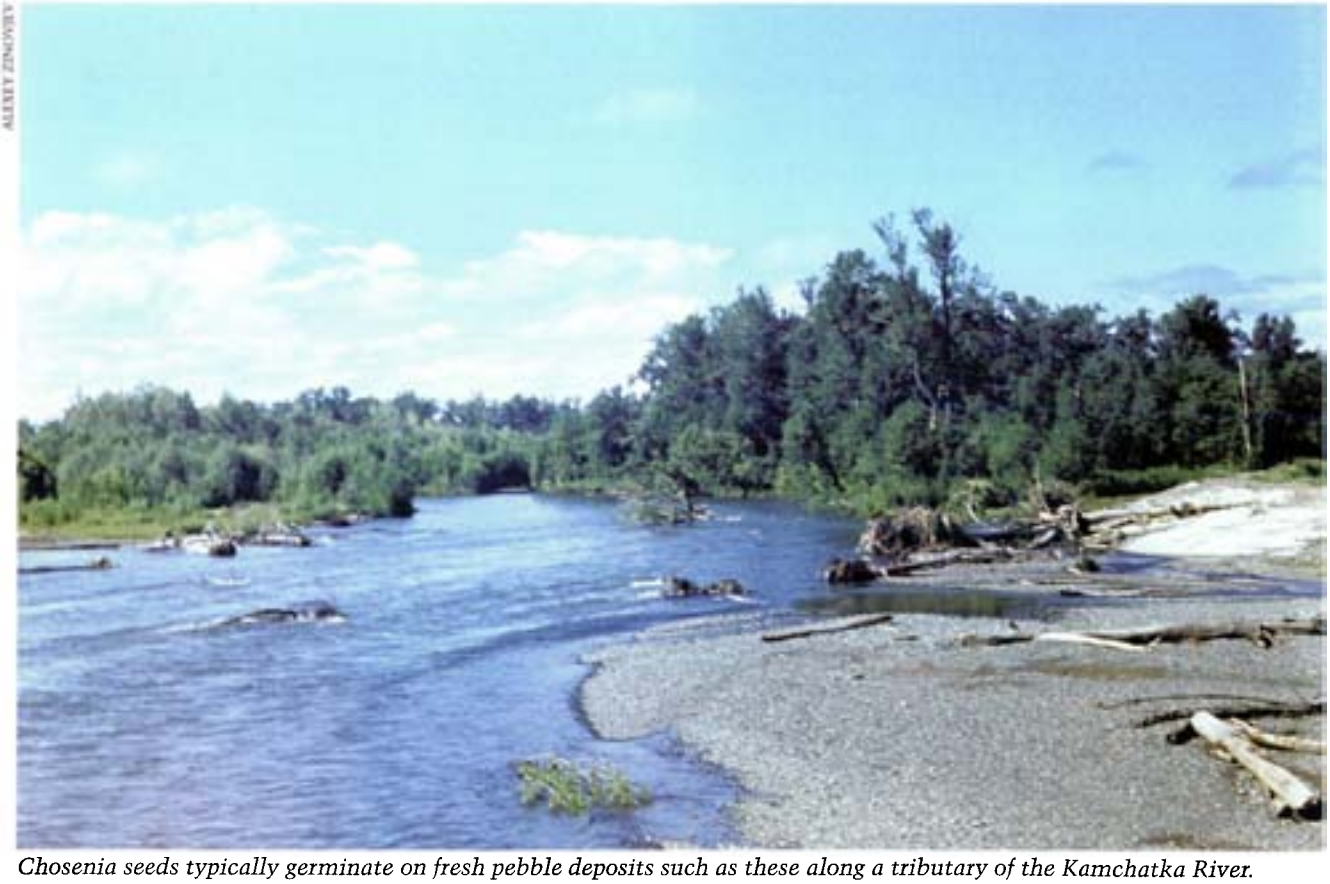
Chosenia: An Amazing Tree of Northeast Asia

Irina Kadis

Many travelers to Northeast Siberia return with fond memories of the young chosenia groves they have seen. These riverside communities harbor many showy flowering herbs that stand out brightly against the otherwise monotonous background of the Siberian taiga. Even more striking are the groves of mature chosenias with trees of a colossal size that is unusual not only for Yakutia, the coldest place on the continent of Eurasia, but even for lushly productive regions like Manchuria. The chosenia groves miraculously emerge on lifeless river pebbles in just ten to twelve years. The entire transformation from tiny seedlings to majestic 60-foot trees on fertile soil normally takes only sixty to seventy years. By then, the total organic mass of the grove may equal the amount accumulated by any other taiga forest in one hundred fifty to two hundred years.

