Floodplain Meadows Partnership

Spring 2020 Newsletter

www.floodplainmeadows.org.uk

The Open University

Welcome to our newsletter for Spring 2020. It's been such a wet winter, followed by a remarkably dry spring. Today the sun is shining and the floodplains are bursting into life, even though we are not able to get out and enjoy them, survey them or talk about them on site ourselves.

COVID-19 and the impacts for the FMP

Everything we were planning to do this year is now being reviewed in the light of movement restrictions due to COVID-19. Many activities have been cancelled/postponed and like everyone else, we are uncertain whether there will be any field survey at all this year. However, we will do what we can, and are all still working, albeit around other responsibilities for some of us, so if you have questions about floodplain meadows, please carry on talking to us.

A flood meadow somewhere in Europe - any ideas what this is and where it grows? Answers on the last page.

Soil carbon - the curent hot topic
Where do floodplain meadows sit in the debate?

Temperate grassland soils have an important role in controlling atmospheric CO_2

The soil carbon pool is several times larger than the atmospheric carbon pool and it has the capacity to absorb and store more (Fig. 1). Globally, soils contain 3.8 times more organic carbon than in above ground biomass (Kobak, 1988). Alluvial soils, such as those supporting floodplain meadows, are particularly important in carbon sequestration because they grow deeper with each flood event providing new soil to fill with carbon. They are precious 'treasure chests', which securely hold large amounts of carbon; in this respect they are probably only second to peat in the UK.

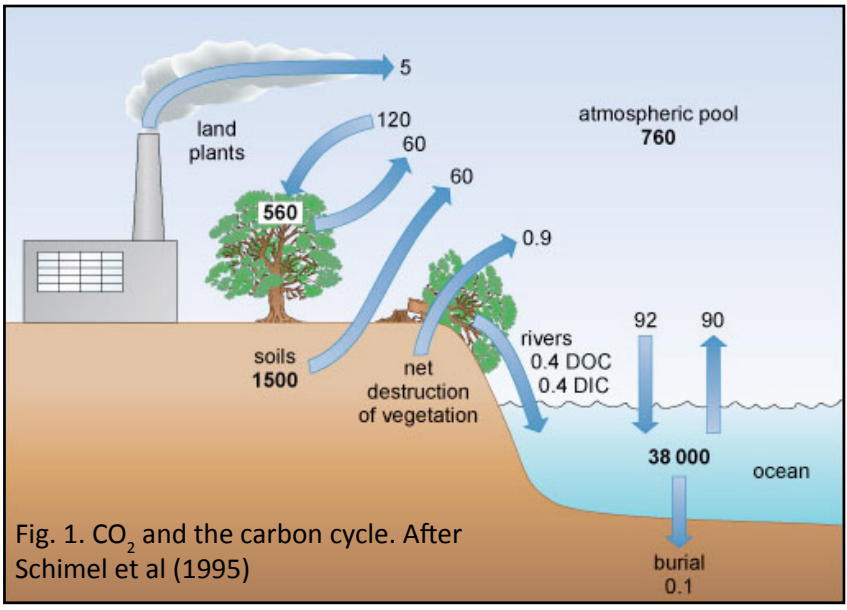


Fig. 1. CO_2 and the carbon cycle. After Schimel et al (1995)

The carbon cycle comprises four major processes: fixation through photosynthesis, release through respiration (above and below ground), sequestration in the soil (short, medium and long-term pools) and precipitation as calcium carbonate in the sea

Carbon, Roots and Humus

Species-rich grasslands support a diversity of root systems (Fig. 2). Where species' mixtures are diverse, plant root systems occupy space more effciently than if growing individually as a monoculture allowing them to lay down carbon in a greater volume of soil. In Fig. 2, the root system of *Knautia arvensis* exploits soil horizontally beneath the root systems of its neighbours. By increasing the diversity of root forms, the occupation of soil will be increased, and hence the overall fixation of soil carbon. A more local example would be great burnet, *Sanguisorba officinalis*, which has a deep rooting distance of around 1m or *Lotus corniculatus* with a rooting depth of around 2m.

