

HABITS OF TREES AND SHRUBS IN LANDSCAPE DESIGN

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Abstract

The most difficult task in landscape design is a suitable choice of trees and shrubs along with their correct graphic presentation. It is impossible to establish detailed norms, which would describe the appearance of plants due to the fact that – as living organisms – they change in time and space. However, it is possible to define a dozen or so basic shapes and height ranges for trees and shrubs, which could illustrate – roughly but sufficiently for the purposes of a landscape designer – the habits of these landscape components so difficult to put into a framework of neat definitions. The knowledge of factors that modify the tree and shrub habits is also indispensable. Such a classification would constitute a basis for ranking all decorative species and cultivars of woody plants that are grown in Poland with particular habit categories.

Streszczenie

Najtrudniejszą czynnością w projektowaniu terenów zieleni jest odpowiedni dobór drzew i krzewów oraz ich poprawna prezentacja graficzna. Nie można stworzyć dokładnych norm opisujących wygląd roślin, ponieważ jak wszystkie żywe organizmy zmieniają się one w czasie i przestrzeni. Możliwe jest jednak ustalenie kilkunastu podstawowych kształtów i przedziałów wysokości drzew i krzewów, które w sposób przybliżony, ale wystarczający dla potrzeb projektowych, oddadzą pokroje tych trudnych do zaprojektowania elementów. Konieczna jest też znajomość czynników modyfikujących pokroje. Tak opracowana klasyfikacja będzie podstawą do zaszerogowania wszystkich uprawianych w Polsce ozdobnych gatunków i odmian roślin drzewiastych do poszczególnych kategorii pokrojowych.

Keywords: Tree crown, Direction of branch growth; Environmental impact; General schemes of tree and shrub forms.

1. INTRODUCTION

As the starting point for our considerations about the habit of trees and shrubs, let us define the term itself. According to a dictionary of botany [1], this is "the general appearance, form, shape of a plant." A slightly more precise definition is available in a dictionary of gardening [2]. This one specifies the word "habit" as "the characteristics of a plant's appearance, concerning shape and growth and plant type (i.e. herb, shrub or tree)." Trees and shrubs share one common feature, which is the ability of the walls of sclerenchymal and water-conducting xylemic cells to become ligneous. Thanks to lignification, stems acquire the quality of being stiff and resistant to breaking, which enables woody plants to attain a conspicuous size and to preserve their form as a landscape component. Trees differ from shrubs in having a single main stem, named trunk, growing vertically from the ground, which only

at a certain height starts dividing into thinner and thinner offshoots – limbs, branches and twigs – that form the so-called tree crown. To a great extent, this is the shape of the crown that decides about a tree's habit.

The authors of dendrology handbooks address the problem of tree habit quite superficially, the habits of shrubs often being omitted. The terminology applied is not uniform, however the schemes corresponding with particular types of tree habit which accompany the available descriptions are fairly clear. An analysis of these depictions [3], [4], [5], [6], [7], [8] indicates 7 categories of tree habit: rounded (globose), domed (mounded), oval, conical (pyramidal), cylindrical (ellipsoidal, broadly columnar), columnar and pendulous. At the same time, all those specialists emphasize that intermediate forms exist between the categories mentioned, which accounts for the difficulties experienced when trying to characterize unequivocally the appearance of a given tree. The habit of shrubs is

discussed by Białobok [3], Krüssmann [5] and Remešová [9], who distinguish 4 categories: oboval (rounded vase), rounded (globose), flat-topped (broadly) globose and prostrate. Precise descriptions for the habits of particular species and cultivars of trees and shrubs have been given by Hieke [10]. A continuation and an up-dated version of Hieke's thought is the Internet-available computer data base "Okrasné dřeviny" (*Eng.* ornamental trees) [11]. This one makes use of 55 schemes of woody plant habits.

Yet there still does not exist any elaboration devoted solely to the question of tree and shrub habits. The paper is an authorial monograph aimed at fulfilling the gap between dendrologists' professional knowledge and the needs and requirements on the part of designers. It aims at providing the set of basic schemes depicting general outline of woody plants habits and relate them to unified nomenclature. The term "basic" pertains to the habits of plants, which grow solitarily in optimum conditions and are not subject to human activity or other environmental effects. Another aim is to determine what factors and in what way modify the appearance of trees and shrubs, which as living organisms, are tremendously susceptible to any environmental impact.