Chosenia arbutifolia (Pall.) A. Skv., one of the fastest-growing trees of Northeast Asia, is closely related to the willows. Indeed, it has often been mistaken for a large willow even by experienced botanists. However, a close look at its catkins and flowers reveals clear differences from willows. The nectaries, or glands—structures



ALEXEY ZINOVIEV

Chosenia seeds typically germinate on fresh pebble deposits such as these along a tributary of the Kamchatka River.

that are found in any willow flower—are missing. The stamens, pistils, and bracts look different from those found in the flowers of both the willow and poplar: the male flower of chosenia has five stamens hiding under the bract, partially fused with it in the lower filaments; and the female flower has two styles, each with a two-lobed stigma. Like poplars, chosenia is wind pollinated, whereas all willows are insect pollinated. These peculiarities alone were enough for botanists to place chosenia in its own, monotypic (single-species) genus. But the list of this tree's interesting traits isn't yet exhausted. Chosenia also surprises us with a distinctive root system featuring a taproot—possessed by none of the willows—along with unique anchoring structures. And whereas the wood of willows has the so-called heterogeneous rays, chosenia's wood has the more phylogenetically advanced homogeneous rays.

A fruiting branch of chosenia.

Chosenia's leaves are also quite special. Like the xeromorphic (water-saving) leaves of the primitive Turanga poplars and willows of the section Longifoliae, they are somewhat fleshy and covered with a bluish bloom, especially on young plants. This bloom also covers the tender, young twigs, which gives chosenias their peculiar appearance. The twigs remain without bark for a few years, contributing to the tree's photosynthesis. Later, they develop brownish bark that darkens with age. The bark on the trunks of old trees exfoliates much like that of shagbark hickory *(Carya ovata)* but unlike that of any willow. (Granted, the bark of *Salix triandra* also exfoliates but in a different pattern.)

Being strictly confined to a certain type of habitat—sandy-pebbly deposits on the banks of mountain rivers—chosenia, like many other riverine plants, always finds itself in a rather uniform environment of river valleys where climatic and soil differences between zones are alleviated. Because of this confinement, chosenia has been able to claim a huge geographic area ranging from the broadleaf forests of Honshu to the harsh tundras of the Anadyr River watershed in Siberia and extending along rivers beyond the Arctic Circle, where no other tree of such magnitude can grow. This vast range—comparable to the entire area of the United States west of the Mississippi River—comprises a major part of Siberian Russia east of Lake Baikal and the Lena River, the Russian Far East, including Sakhalin Island and the Kamchatka Peninsula, northeastern China, northeastern North Korea, and Hokkaido and Honshu Islands of the Japanese archipelago.

The multipurpose tree: From sandals to telegraph poles

The peoples of Northeast Asia have long known, loved, and exploited chosenia for all kinds of industries, from sandal-, clog-, and rope-making to dwelling- and bridge-building. Chosenias have been used for making dugout boats with a displacement capacity of up to one ton; this fact alone gives a sense of the impressive dimensions these trees can attain. Among northern reindeer breeders, chosenia is particularly valued as forage. In the wintertime, the reindeer dig diligently under the snow for fallen chosenia leaves, which contain unusually high amounts of calcium and thus serve as a winter food supplement.