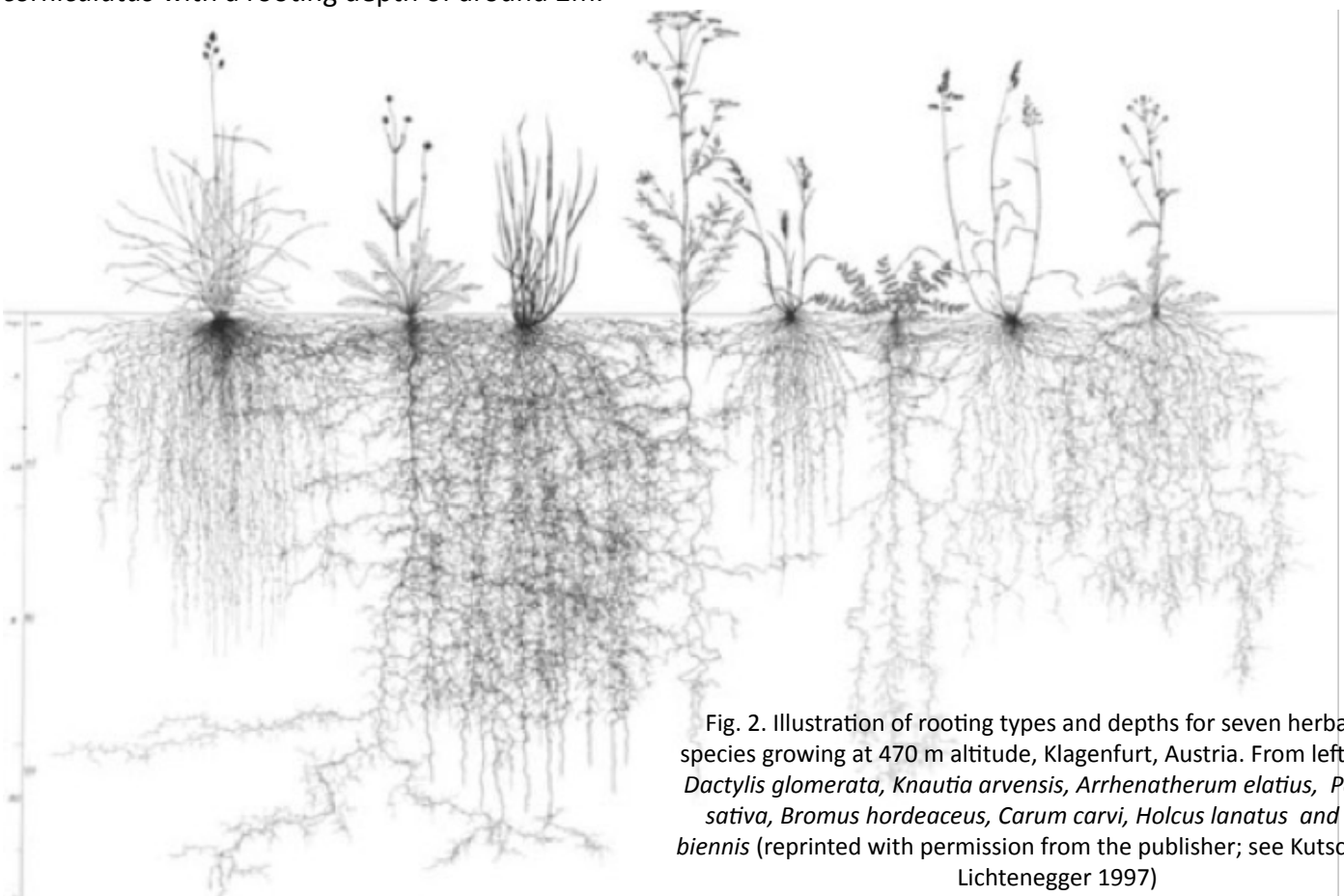


Fig. 2. Illustration of rooting types and depths for seven herbaceous species growing at 470 m altitude, Klagenfurt, Austria. From left to right, *Dactylis glomerata, Knautia arvensis, Arrhenatherum elatius, Pastinaca sativa, Bromus hordeaceus, Carum carvi, Holcus lanatus and Crepis biennis* (reprinted with permission from the publisher; see Kutschera and Lichtenegger 1997)

