CVF Annual Lecture: Can the Cam Flourish Again?

Simon Spooner, 18th March 2024
Simon.spooner@AtkinsRealis.com

The following are the notes for the talk as presented and are free to be circulated to interested parties. Presentation was as a Pseudo Interview with questions written by the author and asked by Anne Miller during the presentation. There are slides in an accompanying presentation. A recording was made and could be converted to a transcript eventually, which deviates in places from the script below, but main points remain the same.

Anne Miller: Your Title for this talk is can the river Cam flourish again, What is your vision of how we could to be living in the future so that the river can flourish? What needs to be different from the past and present?

Simon Spooner: The problems of the river now are part of the problems for the whole environment as a result of the way that humans have been changing the world around them by consuming natural resources.

We build infrastructure, consume energy and farm the land to give us what we want for comfortable and convenient lives with little regard to the consequences to the other living things we share our world with.

Of course the penny has dropped now and most of us recognise that we cannot go on in the same manner, we see the impoverishment of the natural world and the emissions from our industry, homes and vehicles that is upsetting the balance of the atmosphere, changing climates and poisoning the earth and oceans.

We are encompassing that need for action with emphasis on carbon emissions under the overall banner of moving to net zero, but what does Net zero mean in practical terms? And how does that relate to how we manage our rivers? I will present a slightly different take on this. Please indulge a couple minutes on this as I compare how we obtain energy with how we obtain water.

What does net zero mean? By definition: achieving a zero sum of GHG emissions and absorption of carbon from the atmosphere.

in reality achieving the goals is about much more than just carbon, because carbon emissions are really just a symptom of our overall industrial system. The cause of those emissions is mostly because we keep on burning stuff.

Getting to net zero is principally about Not burning stuff, and letting nature recover and thrive.

The fact is that we are living things that are part of a complex living system and we have to stop separating ourselves from the living world and instead embrace and nurture the living world.

The whole balanced climate, ecosystem and most of the energy and materials for humans industrial society is a gift from life.

SLIDE 2

There is Something about what living things are, the very life process, that leads to the ability to absorb energy from the sun and turn that into a sustainable imbalance. There is oxygen in the atmosphere and carbon in the ground because living things have put it there.

In fact, fire is something that is only possible because of life. As far as we know, planet earth is the only place where there is fire. It is a unique thing and everywhere else there is just hot stuff.

That stored imbalance has given us the fossil fuels that we are consuming. As we consume them we are taking from the atmosphere, consuming oxygen, releasing carbon dioxide and other gasses and throwing out this balance that has taken hundreds of millions of years to establish

A fundamental ecological limit for us is how much of these greenhouse gasses the atmosphere can hold before there is a catastrophic collapse in its ability to sustain the conditions we need

This balance or rather imbalance is a great treasure left to us by past living things. And we burn it.

Then we feed ourselves by clearing land breaking up the complex web of living things and replacing it with simplified systems which we pump with energy from fertilisers and harvest with machines.

A lot of the materials that we use to build our houses, cities and machines have been made available to us by living things – steel and concrete especially. …Started as Geochemist .. *Most Iron ore from early photosynthesising bacteria oxidising the ocean – Limestone is the bodies of long dead plankton.*

We have prospered by consuming the biosphere – the living system that we are part of and which sustains us.

In just the last few centuries we have learnt how to really exploit this system for our own narrow and selfish gains and we have prospered enormously as a result. So now we have billions of us living in relative wealth and comfort.

A few hundred years ago the vast majority of people were just about surviving and living lives of harshness and material poverty.

This can be counted as a great success … SLIDE 3

But has come at a cost, one we are just starting to get the bills and summonses from our host. We have consumed much of the treasure, burned down the forests and left stinking piles of trash behind us.

We have also separated our bodies from the living systems that we are designed to be a part of, while this gives us health benefits in not getting ill from bugs and parasites, the immune system that protects us from those bugs and parasites then turns on ourselves leading to a modern pandemic of auto immune related disorders that we are only just beginning to understand.

These things are more complex and interrelated than we realised

But we should not despair, it has not all been a waste because we have had some fun and great times along the way, plus some bad days. We have built cities and other infrastructure that can sustain us in future. Most importantly we have gained and stored huge amounts of knowledge.

The universities and libraries have been built on the back of the energy, the leisure time and the freedom from our each having to feed ourselves from the land that our industrial society has given us. This knowledge can be shared, especially with those who may think they are only on the losing side of the industrial revolution being in less developed countries. Computers, the Internet and the IT revolution make it all the easier to share and access information and knowledge.

