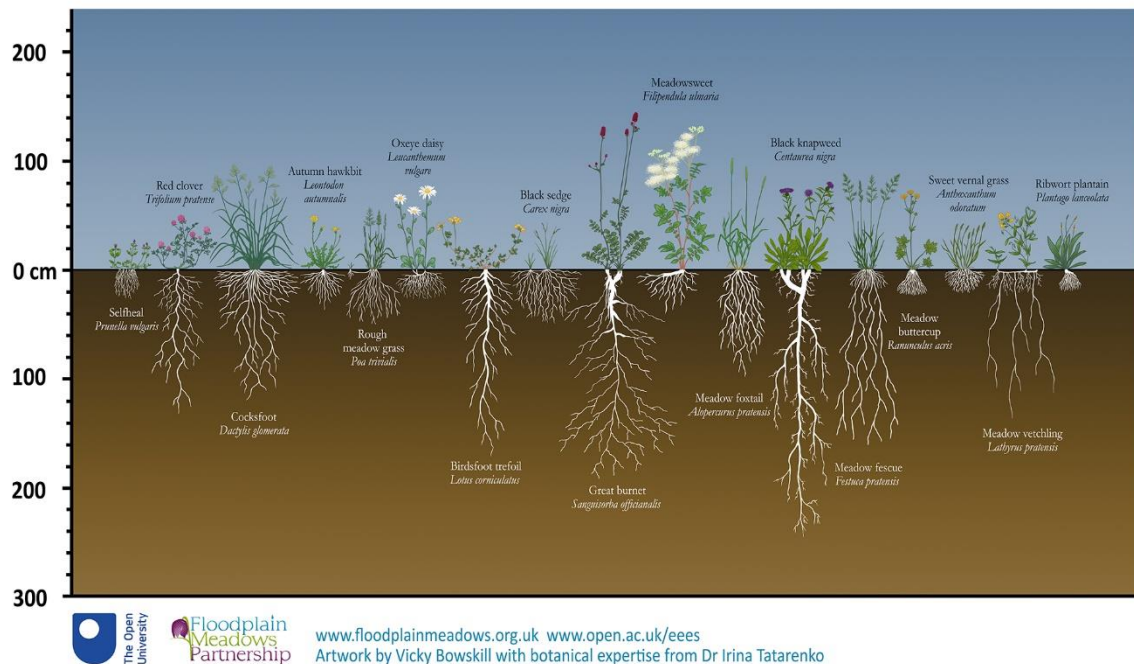


From Shoots to Roots: revealing the above and below ground structure of meadow plants

By Vicky Bowskill and Irina Tatarenko

From Shoots to Roots: revealing the above and below ground structure of meadow plants



Botanical art is a tradition that dates back generations. A good field sketchbook was the mainstay of botanists before we all had a digital camera in our pockets. Even so, a sketch can still be helpful alongside a digital snap, because subtle features necessary for identification can be missed by a camera. And it can be hard to untangle a rambling plant in a species-rich setting like a floodplain meadow. But you can't easily photograph what's going on beneath the soil.

In times past, the illustrations of traveling botanists would have been the only way most people would have been able to see plants from beyond their own area. In more recent years, whilst we've become much more mobile as a population, [botanical knowledge has declined](#), with [many school children unable to name even common plants](#).

There are many good reference books for budding botanists to make use of, along with identification apps that are now pretty good, and accessible training courses from organisations like the [Botanical Society of Britain and Ireland \(BSBI\)](#). But that's just for the parts you can see. What about what's going on below ground? Many of us now know about the importance of our soils for food production, carbon storage and flood alleviation. And one of the most important things for soil health is having a range of plant species with diverse root systems to create a well-structured and healthy soil.

Meadows are communities of perennial herbaceous plants. Their assemblage is driven by the competing and complementary strategies of species, and the physical space-sharing occurs both above and below ground. Differences in plant height and spread, along with the size and shape of leaves ensures effective access to light for a wide variety of species. These aboveground parts are

seasonal and short-lived, so the long life of meadow species (which can be 10-70 years) relies on their below ground organs. The unseen diversity in the spread of the rhizomes and stolons, along with the root depth and intensity of branching, allows efficient access to water and nutrients. Plant roots play a key role in the widespread storage of organic carbon in the soil. This rooting diversity also supports a complex community of soil microorganisms (bacteria and fungi) and invertebrates like earthworms, ants and nematodes which build the soil through their activities.