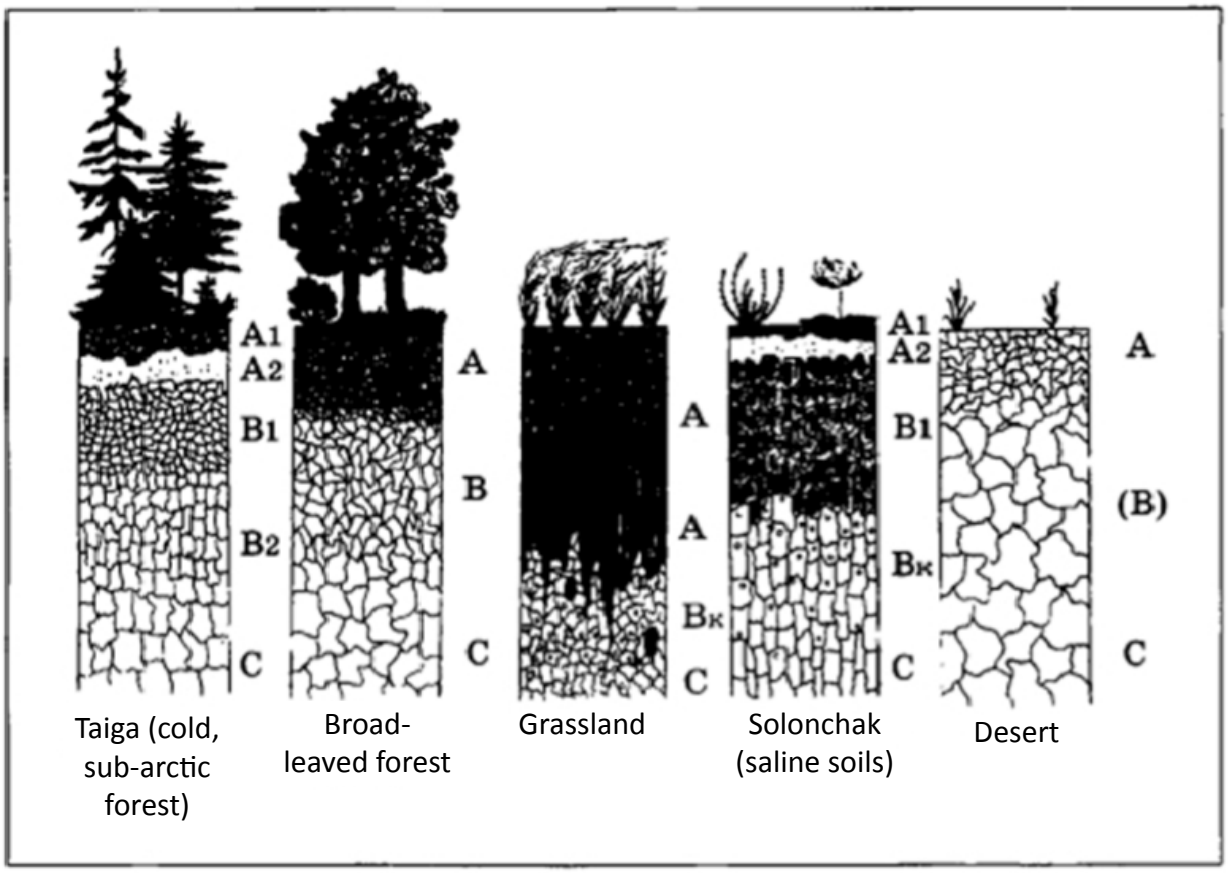


Figure 3. Distribution of humus along the soil profile of different ecosystems (Rozanov, 2004). Dark areas show density and depth of humus.

Established grasslands have a large underground store of humus (Fig. 3) which extends considerably deeper than other ecosystems studied. They also have a root biomass 4-7 times bigger than that of trees (Kobak, 1988), and so grasslands can sustain a higher rate of soil carbon sequestration than arable fields or forests.

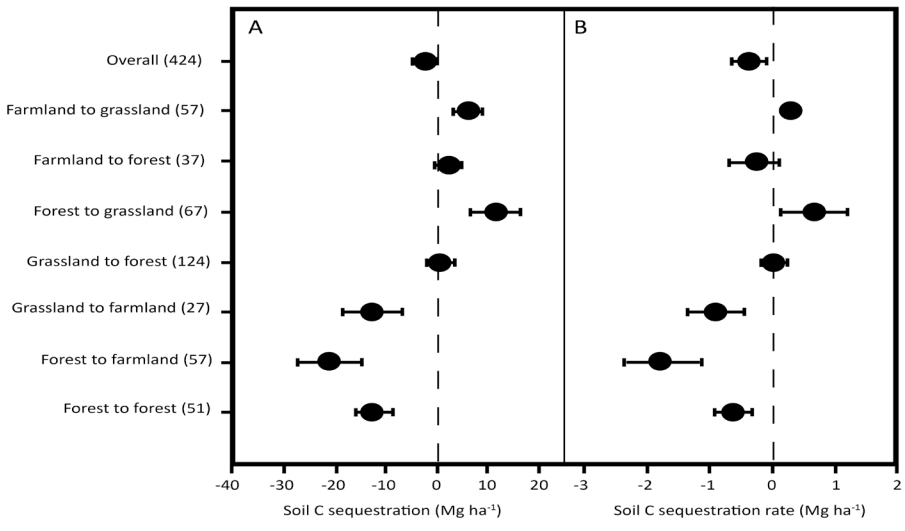
Restoration of grassland and woodland and impacts on soil carbon sequestration rates

The conversion of grassland to woodland shows little effect in capturing carbon from the atmosphere (e.g. Fig. 4) to store in the soil. The biggest losses of CO_2 from the soil to the atmosphere come via respiration. Soils beneath trees tend to respire CO_2 back to the atmosphere at a higher rate than those beneath grassland. High levels of respiration continue after clearance of woodland due to increased respiration of the soil fungi decomposing tree roots. Moreover, wood (lignin) when decomposed, tends to produce large amounts of methane, a more potent greenhouse gas than CO_2.

Soil respiration increases not only after woodland clearances, but also after drainage of peat soils, and conversion of permanent grasslands into arable fields.

Figure 4. The effects of land-use change on soil C sequestration and soil C-sequestration rate.

Note: dots with error bars denote the overall mean values and the 95% CI, and numbers of observations are in parenthesis. Adapted from Deng et al., 2016.



Restoration of species rich grasslands sequesters more carbon than species poor grasslands.

A recent study showed that species-rich grasslands restored from species poor swards, store more carbon in their roots (root C) than species poor grasslands (Fig. 5).