The research involved both accumulation of pertinent literature and analysis of the collected data, and own observations of tree and shrub specimens growing in the region of Lower Silesia, the latter conducted over the period 1989-1995. Cultivars were investigated between 1984 and 1998 in the botanical gardens in Poland and abroad.

2. THE HABIT OF TREES

In general outline, the habit of strong and healthy specimens of tree species growing undisturbed and in isolation is domed (in other words mounded) or conical (also called pyramidal), broader or narrower (Fig. 1). Other tree habits that we encounter around us are a result of human activity or impact of the external environment. The conical habit is related to the mode of growth – the leader does not branch into a few equivalent limbs of equal rank but remains straight and uniform up to the very top. Otherwise, when the trunk produces multiple ramifications almost at the same level, a rounded (globose) tree crown is formed or its broader variant – broadly rounded. A narrow crown, of a diameter not changing substantially in height, rounded both at the top and bottom, is known as ellipsoidal, cylindrical or broadly columnar, whereas its narrower variant – as

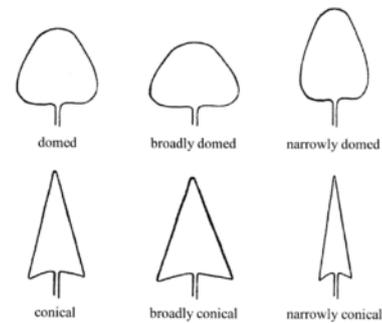


Figure 1.
Schemes (by Szymanowski [4], changed) depicting the general outlines of natural tree crowns

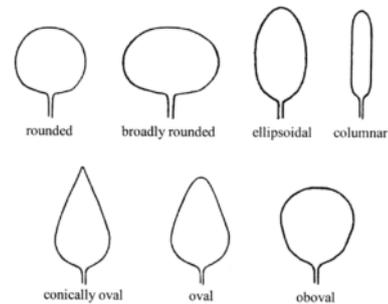


Figure 2.
Schemes (by Szymanowski [4], changed) of the general outline of tree crowns transformed by human activity



Figure 3.
Habits of mature broad-leaved and coniferous trees (from left): Black Alder, Black Pine, Yew (by Mitchell [12]), Lebanon Cedar (after Brookes [6]). Explanations in the text



Figure 4.
The weeping habit (from left): irregular of the Weeping Willow, umbrella-like of a Weeping Higan Cherry grown as half-standard, mounded of a Camperdown Elm grown as standard (by Brookes [6], changed)

the columnar tree crown. A regularly conical tree crown is fairly uncommon: most often it is rounded at the bottom, the habit defined as conically oval. When the crown is rounded also at the top, the resultant habit is oval. A tree crown can also assume the shape of an egg turned upside down, in which case it is termed oboval (Fig. 2). Domed habits are characteristic of broad-leaved tree species, but with some exceptions – e.g. Black Alder or Turkish Hazel – having a conically shaped crown. In general, conical habits are always associated with coniferous trees. Yet crowns of mature representatives of pine species are irregular, yew is more or less rounded and the Lebanon Cedar – horizontal (Fig. 3).

2.1. Age dependence

Tree habits change with age [13]. In juvenile trees that is the leader that grows at the highest rate. Therefore, the crowns of young broad-leaved trees are conically domed or conically oval, while conical in young conifers. In fast-growing broad-leaved species, such as the Canadian Poplar, White Willow or Crack Willow, juvenile specimens assume the ellipsoidal habit. With the trees aging, their crowns broaden: the originally conically oval or ellipsoidal ones gradually become domed or oboval, while the rounded crowns frequently transform into broadly rounded.