Understanding and appreciation of the complexity of meadows can be enhanced by visualisation of the community structure. The aboveground parts of meadow plants have been well described and illustrated in botanical art and literature over the years. But information about below ground plant structures remains scarce, and good illustrations are rarer still.

To bring this subterranean world to life, this diagram of a floodplain meadow community has been created from a variety of visual and text materials and field observations. The artistic digital drawings by Vicky Bowskill have been guided by the extensive literature search and professional expertise of Dr Irina Tatarenko. Research into the changing morphology of roots throughout the lifecycle of plants has been carried out by groups of devoted botanists in the UK and Russia. This diagram presents a compilation of that research, sourced from the publications listed here under References.

Suggested citation:

Bowskill V. and Tatarenko I. (2021). *From Shoots to Roots: revealing the above and below ground structure of meadow plants*. Floodplain Meadows Partnership.

[Creative Commons Attribution - Non Commercial - ShareAlike 2.0 Licence](#)

References:

- Abramova, L.I. 1996. *Prunella vulgaris*. In Pavlov, V.N. & Tikhomirov, B.N. (eds) Biological Flora of Moscow Oblast. Iss. 12. Argus. P. 113-124.
- Bakhmatova, M.P., Matveev, A.R. 1983. *Trifolium pratense* L. In Serebryakov, I.G., Gattsuk, L.E., Zhukova, L.A., Kurchenko, e.I. (Eds.) Diagnoses and keys of the age groups of meadow plants. Part 2. Moscow State Pedagogical University. P. 69-75.
- Beddows, A. 1959. *Dactylis glomerata* L. *Journal of Ecology*, 47(1), 223-239.
doi:10.2307/2257254
- Bilova, A.M. 1976. *Centaurea scabiosa*. In Rabotnov, T.A. (ed.) Biological Flora of Moscow Oblast. Iss. 3. Moscow State University Press. P. 151-161.
- Egorova, V.N. 1997. *Alopecurus pratensis*. In Elenevskiy, A.G. (ed) Diagnoses and keys of the age groups of grasses. Prometey. P. 42-47.
- Ermakova, I.M. 1976. *Festuca pratensis*. In Rabotnov, T.A. (ed.) Biological Flora of Moscow Oblast. Iss. 3. Moscow State University Press. P. 78-89.
- Ermakova, I.M. 1983. *Sanguisorba officinalis* L. In Serebryakov, I.G., Gattsuk, L.E., Zhukova, L.A., Kurchenko, e.I. (Eds.) Diagnoses and keys of the age groups of meadow plants. Part 2. Moscow State Pedagogical University. P. 47-51.
- Ermakova, I.M. 1997. *Festuca pratensis*. In Elenevskiy, A.G. (ed) Diagnoses and keys of the age groups of grasses. Prometey. P. 81-85.
- Ermakova, I.M., Zaytseva, G.A. 1993. *Sanguisorba officinalis*. In Pavlov, V.N. & Tikhomirov, B.N. (eds) Biological Flora of Moscow Oblast. Iss. 9, Pt 2. Moscow State University Press. P. 39-71.
- Grime, J.P., Hodgson, J.G., Hunt, R. 2007. *Comparative plant ecology. A functional approach to common British species*. 2nd ed. Castlepoint Press.
- Gulenkova, M.A. Egorova, V.N. 1978. *Lathyrus pratensis*. In Rabotnov, T.A. (ed.) Biological Flora of Moscow Oblast. Iss. 4. Moscow State University Press. P. 127-137.