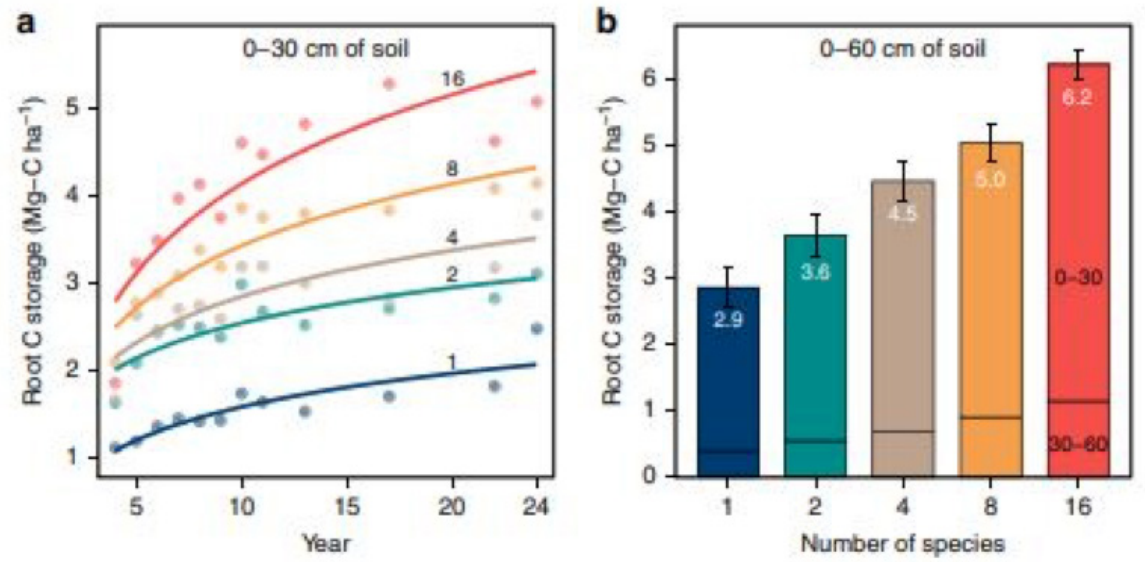


Figure 5. Changes in root C over 24 years (a) Change in root C in upper 30 cm of soil under different experimentally imposed levels of plant species diversity. Data indicate mean root C at a given year, curves fitted with log functions; the number on each curve indicates plant species diversity. (b). Total root C storage after 24 years of growth in upper 60 cm of soil. Numbers in white indicate mean total root C storage, error bars indicate standard errors, and numbers in black indicate soil depth increments (cm) (Yang et al, 2019)

To turn the carbon cycle from emission to storage, areas of disturbed soil need to be left undisturbed and allowed to develop perennial vegetation. This brings us to the main argument: should we plant more trees as a quick solution for capturing excess atmospheric carbon, or should we seek long-term carbon storage, (or both)?

Short-term tree planting is good for above ground carbon storage provided the tree is felled at maturity and the wood is used for something that lasts (e.g. furniture.)

In terms of long-term carbon storage, trees should not be planted into existing permanent grassland as they may both release carbon through soil disturbance and possibly reduce the land's capacity to hold carbon. Young tree plantations sequester carbon into their biomass, but when planted into established grassland they gradually shade out and kill the grass causing the roots to die and much of their carbon to be lost via fungal respiration. As they mature, trees store carbon as cellulose and lignin in their trunks. This can become a large pool of carbon storage, but only until the trees are cut down. At that point, the woodland ecosystem, which has the highest root respiration among all terrestrial ecosystems, becomes a large source of CO_2 emission. Woodland soils tend to have less humus than neutral grasslands (Kobak, 1988). Wood itself is not a reliable store of carbon, compared to peat or humus, because unless it is preserved in buildings or furniture, its carbon is quickly re-released to the atmosphere.

Grassland restoration is good for deep soil carbon storage (unless the grassland is ploughed up!)

In grasslands, root systems of grassland plants can grow to several metres, occupying large volumes of the soil. This ensures a more even distribution of carbon in the soil, compared to restored woodlands (Fig. 6).