So how do we use this knowledge to change and do things differently?

First of all why do we burn fossil fuels and clear away the land? It is to get services – services of nutrition, shelter, warmth, mobility and manufactured goods.

We have learnt to use fire in ever more sophisticated ways to give us ever more services for less effort. We build complex machines and supply chains to keep them running..

But we have, in just the last few decades, also learnt how to get most of these services without burning stuff – by using electrical systems mostly – Electrical systems have no emissions at the point of use – though of course may in supply, but and we have also found ways to harvest energy from the environment around us now rather than consuming the stored energy from the past.

So we can now power the systems that give us the services that we want by getting energy from the present time and not consuming the biosphere – bypassing it as it were

SLIDE 4– discussion of it

We are also just starting to realise that healthy biological systems are diverse and complex with vast varieties of species from microorganisms and fungi to plants and animals working together and that we can nurture and steward such systems to provide us with services that we need – such as nutrition and also ecosystem services for managing water and the atmosphere. We can get what we need, at least in some cases, by embracing the biosphere in all its complexity and working as a part of it.

So we need to both bypass living things for our energy and embrace the whole biosphere for our food.

But this is not just about the supply of our energy or food from distant sources provided by some big corporations or government. It is also about the demand side, how we use that energy in the devices and systems in our homes and businesses. The priority is to change the combustion systems on the demand side – boilers, combustion engine vehicles and some industrial processes – with electric or other alternatives – as we do that so the supply side will follow.

We also need to think about how we can incorporate living things into the fabric of our cities and how we can farm by working with natural systems rather than displacing them.

This means making lots of changes in the property and systems owned by individuals, communities and businesses, properties that are already in existence.

Most of our Current systems for building and changing things are not set up to make such change in individual's or community property so we need to develop new models for incentivising and facilitating people to change their infrastructure systems so that they can obtain pretty much the same services as before but from different systems. Systems that don't consume the biosphere.

How does this way of looking at things relate to our relationship with rivers and their catchments?

We have to look at a healthy river as being a part of a healthy and flourishing system in which people are able to live comfortably by working with the natural systems around them. Harvesting energy and food without destroying the systems that provide it in the first place.

Number one this means acknowledging that we are part of a natural system and this is complex with many, many parts that are connected and work together and are forever changing and adapting. We will never fully understand everything about such systems but we do need to work with them.

Working with natural systems means not trying to engineer and control everything, reducing to the simplest components, instead we have to make space for things, nurture and when necessary steward and curate the different components.

We are only just beginning to understand this as a whole society and to build this into our recorded and documented system of collective knowledge. Many people in the past knew how to work in such a way, more harmoniously with nature, but it was generally not recorded or communicated other than by word of mouth, and so much of this knowledge died with the holders. We can do better now.

We also need to believe that Humans working with natural systems can do better than nature left alone to be wilderness. We can work to greatly increase the services that those system give to us and to the wider environment. We can harvest for our needs but we must also give back.

To some extent none of this is new, we have always been enhancing systems by ploughing, breeding livestock, and by creating closed sheltered spaces for ourselves. But we need to be much more aware and responsible for what we are giving back in order to be sustainable.

This means we need to take much better account of the relationships that humans have with natural systems and reflect those in the contractual systems that we use between humans to identify our obligations to one another when we exchange goods and services.

You have talked in a general way about net zero and the wider climate change challenges we face – but what does this mean for water and how we manage our rivers.

SLIDE 5

So lets talk about rivers and see how some of the themes introduced above can apply to how we manage rivers.

If we want our rivers to flourish we have to let them.

> Through the centuries we have been reaching ever further upstream for fresh water and dumping our waste as close to our doorstep as we can get away with

….Explanation

Also comment on the Mogden outfall picture A centuries old outfall Island recovering the tidal ecosystem

Water that would previously have been available to the aquatic ecosystem is no longer there or greatly reduced in quantity and depressed in quality.

The aquatic ecosystem, which would previously have provided all sorts of services to us is now reduced. Ultimately we need to change how we obtain clean water so that nature gets the first use of available water

But we still need freshwater to drink and clean ourselves and we want it conveniently coming out of pipes in our homes.

So instead of reaching further upstream, we need to extend our infrastructure so that we reach downstream to extract the water and re-use it sending it back upstream within our water infrastructure, use it, and then release our waste water back to the environment treated to a high enough degree so that a healthy ecosystem can manage it before any further abstraction.