2.2. Stems characteristics

The shape of a tree crown depends on the features of stems, namely the angle at which they ramify from the main trunk and their length [14], as well as the thickness of particular branches and twigs, that is corresponding with stiffness. Tree habits are broad when the limbs are long, outspread at an angle approximating 90°, thick and stiff. Conspicuously narrow habits occur in trees under two kinds of circumstances: 1) when all stems are directed upward at an acute angle, as typical of the Lombardy Poplar for instance, or 2) in cases where the lateral stems originating from a well-developed straight leader are thin and hanging, e.g. in the Weeping Serbian Spruce. The tendency of branches to hang modifies significantly the habits of trees. When this property concerns the limbs shooting off the trunk, the outcome is a picturesque irregular weeping habit, such as in the Weeping Willow for example. In extreme cases, the tree does not form any leader at all and its stems either spread over the ground or – when grafted on a trunk (standard forms) – assume umbrella-like or domed habits (Fig. 4).

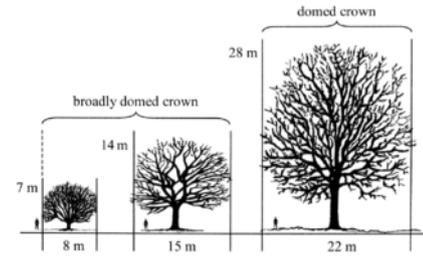


Figure 5. Crown shape and size of mature broad-leaved trees, as issuing from the genetic predispositions of particular species (from left): a small (e.g. Apple Tree), medium (e.g. Field Maple), large tree (e.g. Sycamore Maple)

2.3. Size of trees

Depending on the genetic predispositions of particular tree species, three size categories have been distinguished: small, medium and large, the height ranges conventionally defined as up to 7 m, 8-15 m and over 15 m respectively. The upper limit of tree height in Polish conditions equals 42 m (the Norway Spruce of (the) Istebna provenance or the Douglas-fir from the arboretum of Rogów among others). Averagely large trees reach a height of 28-30 m. The width of crown in large broad-leaved trees 30-40 years of age amounts to ca 12 m, and to ca 6 m in coniferous trees of the same age. In old large broad-leaved trees the crown expands up to 20-22 m (up to 15 m in species of narrow habits), in medium-sized trees up to 13-15 m, in small up to 5-8 m (Fig. 5). In well-shaped 30-m-high London Planes the crown can attain even 30 m in diameter. The tree crown diameter in mature conifers reaches up to 8 m on average. Wider crowns, up to 11 m in diameter, can be found in the Dunkeld Larch, European Black Pine or Douglas-fir.

Among the cultivars of trees, a distinctive group is formed coniferous by dwarf forms. They are characterized by low magnitude of annual growth [15]. It has been estimated that at the age of 10-15 years they reach 0.9-1.8 m in height. Slower growing cultivars, so-called miniatures, of the same age attain heights ranging from 0.6 to 0.9 m, whereas those characterized by a quicker rate of growing (but slower compared with the typical species) are 1.8-4.5 m high. The latter have been defined as intermediate forms.

2.4. Human impact

Trees growing under natural conditions in isolation have their crowns set low on the trunk and the lower

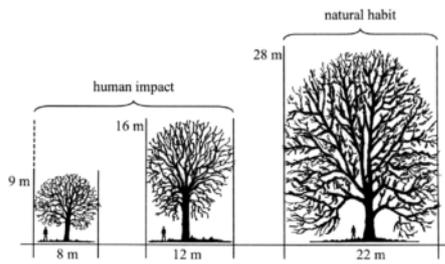


Figure 6.
Human impact as modifying the habit of trees (left-hand side): a standard form with a globose crown, a specimen with its lower branches reduced and an oboval crown. For comparison, the natural form of a large tree with a domed crown reaching to the ground (right)

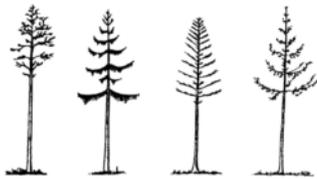


Figure 7.
Habits of coniferous trees growing in a forest habitat (left-hand side): the Scots Pine, Norway Spruce, European Silver Fir and European Larch (after Tomanek [14])

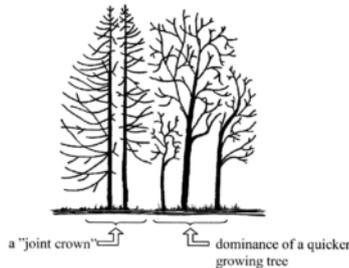


Figure 8.
Interaction of trees growing in a group



Figure 9.
Irregular tree habits: a deformed crown (left), a multi-trunk tree specimen (right) (schemes after the International Society of Arboriculture [8])