The geographic distribution of Chosenia arbutifolia. *Redrawn from Norin 1958, Makryi & Bardunov 1977.*

The most ambitious commercial venture in which chosenia played a role was a bold attempt in the 1860s by the Western Union Telegraph Company to build a telegraph line connecting North America with Europe via the Bering Strait and Siberia. When a competing company succeeded in dragging a telegraph cable across the Atlantic, however, Western Union gave up the entire project, and after several years of hard work the indefatigable leader of the Siberian expedition, George Kennan (a distant relative of the later diplomat and historian of the same name), had to abandon thousands of telegraph poles that had been prepared along the proposed telegraph line with great difficulty. Many of those poles were made from the trunks of chosenia, which Kennan apparently considered to be a kind of large willow or poplar. In the farthest northeast portion of his route, along the lower Anadyr River, it was probably the only suitable tree he could find. By the time the construction was canceled, this remarkable man had bravely surveyed the wildest and most remote regions of Northeast Siberia, notorious for their extremely harsh climate and only sparsely inhabited by nomadic tribes.

A new name for an old friend

Little wonder that Kennan mistook chosenias for willows. Russian settlers of the Kamchatka Peninsula, where chosenia grows abundantly, have always called the tree *vetla* (a tree willow). *Topol* (poplar), its other Russian name, is used in Northeast Siberia, whereas real poplars are called "aspens" there. The Yakuts call it *tiryakh*, which is also their name for a poplar *(Populus suaveolens)* that often grows in mixed groves with chosenia; for willows they have a different word, *talakh*. Chosenia's colloquial names also include *seiakhta* and *sikhta*, in Nanayan and Udegeyan respectively—the languages of some of the ethnic groups in the Far East. *Leomo* and *zhuantianliu* (the willow that pierces the sky) are Chinese names, and *kesho-yanagi* (the beautiful willow) and *karafuto-kuroyanagi* (Sakhalin black willow) are the names used in Japan. The confusion about this tree's identity lasted well beyond the time of the telegraph project. By the beginning of the twentieth century chosenia had been observed by many botanists. However, some mistakenly took it for a willow species familiar to them, others described it as a previously unknown willow, and no one realized that the proliferating names all referred to a single species.

The Japanese botanist Takenoshin Nakai was first to recognize chosenia's uniqueness. At the time of his first encounters with the tree, in Korea from 1911 to 1918, he too had taken it for a willow he already knew. He gradually came to the conclusion that he was dealing with something unlike all willows, and in 1920 he proudly introduced the tree to the scientific world as a new genus of the willow family (Salicaceae), *Chosenia*. The discovery of a new genus in such a well-known family produced a sensation in the field of botany. Educated Russians started to call the tree *koreyanka*, a Russian translation of the name *Chosenia*, which literally means "an inhabitant of Korea." (This name didn't take, however, and was gradually supplanted internationally by *chosenia*.) Nakai did not identify his finding with all the scientific names previously given to the tree, and it took nearly forty years to completely clear away the confusion and to choose the correct species epithet according to the rules of priority.

Chosenia begins life: The first three hurdles

Let's now take a closer look at the tiny chosenia seedlings and the intricate path they must follow to survive and develop into majestic trees. At the very beginning of its life, this remarkable plant depends completely on the water flow and sediment accumulation that occurs in

E H Wilson photographed this freestanding chosenia in Korea, August 1917. He recorded its height at fifty feet and girth of trunk at nine feet

river floodplains. The Far East is famous for its spectacular floods—severe, abrupt, and overwhelming, sometimes even catastrophic. They occur in summer rather than in spring, usually two or three times during the season. As the snow melts on the hills and mountains, it adds to the drenching rains brought by the summer monsoon, turning each river into a powerful stream that soon leaves its bed and fills the entire floodplain. Near the bottom of the riverbed the water is filled with great numbers of drifting pebbles that originate in the river's upper reaches: the noise produced as the river drags them along sometimes becomes so loud that a person talking at the streamside can't hear his own voice. Each flood forms fresh pebble deposits along the riverbanks and may cause the river to change its direction.