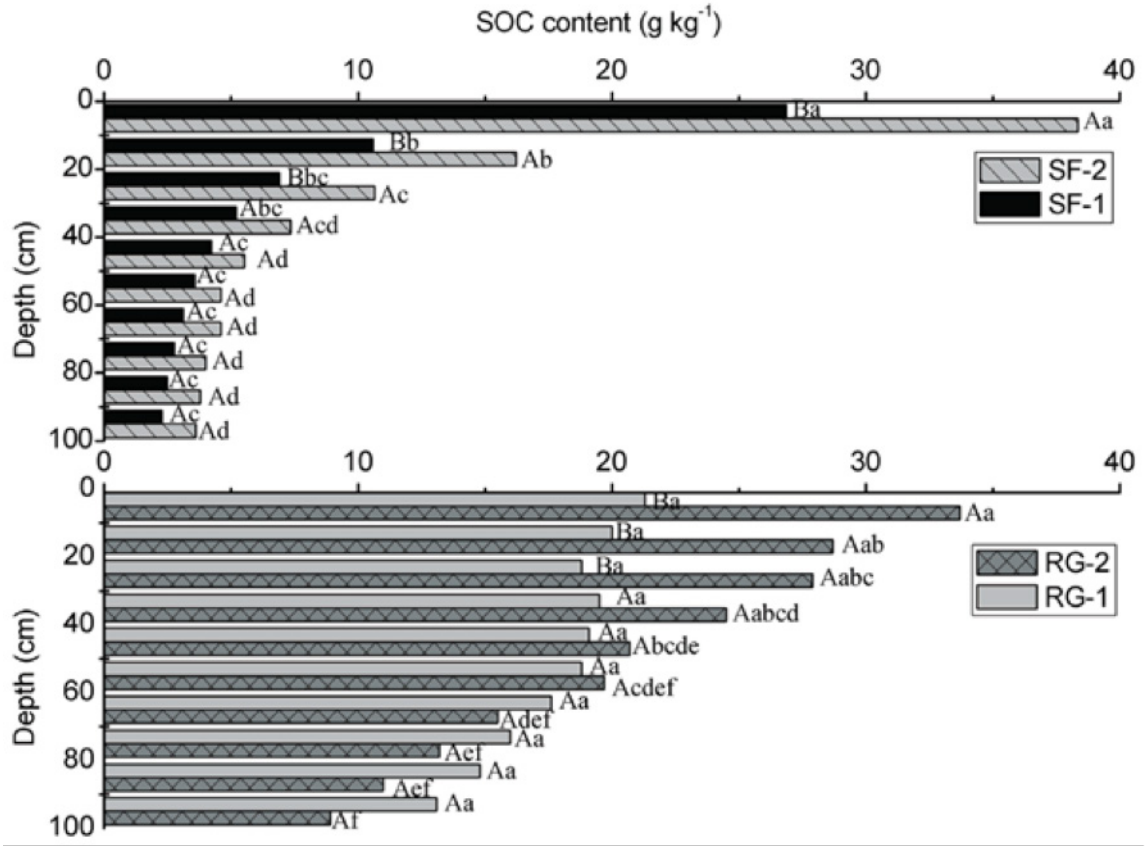


Figure 6. The difference in soil organic carbon (SOC) content. SF-1 and SF-2 are sites of secondary forest while RG-1 and RG-2 are sites of restored grassland. Different lower-case letters denote significant differences among depths within an individual study site; different upper-case letters denote significant differences among vegetation restoration types (P<0.05) (plot to plot and depth to depth, N = 6). (Adapted from Wei et al., 2012)

Floodplain soils as carbon stores

Biogeochemical processes in floodplain ecosystems are very active. Carbon sequestration and storage in floodplain soils has attracted a range of international researchers. For example on floodplains, deep layers of soil were found to contain large amounts of 'buried' carbon (D'Elia et al., 2017). Our own unpublished data suggest that the amount of carbon stored even in the top 10 cm layer of alluvial soil, is very high - further info here; http://www.floodplainmeadows.org.uk/sites/www.floodplainmeadows.org.uk/files/Soil%20Carbon%20stocks%20summary%20130619.pdf. Investigations into carbon sequestration and storage in floodplain soils under British meadows should therefore be continued (and published).
But even without further study, and based on current evidence, we conclude that floodplain meadows should be conserved together with other established grasslands and restored where possible in order to boost carbon-sequestration rates.

To achieve a global target of decreasing CO^2 in atmosphere:

1) Conservation of peat soils is the top priority.
2) Conservation of established low-input, species-rich grasslands is a key secondary goal
3) Trees planted on woodland clearances and wastelands in urban areas will provide a carbon sink from the atmosphere. Established vegetation and their soils should not be disturbed by tree planting.
4) Grassland restoration provides a long-lasting solution for carbon storage in the soil.
5) Floodplain meadows are a perfect store for soil carbon, they should be conserved, and restored where possible.

'Plant trees and save the planet' but what about the grasslands?

Despite this evidence, grasslands are regularly overlooked in terms of their ability to contribute towards climate mitigation as a nature-based solution, for both sequestration and storage of carbon. For example, there are now carbon codes for peatland https://www.iucn-uk-peatlandprogramme.org/funding-finance/peatland-code and woodland https://www.woodlandcarboncode.org.uk/ to ensure that those trading in carbon are doing so with bona fide projects that are genuinely delivering carbon gains. The carbon gains in restoring species-rich grasslands are significant, and the store of carbon in existing species-rich grasslands is high, so should grasslands also have a code?

Additionally, the drive to 'plant trees and save the planet' is already resulting in some well-intentioned, but potentially damaging incidents in the UK, in which trees have been planted into existing species-rich grasslands. Not only does this damage biodiversity, it can also result in the net release of carbon into the atmosphere.

To avoid this, do we need an up-to-date 'valued grassland' inventory, or at least a proper list against which to check all proposals for tree planting. Current guidance on tree planting says that the Priority Habitat Inventory (PHI), available as a download or through Magic Maps https://magic.defra.gov.uk/MagicMap.aspx is the first place to check to see whether there is any existing interest on a site being considered for tree planting. However, the Priority Habitat Inventory is not comprehensive, or reliable in all circumstances. The best way to check is to have a survey carried out in spring/summer, so that you know for sure you are not about to damage an existing grassland of value.

