Transcription Round Table M^3-Workshop 17.06.2010

Members of the panel

Wolfgang Ahlf, TU Hamburg-Harburg
Marc Babut, Cemagref, Lyon
Tom Gallé, CRP Henri Tudor (Moderator)
Graham Harris, University of Lancaster
Penny Johnes, University of Reading
Peter von der Ohe, UFZ, Leipzig
Marc Stutter, Macaulay Institute, Aberdeen
Jeremy Wilkinson, CRP Henri Tudor

Opening – **Tom Gallé**

This is the end of our one and a half day workshop which was quite intense I think and as you saw probably from the program and the invited speakers there was a kind of common thread behind that, of things we wanted to have addressed and I think also it worked, more or less. All of the things I expected have been addressed. This discussion intents to review the main points of interest or the questions that have been raised from the audience or the speakers, questions you missed, things you encounter in your practical work that we didn't address, things where you think research or more practical guidance is needed.

To start with, we had a lot of discussion on how and what to monitor and one main thing that was on my heart was the missing link that we have between our Environmental Quality Standards and the way we monitor. There seems to be no real differentiation or concept of whether in monitoring we measure an ambient exposure, so which would be linked to ecotoxicology and EQS and what that implies - so how we have to monitor to characterize in an appropriate way an ambient exposure. And on the other side, we have the need to quantify loads that leave catchments in order to see whether our emissions are really going down if we aim at reducing emissions and to be able to quantify that.

There seems to be a contradiction between both those monitoring schemes and this is the 1st discussion point: How do people from the ecotox side and from the nutrient side see that and what their opinion is. Is a compromise possible or do we have to split this totally?

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2min55 – **Peter v. d. Ohe**
I think from the ecotoxicological point of view, actually the load is not so much important, maybe later on for the North Sea where this is accumulating. But as long as it is in a flowing waters, the concentration would be of more interest and there even an annual average is probably also not reflecting so much the effects on the community but what we observe is rather that maximum concentrations play a bigger role. While for nutrients maybe the load is more important. So I am not aware so much that the load for pesticides is also monitored in terms of loads or is it more for nutrients, because then I don't see that it's fundamental difference to monitor it. If you know the body of water and the concentration you can also calculate loads, thing which is often done –

Tom Gallé
Yeah, with a big error…

4min – **Penny Johnes**
I don't think that's a compromise, I think if you sample at a frequency which is high enough to give you a reliable load estimate and you fractionate the determinants of interest you'll deliver the data that you need to demonstrate the exposure of things like ionized ammonia for fish species i.e., but you have to sample at a high frequency to do that, so the answer is to develop mechanisms to sample at a high frequency from which you will get good load estimates and you'll get information on the exposure to toxicants. So I don't think it's a compromise, I just think we just need to rethink how we do things.

4min35 – **Tom Gallé** –
Will it be possible in every water body or will we have to make choices?

Penny Johnes
My experience is of course with the UK monitoring system and we do enormous amount of environmental monitoring, but it's all for the wrong determinants of a wrong frequency and, if I could start again, or if we as a community who can persuade the government to rethink what it is been doing for 50 years then we will change the determinants that are monitored and we will more frequently acure locations. So within a basin we might have a hundred km^2 basin, when we have one site where we do things correctly and that might deliver us a reliable record for that point, within the basin if problems become apparent you can do more targeted monitoring that isn't necessarily tied to that point. So I think there are ways of doing it within the existing resources, but we have to change what we are doing at the moment.

5min25-**Tom Gallé**
And what would be your criteria for aggregation of catchments?

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5min32-**Penny Johnes**
I think about 100 km^2 is affordable, I think smaller than that is not. But in terms of mitigation of problems taking in relation to nutrients, then we need to be looking on how measures because a lot of the work we've done have shown that you can't take management strategies out to a basin on a regional scale. You need to home in on all the areas that are really causing the problems first, where you get the biggest response in terms of environmental benefit to the mitigation measures that you put in place and then after that you can go around to the wider region. So you are not talking about having a regional policy that monitor ten thousands of km^2, you need to be going into small farmsteads and talking to farmers.

6min12-**Tom Gallé**
Are there other opinions on that matter from a practical side?

6min20- **Nick Howden**, Bristol University
I talked to the Environment Agency, as I am sure Penny has many times, and asked them why they don't monitor more frequently. And main point for them is if you send somebody out and monitor – say 30 sites in a catchment – they can do that in a day. So they spend one day's worth of time and they get samples from 30 sites. If they have to go, say do it once a day or once a week rather than once a month, you have actually multiple journeys and it's the journey time and the staff time which is costing the money. So the outcome from that really is, I suppose if you want to have high frequency measurements we need to have much better monitoring equipment such that you could install it in the field and simply download it once a month but…what does the panel think about how far we are away from being able to do that?