The more that we extract from downstream treat and pump back to upstream users the more sustainable and plentiful our water supply can be.

There is no such thing as a water shortage, only an absence of infrastructure, energy and organisation. Of course there are great costs to building massive infrastructure system, these need precious materials and will consume energy in construction and operation. Organisation is required is plus financial and human capital.

In the long term it may be the case that renewable energy infrastructure will eventually make energy plentiful and sustainable. With sufficient energy obtaining the materials for construction of such infrastructure is feasible too.

The ultimate sustainable water source is desalination of seawater and transport to distant inland cities. This sounds counter intuitive and frankly nuts, given how unsustainable and polluting the places, such as in middle east, are that currently operating on this principal and by burning oil to do it. But in a longer term if renewable energy is plentiful then the negative side of energy intensive processes like desalination can be far less. However, in a longer term vision this can be part of the way to go, accounting for the geographical conditions and alternatives available.

The key point is to consider how reversing the cycle and taking from downstream to supply upstream is if fact a more sustainable solution once the necessary reservoirs, pipes and pumps are built.

The availability of energy may constrain this now, but in key areas downstream supply can be feasible. Cambridge may be a leading example for this..

So what are the long term and shorter term solutions for Cambridge?

Currently the development of Cambridge is constrained by its water supply.

Whether constraining the development is a good or a bad thing for Cambridge is a debate for another time, but either way it indicates that Cambridge is already causing too much harm to its resources.

most of the supply for Cambridge arises from chalk streams and aquifers which are already over exploited resulting in degradation of the globally rare and special chalk stream aquatic environments.

When it comes to downstream solutions Cambridge is a natural candidate and there is already advances in taking this approach. A reservoir has been proposed to be located in the Fenland region

that would take water from the lower reaches of the rivers Cam and Ouse before they become tidal, store it there to be available to be pumped to treatment and then supply to Cambridge and other cities in the region.

SLIDE 6

So would this mean drinking recycled sewage? What is the difference between directly recycling wastewater and what we do now where one person's treated wastewater becomes the supply for the next person downstream?

Direct recycling of wastewater to supply would of course be the most sustainable solution - as far as possible bypassing the biosphere with our water just as we need to bypass the biosphere with our energy supply.

But at this time it is not really a desirable thing. We still rely almost entirely on living systems to process our wastewater.

Our wastewater treatment plants are massive enhanced biological systems where we provide the infrastructure with tanks, pipes and pumps and then add lots of energy with blowers to super charge a diverse community of microorganisms, bugs and fungi that eat our waste and turn it into more benign stuff. This biological community, fed with energy and supplemented with chemicals is very aggressive in breaking down waste both chemical and biological.

But that does not get everything and what comes out is far from fresh spring water. Some chemicals are not removed at all, some are only reduced and There are residuals of this rather artificial biological system in it so the effluent contains all sorts of bacteria and viruses which are not quite the same as you find in a natural river. They are not necessarily harmful to people directly but they are different.

I want to be clear that this biological treatment is not a perfect system, but it is far far better than not treating the waste and leaving it to the river to try to deal with the problem.

We can then put the effluent through super fine filters and remove almost everything mechanically to produce nearly pure water. But normally we don't, because that is difficult, needs expensive kit and lots more energy.

This water is technically safe to drink

But everybody feels more comfortable , and rightly so, if that biologically and mechanically purified water goes back into the reservoirs and rivers, is exposed to more of the natural processes and is then cleaned again before being used.

To some extent this is what happens anyway, with our rivers now in that communities in the upper reaches discharge waste to the river and then the next community downstream abstracts this mixed with the more natural waters, treats it, dirties it, cleans it and passes it down the line.

The difference of a reverse cycle would be in only collecting the water at the bottom of the system and pumping back to the top to treat and supply ourselves. The treated effluent would still probably go back in the rivers upstream.

This is already done in some parts of the world such as Singapore where 40% of the water supply is wastewater that has been treated through ultrafiltration and reverse osmosis and then discharged into the reservoirs at the top of the system to be abstracted downstream treated and used for water supply.

SLIDE 7

Note the difference that where there is desalination of seawater by reverse osmosis this is sent direct into the potable water supply. Where the same processes are applied to treated wastewater effluent then it is put into open reservoirs first. Spends a bit of time in the wild, then is treated again before being part of potable supply.