During late July to early August—often immediately following a summer flood—chosenia trees disseminate their abundant, minute seeds, each weighing no more than 0.25 mg and bearing a crown of white hair. The seeds cover the entire surface of the water, crowd the riverbanks, and accumulate along the water's edge. It is mostly on newly deposited pebbles that the seeds succeed in taking root. They germinate right away, and multitudes of seedlings appear on bare, moist pebbles at the very edge of the flowing water, where the most favorable conditions for germination are found. Along the banks of meandering rivers, seedlings of different generations

The exfoliating bark of an old chosenia.

sometimes appear as distinct stripes: the older the plants, the farther away from the water they are located.

The young chosenia seedling is tiny: only one centimeter tall. The root, however, extends down between the pebbles as much as three to four centimeters (just over an inch to one and one-half inch). Most of these little plants do not survive the next flood, but those that hang on for at least a month become so firmly anchored between the pebbles that you cannot pull or even dig them out without breaking the root.

During the second year, the primary shoot dies back, and another shoot, larger than the first, starts growing. By the end of the second growing season, this new shoot becomes prostrate, with just the very tip extending above the pebbles. Finally it too dies off to be replaced during the third summer by three or four virgate (long and flexible) shoots that avoid damage from severe floods by lying flat on the pebbles, giving the entire plant the look of a prostrate rosette.

A tree that provides for itself

Juvenile chosenia leaves are even more succulent than adult leaves—fleshy and juicy and covered with pruinose bloom as if they were leaves of some desert species. There is nothing strange about this resemblance, since during the periods of drought between floods the bare pebbles around the young plants may become as hot as 50 degrees C (120 degrees F).

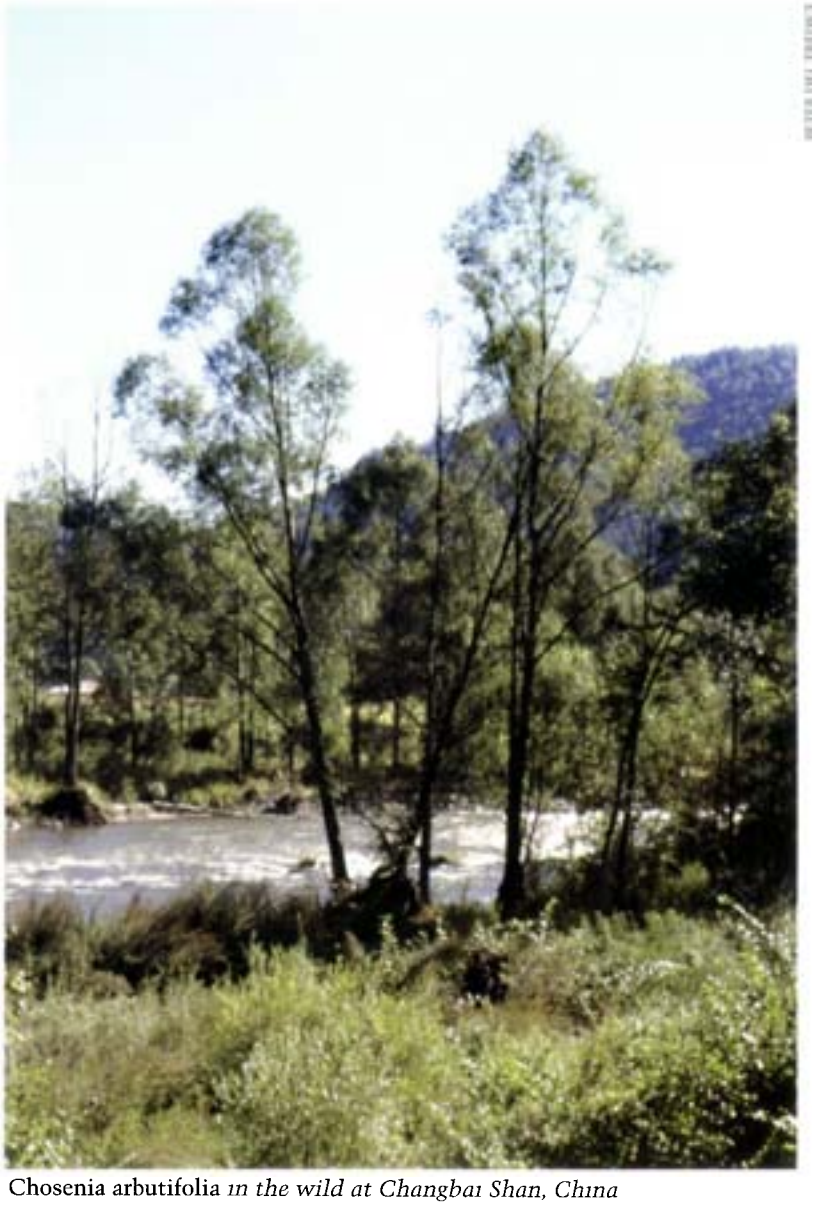
It is only during its third and fourth years that chosenia gradually abandons the prostrate habit and starts to grow as an upright shrub. By this time, the young chosenia already finds itself a few feet away from the flowing water's edge. Of course, this happens because of the river's meandering rather than any movement of the plant.

