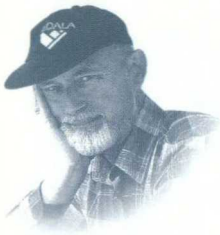
Grasses – a vegetable-kingdom success story

All-Pervasive Grasses



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Profesor Ludwik Frey studies the taxonomy, distribution, karyology, and embryology of the higher plants and the history of botany. As a grass enthusiast, he has authored a book on the "poetry of grasses"

On every continent and in every habitat, grasses discretely pervade our environment. But despite their ubiquity, grasses have a subtle beauty and still pose a challenging subject of scientific inquiry

Grasses are one of the most important and most diverse families within the kingdom of flowering plants. In terms of species numbers (8–10 thousand) they are only surpassed by the sunflower, legume, and orchid families. Areas where grasses are the dominant form of vegetation – i.e. steppes, savannahs, prairies, pampas, and campos – cover nearly 1/3 of the Earth's land surface.

Grasses are fascinating to researchers because we still know so little about them, despite their commonality. They most likely first appeared in the Paleocene, then surged in development and distribution in the Oligocene, to become nearly the dominant type of plant life in the Miocene, forming typical formations, especially savannahs. They may have first arisen in either tropical forests or mountains. Their tricky biological classification is still being ironed out nowadays.

Growing from the grass-roots...

As extraordinary plants with extraordinary traits, grasses evolved the ability to survive and thrive over large areas of the earth's surface, in spite of unfavorable conditions (whether natural or human-induced). That is why they are frequently classified as cosmopolitan plants, and often described as expansive or even invasive.

Grasses' specific nature manifests itself in their embryonic growth and physiology, but above all in their simple anatomic structure and morphology, extraordinarily favorable to survival. This structure enables grasses to follow a principle known to Eastern martial arts: "One must bend in order to win." A leaf of grass contains large quantities of dead mechanical tissue (sclerenchyma) which surrounds the vascular bundles and forms a tight cylinder around its outside, reinforced

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Sand couch grass easily withstands the extreme conditions offered by sand dunes

by ribs adjacent to the epidermis. This ensures the mechanically optimal distribution of sclerenchyma and serves to protect the stem against breakage. The advantages of this are summed up by an old Polish folk adage: "The oak was broken, but the reeds survived unharmed." Nevertheless, grasses' greatest adaptive achievement is the fact that they grow not from their tip, but from the base of the blade or leaf, in what is called "intercalary growth," enabling a plant to grow even when it is cut from above. That is why grasses can tolerate mechanical damage so well, i.e. being "trimmed" by animals or clipped or broken by machinery.

Grasses can survive in areas that are highly diverse ecologically, from very wet to extremely dry and from scorching hot to arctic cold. They occur in nearly all types of habitats inhabitable by flowering plants, from the seacoasts to high mountains, from the equator to sub-polar regions. Even inhospitable Antarctica is inhabited by an endemic species of grass - the Antarctic hair grass.

All of that means that grasses have an important role to play, e.g. as pioneer species in the colonization of difficult areas, previously deprived of vegetation in various ways. They appear in such areas via natural selection, as well as through human introduction.

Beaches, forest clearings, and road shoulders

Among their other roles, grasses make an important contribution to the colonization of islands. For example, the pioneer species that first appear on *skerries*, or small rock islets, along the coast of the Gulf of Bothnia and Gulf of Finland, include creeping bent, red fescue, and tall fescue. One of the first species that appeared on the beach of the island of Surtsey near Iceland, the product of a volcanic eruption in 1963, was dune grass. Beaches and coastal dunes offer difficult habitats, in view of their chemical composition, unstable base, and the extreme climactic conditions. But in addition to dune grass, some of the best species at colonizing them are marram grass, certain *Agropyron* species (such as sand couch grass), and their hybrids. Mudflats, salty seaside marshes that become intermittently inundated and exposed, also offering a difficult habitat, are first of all colonized by certain salt-loving species of alkali grass.

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Grasses possess a beauty evident to anyone who takes the trouble to look - even in very commonly-encountered species like this cockfoot

On inland terrain, as well, grasses are among the first plants that appear in areas that have been altered either naturally or through human intervention - such as wood small-reed, appearing in cut forest clearings, or love-grass, appearing on one of the Hawaiian islands where vegetation had been completely devastated in the early 1900s after rabbits were introduced there. In deserted post-agricultural areas in North Carolina in the US, for example, crabgrass grows profusely. In Poland, ruderal habitats - i.e. lands disturbed by strong human impact, such as trash dumps, slag heaps, ditches, railway embankments, roadside shoulders, or construction areas - also witness the appearance of such species as perennial ryegrass, spreading meadow grass, or low love-grass, or recently also wall barley.

It would seem, therefore, that grasses' flexible and rapid reaction to environmental change, their extraordinary colonization abil-

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Many grasses have a fascinating delicacy and hard-to-perceive charm – such as this foxtail species, already reaching the seed-bearing stage

ities, and their capacity to survive in altered environments are all favorable traits from the human standpoint. This is indeed especially true in the case of lands to be recultivated, where many grass species and varieties serve to initiate soil renewal, subsequently enriching soil properties and enabling biological life to recover in such devastated areas. Yet this is not the whole story, since grasses are not always in fact desirable everywhere they appear – especially not when species of foreign origin pose a danger to the indigenous flora.