Action you can take

• If you are planning to plant trees into grasslands, please check that your site does not already have grassland (or other) interest. Follow the good practice guidance, for example on the Woodland trust website here https://www.woodlandtrust.org.uk/plant-trees/advice/where/ Information on locations of floodplain meadows can also be found on our webmap here http://www.floodplainmeadows.org.uk/about-meadows/meadow-map
• If you hear of examples where trees are being planted into species-rich grassland, and particularly floodplain meadows, please let us know. We can compile a list and share with Government agencies.
• We are in the process of working with NE to see if we can put our data into the Priority Habitat Inventory, where it is not already covered by the existing layers. Tell us about any sites you know about that are not listed on our webmap.
• Please share this and similar articles widely. Ask to put information about this topic in your organisational/community magazines.
• Treasure and protect your old meadows and their soil in particular; restore more meadows.

References

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Deng L., Zhu G., Tang S., Shangguan, Z. 2016. Global patterns of the effects of land-use changes on soil carbon stocks Global Ecology and Conservation 5 (2016) 127–138

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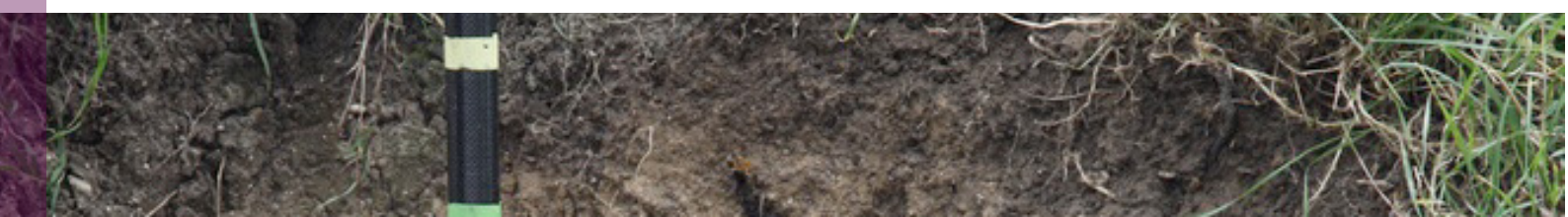


Having a break: (much like our annaul fritillary survey this year)

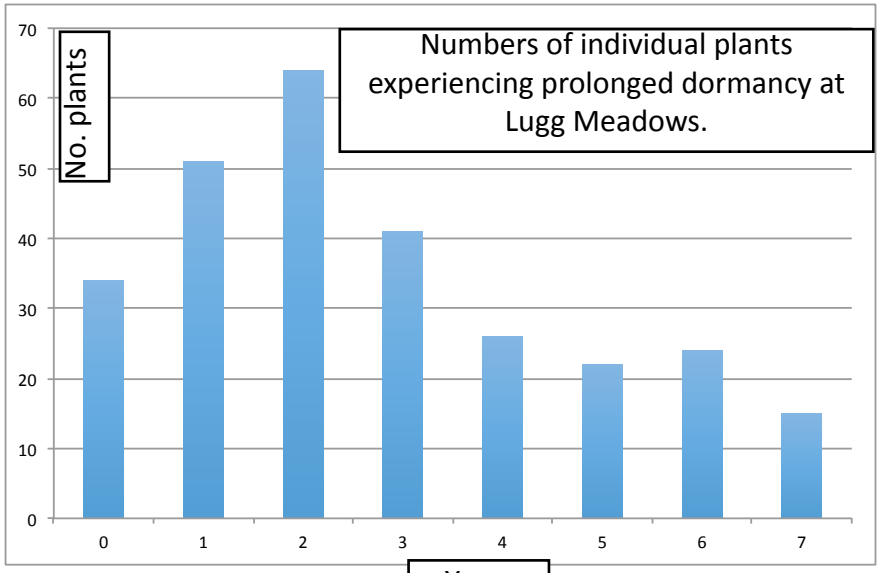
Dormancy in snake's-head fritillary (Tatarenko, 2019)

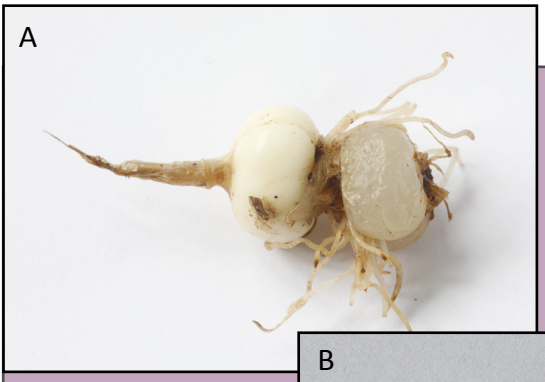
Prolonged dormancy in snake's-head fritillary was observed during 8 years worth of monitoring 203 individual plants on Lugg Meadows in Herefordshire, by Irina Tatarenko from the FMP.