Yet another important process contributes to "moving" the young chosenia plants away from the running water. Their long, vigorous shoots, especially the lower ones, are damaged during floods and die, but they don't fall off. Instead, they form a thick, brushlike network that functions very much like whalebone, efficiently catching alluvial material and forming large sediment deposits around the tree. This nourishing soil layer may grow as much as a foot or more during a single flood. Generally speaking, the older the plant, the higher its position is and the greater its distance from the edge of the open water where it began life. If you dig into the soil in an old chosenia grove, you will find it to be layered like a cake, with each layer representing a single flood, its lower parts consisting of coarse material and the upper ones of fine particles.

A chosenia seedling growing on pebbles in the Maritime Province, Russian Far East.

The champion of the neighborhood

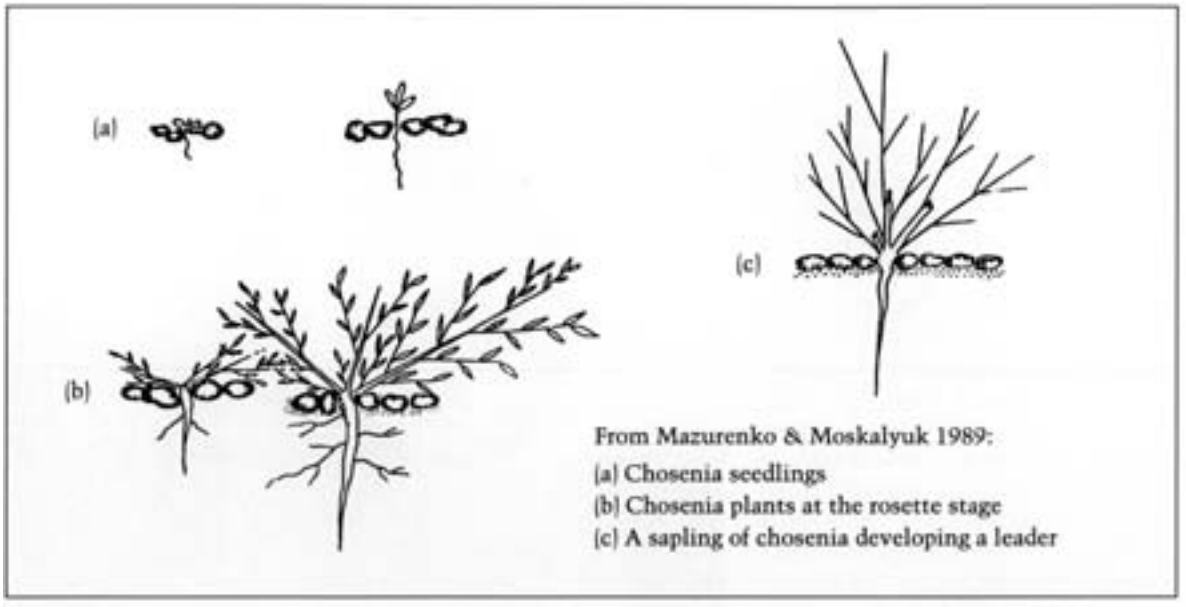
Every year the chosenia saplings lose a large share of their branches. Young branches are brittle and break off easily, which is not unusual in the Salicaceae. During the summer floods, many branches are scratched by moving pebbles, but even more of them—up to half of all the branches—do not survive the harsh winters. Anything that protrudes from the snow dies back, if it is not consumed by moose or reindeer. This huge dieback doesn't hinder the sapling's growth, however. During its early years, this amazing tree performs rather like a semishrub, producing one generation of branches after another. Every year the new growth becomes more and more vigorous, and the growth rate accelerates accordingly. By the age of five, a young chosenia may be adding up to a full meter to its height in a single season. About this time, the sapling "realizes" that it is destined to develop into a majestic tree and produces a leader with a crown of powerful virgate shoots around it, all densely covered with thin and slender pruinose leaves. At this point the plant's habit is intermediate between those of a tree and a shrub.