Figure 10.
A deformed habit of a tree species of foreign origin susceptible to frost in Polish climate conditions (after Mitchell [12])

branches reach to the ground. If such trees occur in the neighbourhood of buildings or along roads, they are usually deprived of the low branches, which give too much shadow or constitute a hindrance. After removal of the low stems, the crowns often become oboval (Fig. 6). Such habits, sometimes identified as obconical or vase-shaped, are also acquired by certain cultivars, e.g. “Kanzan” and “Fugenzo” Japanese Flowering Cherry, and some columnar forms of broad-leaved trees, such as the Dynasty Chinese Elm, having reached mature age.

The best option is to create the desirable habit in case of young tree specimens, still at the stage of nursery production. It is then possible to shape trees in the standard form – with well-distinguishable trunks and crowns formed adequately to attain the proper appearance and at suitable height level (Fig. 6). When considering the impact of man on the appearance of trees, the topiary method should be mentioned. Thus obtained shapes are entirely artificial and the term which would be more appropriate in this context is “plant sculptures”.

2.5. Influence of other trees

When trees live in a tree stand, their crowns are narrow and set high, while the trunks remain visible to a considerable height (Fig. 7). The rate of growth of two neighbouring trees which represent the same species is comparable and their crowns are complementary, forming a single “joint crown” (Fig. 8, left-hand side). In a compact multi-species group this is only the quickest growing tree specimen that takes the proper habit. The crowns of trees that develop slower are deformed, and the trees of the slowest growth rate die because of excessive shadow (Fig. 8, right-hand side).

2.6. Impact of the inanimate environment

The 100-year-old specimens of the Scots Pine growing in a tree stand reach a height of 35 m when under exceptionally favourable conditions, whereas only 18 m in a poor habitat. Species which can tolerate drought, such as the Field Maple for instance, in dry habitats are significantly smaller or even take the form of a shrub. Under unfavourable conditions, typical of large towns or cities and of the roadside environment, trees live shorter and never attain the species-specific size. Hurricanes or the weight of snow can bring about breaking of the limbs that make the frame of the crown, which leads to its deformation. When this is a broad-leaved tree whose trunk

undergoes destruction, subsequently a few equivalent (of the same rank) trunks are produced at its basal part, and the effect is a tree of atypical multi-trunk structure (Fig. 9). Irregular deformed crowns and a size substantially smaller than that typical of a given species are also reported for trees of foreign origin and low frost-resistance (Fig. 10). Their habits are “shaped” by exceptionally severe winters, which naturally occur at certain intervals.

3. THE HABITS OF SHRUBS

In contrast to trees, shrubs are devoid of the trunk. Although the shrub growth mode is typically a characteristic feature of species ranked among shrubs, under certain conditions also species of trees can grow shrub-like. This pertains to three types of situation: when the part of a tree above the ground has been damaged; when a tree grows under unfavourable conditions (for instance a Field Maple in a dry habitat); or when this is a tree cultivar normally characterized by shrub-like growth (e.g. Scots Pine “Watereri”). The shapes of large and medium-sized shrubs can be classified as: oboval (rounded vase), domed (mounded), rounded (globose) and broadly rounded, whereas the lower shrubs assume the following habits: semirounded, cushion-like or prostrate. A unique habit, defined as vase-like (obconical), is typical of the Blaauw Chinese Juniper (Fig.11). Similar habits, but higher and broader are formed by the Anglo-Japanese Yew cultivars: “Hatfieldii”, “Hicksii” and “Hessei”. Broad and low vase-like habits are found in some Cherry-Laurel cultivars, e.g. “Otto Luyken”, or cultivars of the Plumosa Group Chinese Juniper. The shapes of shrubs are not age-related, only the size undergoing change with time [13]. The situation is different in some coniferous tree cultivars of the shrub-like growth type – with age these can develop a leader and then their habit transforms into conical.