In many parts of Saudia Arabia and much of the middle East all of the water is entirely obtained by desalination of seawater and there is not engagement with a natural water cycle. Though that is a model for a totally different setting that we would not want to follow.

So in Cambridge, with planned construction of new lowland reservoirs and also the re-location and rebuild of the Wastewater treatment plant we have the opportunity to put in place a more sustainable infrastructure system and overcome some of the resource constraints that we face.

I make no statement here on the rights or wrongs of that relocation, only that if rebuilding the treatment works there or somewhere else it is an opportunity to make it better.

For the foreseeable future wastewater treatment works will be big engineered mechanical systems consuming lots of energy. The only way to move to properly natural systems, such as engineered wetlands, would be for very local systems that are able to treat small amounts and reuse the effluent locally – this may be good one day, but will require some major changes.

That is still talking about big, long term strategic infrastructure projects, what can we be doing at the local level to get the aquatic ecosystem to recover.

Turning around how we do things and letting the river have the water first and us take it second is a long term plan which may take decades to centuries to complete and will be done differently in different rivers. Our local chalk stream rivers have particular sensitivity and value and should be managed in a particular way

But there is much more that we need to do to change the runoff that enters the rivers from our cities and also from our farmland.

First of all farmland

In many cases what water is left to go into the river has to pass over and through intensively farmed land and soils. These are very far from natural in the way that they absorb and retain water and how they chemically change it.

If we want healthy water we need to have healthy farming systems,

we also have to take responsibility for the way our buildings and urban spaces affect the river and our local environment.

So we need to change our farms and our buildings – but how and who is going to do it?

Yes so What are you proposing that can actually be done and that we as the community living in the Cam Valley can engage with?

The problem is that our current systems of managing buildings and farming works on a system of contracts between people which are focused on goods and products rather than the service that we or the environment receives. These contracts do not normally include nature and the environment in their terms.

But they can now – we have worked out how to quantify some of such benefits and how to incorporate those into a contractual framework so that people can offer to pay to receive benefits and individuals or communities can be incentivised and supported to bid to be paid for delivering such services. There are examples of how this is being implemented – though far from perfect.

There are moves in this direction with initiatives such as Environmental Land Management (ELMS) a sort of nature focussed replacement to some of the EU agricultural grant schemes. Also Biological Net Gain by BNG which urban developers have to pay toward schemes to re-instate lost biodiversity.

I would like to give an example of how has been done in the field of natural flood management. This is a method of reducing the risk of flooding in a particular area by changing aspects of the rural landscape and farmed areas to make them better at retaining water when it rains and then releasing it slowly afterwards so there is not a sudden flood. It can be used instead of building concrete channels or walls to effect a reduction in flood risk and then the cost can be compared to such engineered solutions.

SLIDE 8

There are organisations such as The National Highways Authority who are subject to flood risk at their assets – such as sections of motorway – and are willing to pay to reduce that risk.

The land owner needs to make changes to the rivers and streams and their fields, say by putting in a series of small dams and pools in streams , by decompacting soil in fields or changing ploughing regimes so it is more absorbent or by planting trees and hedgerows. – Nature based solutions

The land owners will only do this if there is a benefit to them in terms of payment or if they thought it would increase the revenue from their land. If there is a benefit in terms of an ecosystems service that at least one stakeholder is willing to pay for then schemes can be set up to encourage landowners to bid for funding to provide a flood risk reduction service.

It is quite complex to quantify the flood risk reduction from different possible measures in specific locations, but it is possible, and people have developed Online tools for doing this. The landowners also need a lot of guidance in how to plan and implement such measures.

Hundreds of such measures need to be undertaken across dozens of farms to have even a small effect.

The problem is that the Highways authorities don't want to deal with a lot farmers across hundreds of schemes. But they can appoint intermediaries.

In the example of this National Highways Natural Flood Management scheme the local rivers trusts were contracted to liaise with farmers in a £ 1million programme to deliver reduced flood risk in specified locations.

SLIDE 9

The important thing to draw from such an example is that an ecosystem service was quantified, A stakeholder was Identified willing to pay for it, and individuals were encouraged to bid to provide that service facilitated by a suitably qualified third party. This forms a 3 tier stakeholder model.

SLIDE 10

This model can be applied in all sorts of different situations where either local nature based solutions are required or where demand side changes are required to people's infrastructure. We need to change so much about the way that our homes are heated water runs of our buildings and how our food is grown. This change has to happen on individuals or communities' property but in making those changes they are providing multiple benefits.