Chosenia arbutifolia *in the wild at Changbai Shan, China*

A few years later, when the crowns of the young chosenias merge, the trees start to thin out and develop into a grove typically consisting of some thirty to one hundred trees. The grove still endures floods, but since the trees are now farther from the river, the water flows much more slowly and deposits fine particles rather than heavy pebbles. By the age of eight to ten, trees normally reach 7 to 8 meters (22 to 26 feet) in height, their stems 10 to 15 centimeters (4 to 6 inches) in diameter. The leader starts to dominate; the only trace remaining of virgate branches is the dense brush at the bottoms of the stems. These remnants continue to serve as alluvium traps during floods.

A grove of young chosenias with its open canopy and fertile alluvial soil produces a showy plant community that is brightened by abundant grasses, flowering legumes, and other herbs—plants not specific to chosenia groves but also occurring in willow, poplar, and other riverine woods. Some of them have a much wider distribution than chosenia and can be found even outside the river valleys. In northern Yakutia, for



From Mazurenko & Moskalyuk 1989:
(a) Chosenia seedlings
(b) Chosenia plants at the rosette stage
(c) A sapling of chosenia developing a leader

example, the legumes found in chosenia groves (species of *Astragalus, Oxytropis,* and *Hedysarum*) are also widely distributed in sparse larch forests and mountain tundras.

Chosenia's period of intensive growth lasts until the trees are about thirty years old. By then most attain heights of 25 to 30 meters (80 to 100 feet) and trunk diameters of almost half a meter. Records exist of chosenias as tall as 40 meters (130 feet) and as thick as 1.5 meter (5 feet). The root system of an adult tree consists of a central taproot that extends as far as 3 meters to reach the underground water table; its entire surface bears scars left by moving pebbles. Many thread-like roots grow downward from all sides of this "carrot." In addition, at a depth of 30 to 40 centimeters (12 to 16 inches), the taproots of adult trees develop three to five horizontal appendages, each shaped like and serving as an anchor. This system stabilizes the tree in its very unstable environment: adult chosenias remain standing even in strong winds and through the majority of severe floods.

The lower branches of a young adult tree reach upward at a 60- to 70-degree angle, whereas the upper branches are more nearly vertical. This branch arrangement, typical for a tree growing in open space, makes the shape of the crown pyramidal. When the trees grow in dense groups, their crowns are umbrella-shaped. During the winter the trees drop the tender top portions of their branches. This enables them to conserve water during extreme Siberian winters. The deadwood brush at the lower trunks persists for a long time, but as the trees "move" farther away from the riverbed to the center of the floodplain, it gradually loses its importance; by then the trees are situated as high as 1.5 meters above the water level and are flooded only once or twice a year. It is dark and damp underneath the canopy of a mature chosenia grove. Only shade-loving grasses and herbs survive here.

The majestic trees are not long-lived: they start to decline at the age of seventy to eighty. First the top dies back. Then pieces of the trunk start to break off, beginning at the top and working down. Ugly outgrowths caused by bacterial attacks replace the brush at the bottom of the trunk. On average, if a thirty-year-old grove contains some 30 to 50 trees, then by the age of one hundred there normally remain only three to five venerable patriarchs that stand as far as 150 to 200 meters away from the river and almost never experience floods. Poplar and larch trees tend to take over and succeed the chosenia groves.