3.1. Features of stems

This is in shrubs rather than in trees that the length and thickness of stems as well as the growth direction have significantly more effect on the habit [16]. The types of stems in shrubs and the corresponding habits are illustrated with particular species in Fig. 12. Upright stems are related with the oboval (also vase-like) habit, drooping and nodding stems with the rounded (also domed) habit, horizontal or ascending with the cushion-like and semirounded (also broadly rounded) habit, whereas plants of creeping stems

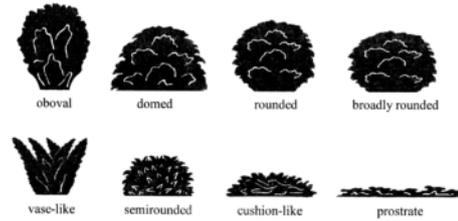


Figure 11. Schemes depicting the habits of shrubs (after Hieke [10], changed)

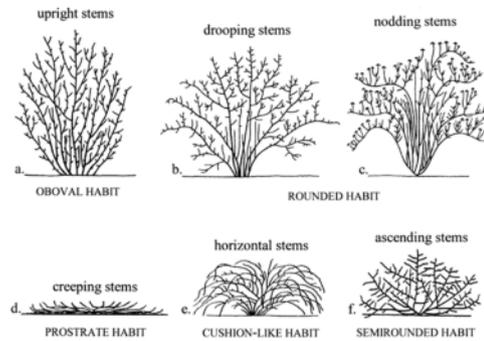


Figure 12. Dependence of the shrub habit diversity on the stem features: a. Quince, b. Common Hawthorn, c. European Elder, d. Creeping Juniper, e. Wolfberry, f. Japanese Quince (after Rabsztyń [16], changed)



Figure 13. Atypical habits in shrubs (by Hieke [10]): the spreading habit of the Pfitzer Juniper (left), an irregular habit of the Hollywood Juniper (right)

always have prostrate habits. The characteristic spreading and open habit is typical of numerous cultivars of the Pfitzer Juniper and some of the Eastern Redcedar, e.g. “Tripartita” or “Grey Owl”. Their branches are straight, stiff and obliquely rising. The irregular shapes characteristic for the Hollywood Juniper are absolutely exceptional (Fig. 13).

3.2. Size of shrubs

Using the height criterium, four categories of shrub size have been distinguished: low – up to 0.5 m, small 0.5-1.2 m, medium 1.2-2.5 m and large 2.5-4 (up to 5) m. The diameter of oboval, vase-like, domed and rounded shrubs is smaller or equals their height. In the remaining habits the diameter can exceed the height two, three or more times, in prostrate shrubs