Invaders and strays

Like other alien species appearing in the flora of many regions of the world, some grasses may be dubbed "strays," "newcomers," "vagrants," or in extreme cases "invaders." Such invasions represent one of the most important threats to biological diversity on a worldwide scale.

Pervasive grasses account for a particularly large share of such expansions, with over 100 grass species listed as invasive in one or more regions of the globe. The regions most frequently mentioned as at threat of grass expansions are Australia, New Zealand, North America (especially California), South America (Chile), and the Oceanic islands.

Many grass species meet at least several of the criteria used to define "expansive" plants, such as a broad range of tolerance to living conditions, a great capacity for vegetative reproduction, and the production of ecotypes, polypoids, and hybrids. The most widespread means by which grasses become dispersed, frequently across great distances, involves the transport of diaspores (seeds or other plant parts that can give rise to new specimens at a new location) by means of the wind, animals, and humans, or more rarely water. This process is frequently facilitated by highly specialized morphological structures, such as awns and hairs of various shapes and structures.

Manna from America

The expansion of grasses is hard to control. The giant reed, a plant growing up to 8 meters tall which most likely originated in eastern Asia, was purposefully brought to California from Europe (the Mediterranean region) in 1820, as a decorative and anti-erosive plant for reinforcing the banks of canals and drainage ditches. However, at present the species is recognized as an invasive one in the United States, where it has spread from Maryland to Northern California. In Italy and Greece, too, it is encompassing ever-greater territory. In fact, it has been listed among the world's 100 most dangerous invasive species.

Expansion in the reverse direction, i.e. from America to Europe, has been reported in the case of fowl manna grass. It is not clear how this species, which demonstrates

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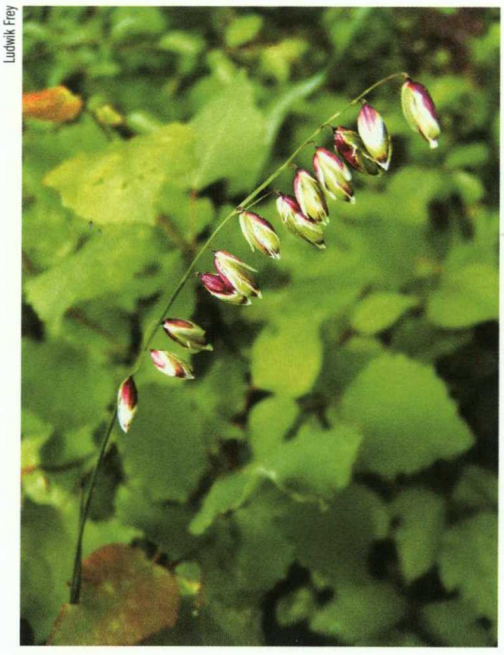

This mountain melick grass (known as "pearl grass" in Polish) has a spikelets that glisten like real jewels

Wiesława Frey

Thrust proudly upright, bushy and impressive, the plumes of this pampas grass from South America, called the "queen of all grasses," make for a striking garden ornament

invasive tendencies especially in damp areas, first made its way to our continent. Four possible paths are conjectured: transport by birds, among the seeds of other grasses, with horse feeds, or... together with blueberry seedlings! Fowl manna grass was first observed in France in 1849, at a single locality. Since then its range has gradually expanded, with its easternmost occurrences being recorded in Poland, Ukraine, and Russia, which it reached in 2000.

An example of a rapidly-expanding grass in Poland can be found in annual vernal-grass, which originated from the Atlantic portion of Western Europe and was most likely brought into our territory by French troops stationed in the Pomerania and Wielkopolska (Great Poland) regions after the Prussian war of 1806. The occurrence of vernal-grass nevertheless went unnoted in the literature, and was probably ephemeral. Known localities were only recorded in the latter 19th century in Pomerania and Silesia. The species was not present in central Poland until 1960, but was known to be present at 118 sites in 1975, with as many as 437 new localities being noted within the next decade. With time, more and more reports of its presence in various Polish regions have appeared.

We can therefore conjecture that due to their expansiveness and adaptive abilities, grasses are likely to be among the new "stray" species seen in various parts of the globe in the future, including in Poland.

Six in danger

Alongside this plethora of expansive and invasive types of grasses, there are also certain grass species whose survival is in fact under threat. The underlying causes behind the occurrence, appearance, and disappearance of grasses make for quite intriguing study. Research underway for several years now at the Institute of Botany, Polish Academy of Sciences, has combined field visits, investigation of herbarium material, and verified data drawn from the literature to track the distribution of rare, sometimes even threatened grass species in Poland. So far we have studied six species in this regard: North Africa grass, slough grass, rat tail fescue, squirrel tail fescue, common river grass, and king ranch bluestem. Pinning down the distribution, localities, and population numbers of these species will yield a useful basis for protective measures in the future. ■

Further reading:

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