Cultivated chosenia: A very different story

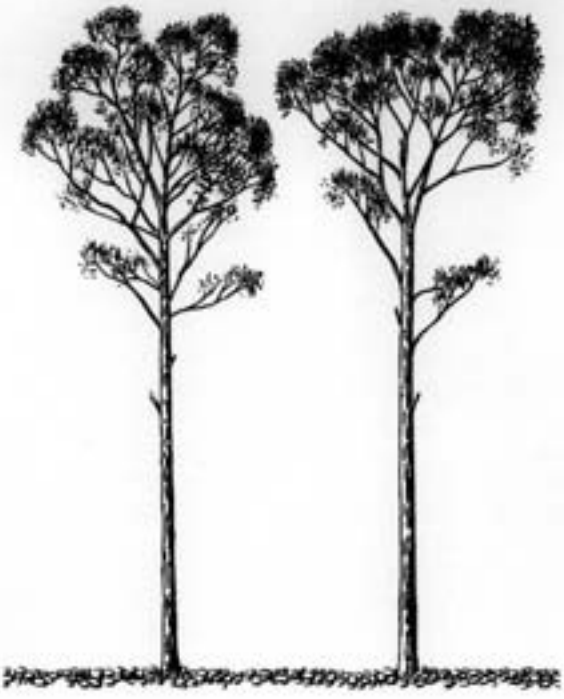
Chosenia's life cycle in nature suggests that it belongs to a certain type of plant called *explerents, R-strategists,* or *opportunists* in accordance with

(b)

(a)

From Kolesnikov 1937:

(a) A young chosenia tree
(b) The adult habit of a solitary-growing chosenia
(c) The adult habit of chosenias growing in a grove
(d) An aged chosenia in decline



(c)

(d)

A chosenia beginning to decline, Changbai Shan, China.

their biological strategy. Opportunists yield favorable places to other, more competitive species and thus avoid competition. Ruderal weeds as well as species of the early successional stages belong to this group. However, avoiding competition requires a trade-off: opportunists must face rather difficult growing conditions, unsuitable for the majority of species. In order to survive on the bare pebbles, chosenia has developed its peculiar traits: a root system that features a strong taproot along with anchoring structures; a prostrate habit at a tender age followed by semishrub-like behavior for a few years; succulent, water-saving foliage; the ability to collect and preserve nutritious material for itself by means of a brushlike network of dead and broken lower branches.

Yet another distinctive character of the chosenia is its plasticity—its ability to suppress many of these adaptations when they are not needed. To grow a chosenia you needn't provide bare pebbles, Siberian winter temperatures, or harsh floods. With adequate moisture, light, and good drainage, it will do well in an average garden. When it is not forced to meet the challenges of life in the wild, it demonstrates its unique abilities in a very subtle manner. In cultivation it starts life as a "normal" tree seedling: though the seedlings easily become distorted, they never develop a truly prostrate habit and tend to produce a few weak roots rather than one taproot. Their juvenile leaves don't look much different from the leaves of adult trees. The young tree does retain a tendency to cast off branches even in cultivation, with new generations of more and more vigorous branches being produced yearly. However, this tendency never reaches the point where the plant acts like a semishrub. It usually develops a leader and starts to grow into a tree earlier in cultivation than in the wild. Indeed, the most challenging part of growing a chosenia in the garden is the propagation itself. Unlike most willows, chosenias are difficult to grow from cuttings, and because the seeds lose viability very quickly, there is little hope for successful propagation when the seed source is remote.

Sources

Little is known about this interesting plant in the West since most publications about chosenia are in Russian, Chinese, Japanese, and Korean. This narrative is based on the Russian literature and incorporates data on chosenia published in a few articles written over a period of more than half a century.

The earliest of the articles was written in 1937 by Boris P. Kolesnikov, then a PhD student who was to become a prominent botanist and a famous researcher in the forests of the Far East. Only during his later years did he leave the Far East for the Urals, where he developed the Forest Science Laboratory at the Institute of Biology in Sverdlovsk (Ekaterinburg). Kolesnikov represented Russian forest science at many international forums.