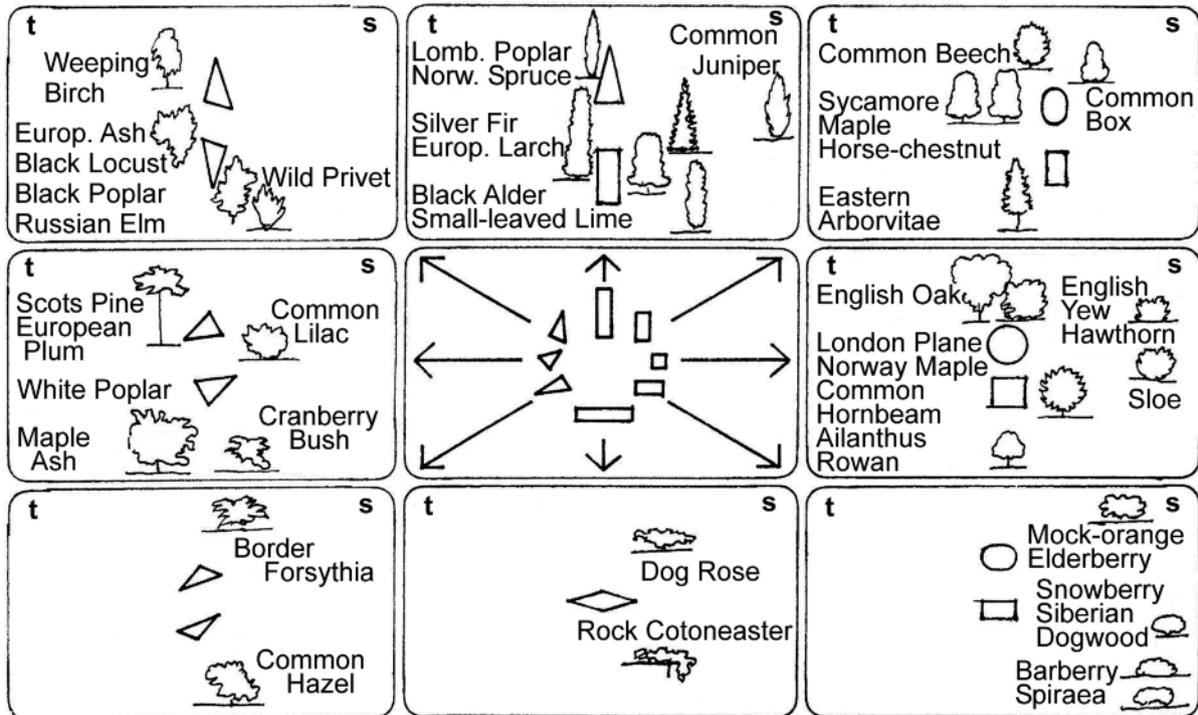


Figure 14. Schemes of tree and shrub habits according to Łuczyńska-Bruzda [19]

even a dozen or so times. Like in case of trees, one should be aware of the effect of the external environment on the size of shrubs. The highest impact is that of the habitat abundance and availability of water.

4. SUMMARY

As genetically determined, the habits of woody plants (the mode and rate of growth, features of stems among others), are always regular and predictable. In case of trees they are rounded or conical, whereas oboval, rounded, broadly rounded, cushion-like or prostrate in shrubs. However, when observing trees and shrubs in the surrounding landscape, most often

we encounter irregular or even deformed habits. These are results of the impact of external factors such as hurricane wind, ample snow, ringing frost, too close neighbourhood of other trees or buildings, cutting off limbs by man etc.

The herein presented schemes of the basic habits of trees and shrubs are discussed from the dendrological perspective. The forms of woody plants as seen by an architect are shown in the classification by Łuczyńska-Bruzda (Fig. 14). Although naturally different these two approaches to the tree and shrub habits overlap to some extent. The forms ranked with the category “irregular, geometrical solids” can be matched with the mentioned schemes as follows:

- | | | | |
|---|-----------------------------|---|---|
|  | regular cuboid | ↔ | rounded, broadly domed, broadly conical |
|  | vertical cuboid | ↔ | narrowly domed, narrowly conical, ellipsoidal, columnar |
|  | intermediate cuboid | ↔ | domed, conical, conically oval, oval, oboval, vase-like |
|  | basic horizontal cuboid | ↔ | broadly rounded, semirounded |
|  | elongated horizontal cuboid | ↔ | cushion-like, prostrate |

A detailed and comprehensive classification of irregular shapes requires separate studies. The grouping proposed by *Łuczyńska-Bruzda* (Fig. 14 left column) is not sufficient. Fig. 14, which relates particular genera to individual habits, raises doubts, too.

In the process of landscape design, the habits that are predictable, which is genetically “programmed”, should be taken into consideration. As shown in the present paper, they can be reduced to several basic schemes, to which the habits of most trees and shrubs can be assigned. Yet, there exist an inconspicuous group of species and cultivars characterized by very unique habits. This category comprises most cultivars which have weeping stems as well as juniper cultivars: of the Pfitzer Juniper and Hollywood Juniper, and shrubby forms of the Eastern Redcedar.

Selection of a desirable habit and its depiction by means of a scheme in a plan of a green area fragment is an easy task. It is significantly more difficult to match a specific species or cultivar of woody plants with a scheme drawn. Each of the schemes presented in this paper is assigned to a whole group of trees or shrubs having similar habits [13], [17], [18]. However, particular plants not only differ in ornamental features but also in their requirements concerning the soil type, humidity of the soil and air, air purity, availability of light, and air temperature in the summer and winter season. When deciding on the species/cultivars composition, a landscape designer should predict the size that particular plant components of the designed area may attain. The designer has to select the age category of the plants to be placed in the picture, and assess if the edaphic and microclimatic conditions satisfy the plants' requirements [20]. The size categories provided by this paper correspond with optimum conditions. When the actual conditions diverge from the optimum, the size of plants should adequately be diminished.

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