- Gulenkova, M.A., Egorova, V.N. 1983. *Lathyrus pratensis* L. In Serebryakov, I.G., Gattsuk, L.E., Zhukova, L.A., Kurchenko, e.I. (Eds.) Diagnoses and keys of the age groups of meadow plants. Part 2. Moscow State Pedagogical University. P. 80-86.
- Harper, J. (1957). *Ranunculus acris* L. *Journal of Ecology*, 45(1), 289-342. doi:10.2307/2257092
- Howarth, S., & Williams, J. 1968. *Chrysanthemum Leucanthemum* L. *Journal of Ecology*, 56(2), 585-595. doi:10.2307/2258252
- Jermy, A.C., Simpson, D.A., Foley, M.J.Y., Porter, M.S. 2007. *Sedges of the British Isles*. BSBI, London.
- Jones, D., & Turkington, R. 1986. *Lotus corniculatus* L. *Journal of Ecology*, 74(4), 1185-1212. doi:10.2307/2260243
- Krylova, N.P., Rabotnov, T.A. 1975. *Trifolium pratense*. In Rabotnov, T.A. (ed.) Biological Flora of Moscow Oblast. Iss. 2. Moscow State University Press. P. 89-101.
- Musina, L.S. 1993 *Leonthodon autumnalis*. In Pavlov, V.N. & Tikhomirov, B.N. (eds) Biological Flora of Moscow Oblast. Iss. 9, Pt 2. Moscow State University Press. P.94-102.
- Piskovatskova, N.I. & Mikhailova, I.S. 1983. *Lotus corniculatus*. In Rabotnov, T.A. (ed) Biological Flora of Moscow Oblast. Iss 7. Moscow State University Press. P. 111-127.
- Piskovetskaya, N.P. 1983. *Lotus corniculatus* L. In Serebryakov, I.G., Gattsuk, L.E., Zhukova, L.A., Kurchenko, e.I. (Eds.) Diagnoses and keys of the age groups of meadow plants. Part 2. Moscow State Pedagogical University. P. 76-79.
- Rabotnov, T.A. (ed.) 1980. Genus *Carex*. Biological Flora of Moscow Oblast. Iss.6. Moscow State University Press.
- Rozhanskaya, O.A. 1984. Ecological and biological characteristics of *Filipendula ulmaria* (L.) Maxim. Dissertation. Moscow State University.
- Sagar, G., & Harper, J. 1964. *Plantago major* L., *P. media* L. and *P. lanceolata* L. *Journal of Ecology*, 52(1), 189-221. doi:10.2307/2257792
- Serebryakova, T.I. 1956. Shoot development and seasonal rhythm of growth of the plant of floodplain meadows in Middle Oka river. *Uchenie Zapiski of MGPI named after V.I. Lenin*. Vol. 97. Iss. 3. P. 43-120.
- Sugorkina, N.S. 1983. *Leucanthemum vulgare* Lam. In Serebryakov, I.G., Gattsuk, L.E., Zhukova, L.A., Kurchenko, e.I. (Eds.) Diagnoses and keys of the age groups of meadow plants. Part 3. Moscow State Pedagogical University. P.62-66.
- Sugorkina, N.S. 1996 *Leucanthemum vulgare*. In Pavlov, V.N. & Tikhomirov, B.N. (eds) Biological Flora of Moscow Oblast. Iss. 12. Argus. P. 140-154.
- Zhukova, L.A. 1983. *Plantago lanceolata* L. In Serebryakov, I.G., Gattsuk, L.E., Zhukova, L.A., Kurchenko, e.I. (Eds.) Diagnoses and keys of the age groups of meadow plants. Part 2. Moscow State Pedagogical University. P.42-46.
- Zhukova, L.A. 1983. *Plantago lanceolata*. In Rabotnov, T.A. (ed) Biological Flora of Moscow Oblast. Iss 7. Moscow State University Press. P. 197-103.
- Zhukova, L.A. 1983. *Ranunculus acris* L. In Serebryakov, I.G., Gattsuk, L.E., Zhukova, L.A., Kurchenko, e.I. (Eds.) Diagnoses and keys of the age groups of meadow plants. Part 2. Moscow State Pedagogical University. P.23-27.
- Zhukova, L.A. 1997. *Anthoxanthum odoratum*. In Elenevskiy, A.G. (ed) Diagnoses and keys of the age groups of grasses. Prometey. P. 28-31.