Monitoring was undertaken using our highly accurate GPS, which allowed us to return to exactly the same plant each year (or the same place anyway, if the plant was dormant). Our findings show that:

A one-year dormancy was most frequently observed in the population, followed by 2-year dormancy. A seven-year dormancy was the longest recorded period.
Twenty two percent of plants didn't display dormancy during the 8 years of recording. We found there was a large variability in the patterns of individual plants entering and re-emerging from dormancy in different years, suggesting that individual genetic heterogeneity is a factor driving dormancy in individuals. This was further evidenced by the synchronous disappearance and re-emergence of clones (groups of plants emerging from the same place, thought to have reproduced vegetatively from a single bulb).
Three morphological states were identified in dormant plants including a false dormancy in individuals which carried on growing below ground.

Excavation of dormant plants in 2018 revealed that their states below ground differed from each other. The series of photos A-D below show some of the differences in the states of the bulbs (photos all from Tatarenko, 2019).





A- Dormant for 2 years, since flowering in 2015. It had an episode of growth below ground, forming a new bulb.

B- flowering in 2017. In 2018, it started bud growth, but stopped 5 cm below the ground surface, all roots died, probably affected by external factors

C - flowering in 2012. Two plants were formed as a result of vegetative reproduction, one of them developed an adult vegetative aerial shoot in 2015, and then both of them carried on below ground growth, not forming bulbs, but shoots bearing a sequence of succulent scales.

D - only 1 bulb, flowered in 2012, then dormant for 3 years. Re-emerged in 2016 as adult vegetative, then dormant for 2017 + 2018. Had below ground growth, resulting in vegetative reproduction and formation of a clone with the smaller plant with two bulbs (right) excavated next to the mother plant.

Reference
Tatarenko, I. (2019). having a break: prolonged dormancy observed in a rare species, Fritillaria meleagris. Environment and Human: Ecological Studies, Volume 9, pages 302-324 http://www.floodplainmeadows.org.uk/sites/www.floodplainmeadows.org.uk/files/Tatarenko_Fritillary_dormancy_2019.pdf (only the front page is in Russian, scroll down for the full paper in English).

600 ha of *Calthion*-type vegetation identified in Scotland

Last summer we visited the Scottish mainland (north coast) and Islands (Inner and Outer Hebrides, Orkney Islands and Shetland Islands) to collect data from grasslands that appeared to be part of a suite of grasslands within the *Calthion* community but that had previously been variously and inconsistently described and coded. The problem with not being able to define a plant community to a universally agreed definition is that it is tricky to get an idea of its extent, rarity and conservation value at a national scale. The grasslands of interest were typically associated with crofting and a hay cut and/or grazing management.

We secured funding from both the Halpin Trust and The Open University Scotland in 2019. Despite the distance and difficulties with accessing these remote sites in a short timescale, we managed to collect 293 quadrats from 31 sites. We have analysed these along with other (older) quadrat data from similar locations (847 quadrats in total) and have been able to define new community descriptions to add the suite of those already sitting within the *Calthion* group (e.g. MG8). A new fen meadow community type was also described. These plant communities are additional to MG8 and related communities - they are too different to be included within any existing community types. The community descriptions are still in draft but are currently described as:

Background image Ollaberry - Shetland Islands

***Caltha palustris-Carex nigra* grassland Typical**
Caltha palustris-Carex nigra-Cynosurus cristatus
***Agrostis stolonifera-Bellis perennis Ranunculus repens* subunit**
***Agrostis stolonifera-Bellis perennis Plantago lanceolata* subunit**

Using these defintions, and the rough mapping we undertook in 2018 and 2019, we have identified 600 ha of vegetation that has previously been largely overlooked in conservation terms. This compares to the just over 1000 ha identified in England and Wales, so it is a significant resource. We hope to publish the findings properly later this year, and then work with Scottish Natural Heritage and others to build on this information, including looking at better representation in agri-environment schemes, greater recognition of the value of these grasslands and the important link to the crofting community.

If anyone would like to be involved in this process, please get in touch Floodplain-Meadows-Project@open.ac.uk

Aith Meadows on the Shetland Islands.

Loch Hallan - Outer Hebrides

Policy update

New Environmental Land Management Scheme (ELMS) Consultation

The ELMS first phase consultation is out https://consult.defra.gov.uk/elm/elmpolicyconsultation/ but has been delayed indefinitely due to COVID-19. We are planning to submit a response.

The key focus of our response will be the need to include a floodplain specific element in the scheme that offers benefits to landowners who change to sustainable and beneficial land-use practices in floodplains (particularly floodplain meadows which deliver a range of benefits and are still part of an agricultural system).

We are happy to share our draft comments in more detail with anyone else who is planning to submit a response, and would be really pleased if more responses could highlight the need to have a floodplain focussed option.

We are also planning to run a workshop in London to explore the following themes:

- Is current floodplain management in the UK sustainable?
- Do current policies encourage sustainable floodplain management?
- What would we like to see?
- What up-coming policy programmes can be used to deliver our aspirations?

We hope to produce a road map to identify the mechanisms for delivery of sustainable floodplain management.