Vera A. Sheludyakova, who wrote about chosenia growing in Yakutia as early as the time of World War II, founded the main herbarium depository in the Republic of Yakutia, for which she collected thousands of specimens during her daring field trips across the territory of this wild, remote region.

Alexey K. Skvortsov, whose eighty-fifth birthday was celebrated in February 2005, is a world-class specialist on the amentiferous plants (i.e., plants that produce catkins) and is also renowned for his floristic studies. It was Skvortsov who found the correct species epithet for chosenia in 1957. Skvortsov has worked for many years at the Main Botanic Garden in Moscow.

Boris N. Norin (1924–2001) is another prominent Russian botanist. He is credited with original approaches to the study of the vegetation structure in the tundra and forest belt. Boris Nikolayevich worked at the Botanical Institute of the Russian Academy of Sciences in St. Petersburg.

A few articles produced by the younger generation of investigators have played an important role in the contemporary understanding of the species' biology, life cycle, phytosociology, and distribution details. The majority of articles were published in *Botanicheskiy zhurnal*, the chief organ for botanical science in Russia.

I gratefully acknowledge the article by M. T. Mazurenko and T. A. Moskalyuk (1992) that has largely made the spine of this story. Maya T. Mazurenko (born 1935), PhD in biology, works at Tver University. Tatyana A. Moskalyuk (born 1947), PhD, works at the Montane Forest Station of the Far East Branch, Russian Academy of Sciences.

Citations

Golysheva, M. D. 1973. [On the structure and formation of the leaf in *Chosenia arbutifolia* (Pall.) A. Skvorts]. *Bot. zhurn* 58(12): 1764–1774.

Kennan, G. 1910. *Tent life in Siberia. A new account of an old undertaking. Adventures among the Koraks and other tribes in Kamchatka and northern Asia* Gutenberg eBook Project. Release date: 12 May 2004.

Kolesnikov, B. P. 1937. [Chosenia and its communities in the Far East]. *USSR Acad. Sci Far East Branch Proc.*, ser. bot. 2: 704–800.

Makryi, T. V., and L. V. Bardunov. 1977. [A discovery of *Chosenia arbutifolia* (Pall.) A. Skv. (Salicaceae) west of the Baikalsky Mountain Range (Cis-Baikal Region)]. *Bot. zhurn* 62(11) 1669–1671.

Mazurenko, M. T., and T. A. Moskalyuk. 1989. Ontogeny of *Chosenia arbutifolia* (Salicaceae) in the Magadan Region. *Bot. zhurn.* 74(5): 601–613

Moskalyuk, T. A., and M. T. Mazurenko. 1992. [An amazing northerner—chosenia]. *Priroda* 12: 52–59

Norin, B. N. 1958. [Some characters of chosenia communities (*Chosenia macrolepis* Ass.) at the extreme northwest of their area]. *Bot. zhurn.* 43(6): 847–850.

Sheludyakova, V. A. 1943. [Chosenia in the Republic of Yakutia]. *Bot zhurn.* 28(1): 30–33.

Skvortsov, A. K. 1957. *Commentationes de morphologia et systematica salicarum.* IV. [On the correct species epithet for *Chosenia*]. *Bot. materialy Gerbariya Bot in-ta AN SSSR* 18: 42–47.

Trofimov, T. T. 1964. [Some interesting Far East plants in the Moscow University Botanic Garden] *Bot zhurn.* 49(11): 1563.

Yegorov, A. D., and V. B. Kuvayev. 1958 [Chosenia and broad-leaved fireweed—promising forage plants for the reindeer]. *USSR Acad Sci Yakut Branch Reports* 1: 92–95.

Irina Kadis, a curatorial assistant at the Dana Greenhouses, has been working at the Arnold Arboretum since 1994. She is a graduate of St. Petersburg University with a major in plant ecology. A student of the willow family, she translated into English a major Russian monograph on Eurasian willows, which was published in 1999.