Take the example of the National Highways Flood scheme, the measures taken also provided benefits of carbon sequestration, biodiversity gain and water quality improvements. If those benefits could also be quantified and assigned to a stakeholder in government or industry who is required to deliver such improvements, then the value of measures can increase with multiple payments to the individuals delivering the change on their property.

This can apply for example to providing sustainable urban drainage measures on individual houses or community buildings – soakaways, retention ponds, disconnection of surface drainage from foul etc as part of water sensitive development or retrofitted to existing buildings.

Where they are built The Water company receives a benefit of runoff reduction which can reduce treatment costs and sewer overflow spills. However the water company would not be able to directly undertake such work which has to take place on other people's property without great difficulty.

Sustainable Drainage schemes also provide other benefits, such as urban greening and aesthetics, improved air quality, improved local climate which may be valued by other stakeholders and so contribute to their funding if linked with the right high level stakeholders

So that is about what happens in our towns, but most of the river catchment is in the countryside what do we need to do there to help the river to flourish.?

Probably the best way is to transition to regenerative farming – which is based on greatly reduced ploughing and the nurturing of diverse mixes of crops which can work together symbiotically to provide harvestable products. This is soil focused and a healthy soil will cycle nutrients more efficiently, retain and release water more effectively and be less prone to erosion and soil loss.

But how to transition to that, even if it is profitable in terms of food production alone, there is a period of several years to change and establish the systems before they are productive and what is the point of the farmer to provide all of the additional ecosystem services if society does not value them and provide rewards as appropriate.

We need to have systems of quantifying the multiple benefits of different measures and connecting those with the different stakeholders who need to demonstrate delivery of benefits and services, to facilitate the establishment of them and to build and deliver services.

We are developing such systems with lots of pilots in specific sectors. Now we need to coordinate to realise the benefits of interlinked systems. Also there are a lot of these changes to infrastructure and systems that only show benefit if a lot of people change together and so there need to be some sticks as well as carrots to encourage such change.

So overall what do you think are the most important things that we can do if we want our River Cam to flourish again?

I have tried to present a different way of looking at things, putting living things at the centre and humans relationship with those living systems as being crucial to be able to transition to a more sustainable and healthy way of living.

Our way of living is dependent on getting services from the things that we build and manufacture. It is the services that we value, because they sustain us. We do not necessarily value the buildings or the machines themselves,– though we are often mistaken in thinking that we do (because we get social recognition for owning lots of stuff as a sign of power). What we have tended to ignore is all of the other services that natural systems provide that sustain us.

This can be looked a as a supply side and a demand side. The supply side is the big infrastructure that supplies us with our energy, water, transport and many manufactured goods as well to some degree with food. The demand side is the at local levels, in our own buildings, land and vehicles that we own or use as individuals or as a community

In both cases we need to change those to get the same services that we value from new systems that don't consume the biosphere but instead harvest sustainably from the world around us.

On supply side this means changing fundamental aspects of our major infrastructure – for energy and water in these examples – to stop consuming the living systems that support us and instead learn how to work as a part of those living systems or to ensure that our actions are fully separated, bypassing living systems as far as possible.

So for energy, we need to get it from the sun more directly and for water we could let natural systems have the water first and then recover what is left for our own needs. With "what is left" becoming more than there is now and of higher quality.

So that is the first of my key takeaways – let nature have the water first and reverse the water cycle.

On the demand side I think that we need to further develop approaches to quantify the benefits and services that nature based solutions provide so that these can be clearly linked with National and regional Targets for thing like carbon sequestration, reduction of flood risk, nutrient management, River water quality targets, biodiversity gain, reduction of sewer overflow spill impacts.

We need to connect those national level targets with funding systems that will incentivise and support individuals and communities to work together to deliver the changes that are required.

In towns and cities this may include grants to install soakaways, storage ponds or other means of retaining and treating storm water on site rather than sending to the sewers and surface drains.

In rural areas this can be about encouraging the transition to regenerative and resilient farming methods.

Looked at in this way I think that it is entirely possible that the River Cam could come to flourish beautifully, possibly more than it ever has in the past with humans taking proper care and working with the river, its whole catchment and their cities as part of that.

This will not be easy and has to be part of a lot of other fundamental changes to how we do things. But humans have made many great and dramatic changes in history, often they seem a bit accidental in hindsight, but this time we really need to be aware and deliberate about building bit by bit systems that will work in the future, because if we don't the future will be very grim for us all.