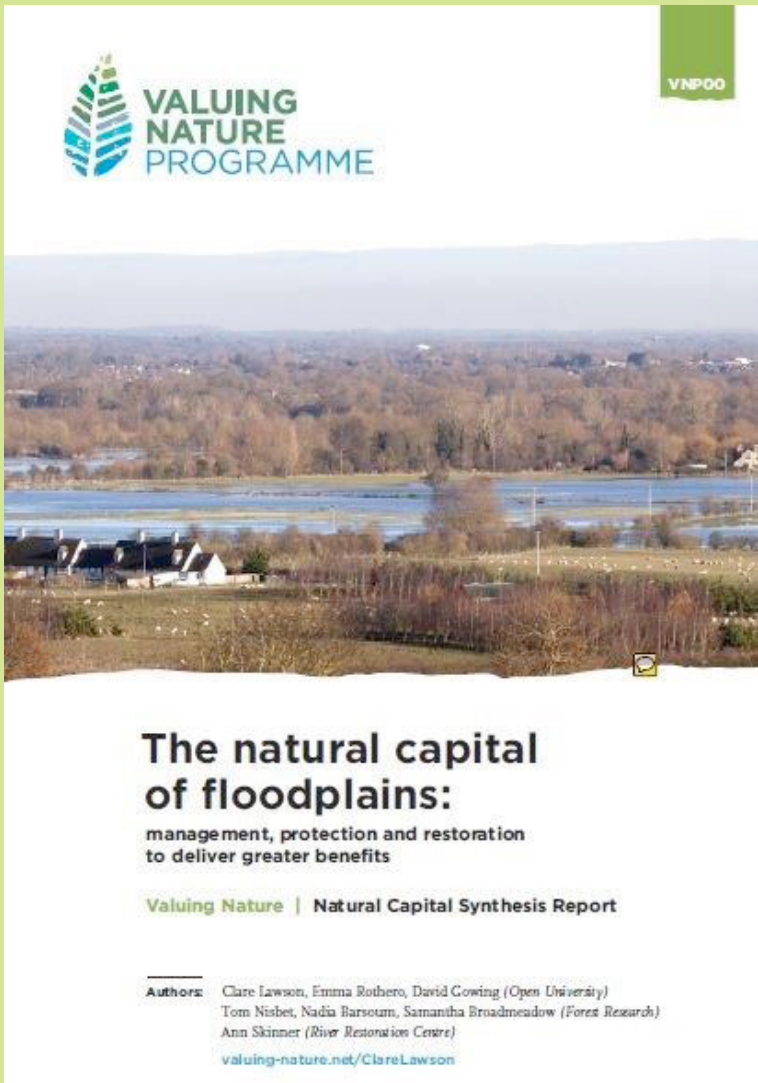
If you want to come and have not already received an invitation, please do get in touch. We have not set a date yet due to uncertainty over COVID-19, (our original date has been cancelled) but if we have you on the list, we can keep you informed. Please get in touch with Olivia on olivia.nelson@open.ac.uk.

We are also planning to respond to the Environment Agency Challenges and Choices consultation (delayed till 24th September 2020) https://consult.environment-agency.gov.uk/environment-and-business/challenges-and-choices/

EFRA Flooding inquiry https://committees.parliament.uk/work/107/flooding/

We are also considering whether we would like to take some messages to COP 26 (now delayed until 2021, in Glasgow).

We have also just become a member of Wildlife and Countryside Link and hope to work with them more closely over a wider range of policy consultations. Our key policy messages are also highlighted in the Valuing Nature paper here http://www.floodplainmeadows.org.uk/sites/www.floodplainmeadows.org.uk/files/VNP09-NatCapSynthesisReport-Floodplains-A4-16pp-



IN BRIEF

Ambassador update

Our **Phase 2 Ambassadors** have been given their completion certificates..hurrah! From top left - right- Margaret Trigg (Yorks), Emily Dresner, (London) Tom Hayward, (Oxon) Jim Horsfall, (S. Yorks) Simon Barker (Herefordshire). Bottom left-right Gareth Williams, (Sussex) Ali Swanson (Gloucestershire), Rachel Remnant (Hampshire).

Phase 3 are currently stalled slightly due to COVID, but will resume their studies when they are able to access their field sites

PhD student updates

We have a new PhD student who has rapidly started to make her mark in the team. Vicky Bowskill worked at CIEEM for more than 6 years as Member Networks Coordinator, before taking the plunge to develop her Open University degree, completed in 2018, into a PhD study. Vicky is looking at the relationship between hay cutting date and crop quality and yield on floodplain meadows to seek synergies between agricultural production and biodiversity. Thanks to everyone who took part in her recent questionnaire and look out for more on this project as it develops.

FMP questionnaire for landowners/managers

Thanks to all of you who completed this questionnaire. It has now been closed but we got an awesome 97 responses. We are planning to use the responses to evidence to Government that we are making a difference with our research. Some headline stats include 87% of responders said we had helped to change their approach to management methods, 81% said our advice had specifically informed their approach to hay cutting and 73% of responders said we had encouraged them to start/consider restoration projects.

Answer to the question on the front page. The plant is *Narcissus bulbocodium*, the petticoat daffodil or hoop-petticoat daffodil. It is native to southern and western France, Portugal, and Spain. The picture was taken at an elevation of 1100m in the Picos de Europa, Spain on 5 May 2019 by our very own Mike Dodd. It is found there in wet meadows, similar to our own hydrologically, but with some different species.