7min15- **Penny Johnes**
My experience about equipment is that for inorganic nutrients we are quite a long way down the line and we have relatively robust sensors that if we calibrate on a frequent basis can give you quite good data – we have seen some examples during the conference today in particular. I have been told that there are sensors for total N and total P – I don't believe it, because I know how you do the analysis in the lab and you couldn't possibly just sense that information. So with the demonstration test catchments program which is this big investment by the UK government and which has just started this year – one of the things we are going to be doing is comparing what you get from those new sensors for total nitrogen and total phosphorus with what we would get with the traditional lab analysis and there is a very detailed cross testing program going on in each one of the demonstration test catchments, at that each one of the sites, to actually evaluate this.
So we do get an answer, in maybe three years time but I think there are probably a whole range of other interests, not nutrients, where I am not sure what the progress is with sensors.

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8min15- **Peter von der Ohe**
I would really highly support this because the frequency would allow us to better detect the maximum concentrations and indeed less other sites would be fair enough for this purpose.

8min30- **Tom Gallé**
Wouldn't that call for a kind of stratified sampling? For example, for pesticides, you rather know the period when you expect them. Same for sediments, there are periods where there are more sediments, maybe it's not the period where they are most relevant to the biota. In winter they might not be as relevant as in summer when there is a big flood wave, which is quite rare but which can happen and which can have a very big effect. So do you recommend regular sampling schemes?

9min08- **Penny Johnes**
I would still say – with our experience, which is only based on nutrient data and I stress only nutrient data - when we've interrogated records with daily sampling post storm events against daily sampling to roundabout a 100 km^2, we do appear to capture the full range of behaviours in the basin. Now, I got a colleague, Phil Jordan, who works in Northern Ireland, and he's been doing a very detailed study on the river called the Blackwater and he published a couple of papers in 2007, where they went down to a much smaller scale, they were looking at 10 km^2 and they were trying to pick up individual farm pollution incidents and he has demonstrated very clearly that at that spatial scale, daily sampling is not good enough. You need to be down to continuous monitoring and they have trailers with the flow max system set up to pick up these individual events that occur from minutes to hours rather than days to weeks.

So, the frequency which we need to sample depends on the scale on which we are doing the monitoring and that in itself is determined by the question that you are answering. So you have to think about whether we can have one overarching scheme, which gives us a broad picture at a national scale of what it is going on in our drainage basins, but within that we do more detailed sampling as targeted on top.

10min25 – **Marc Stutter**
Clearly, the highest temporal and spatial resolution sampling is the holy grail that we can never afford. Regulators would have a fit we suggested it we needed it. I think what we then need is - we do need high resolution data, we need to know about the loads, and we need to know about these ambient exposures - the cycling rates and resident times and things…and what we need is a good mechanism to go from data rich to data poor. So, data rich is going to be our research intensive catchments and then we need the right frameworks to put that information into the data poor areas which probably are going to be a very patchy national monitoring that's done for policing requirements.

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11h30 – **Jeremy Wilkinson**
Penny said in her presentation when she was showing us these examples that nothing was done about farms and obviously that's a big issue. If we are talking about this business of whether you go for the holy grail of very intensive spatial and temporal monitoring which is obviously ridiculous from an economic resource point of view. On the other hand if you do have your 100 km^2 catchment and monitor that and then you go back to your catchment and you have an investigative team which is set up with all the equipment that it needs to go around, they are like an investigation team. They go around and look at the conditions. They do risk assessments. They locate areas where there are problems or they find out where there are no problems. And then they go and do some monitoring for few days or a few weeks to the point where they can characterize some of the on-ground problems and then deal with those in a more direct way. But it does require that rather than you having a rigid system whereby yes like by once a month, once a week can sample, you have to have a team of well trained and skilled people who have an eye for dealing with these issues and also the personal skills to deal with the farmers so that they can come to a win-win situation for the farmer and for the ecosystem and the water body itself.

13min12 – **Tom Gallé**
Is this also a discussion about sampling at base flow or high flow? What is the more relevant?

13min20 – **Jeremy Wilkinson**
Well, no, it's not, it's exactly what we've been talking about. Nobody is saying "you should sample at high/low flow…" I mean it is obvious, if you are dealing with something which behaves in response to a storm event then you do event based sampling or some kind of stratified system. It's not rocket science. We should be able to deal with these things.

13min 40- **Penny Johnes**
But if you think about it in a holistic sense, lets recognize that we're not going to get 16 different systems, one for heavy metals, one for nutrient samples, one for sediment transfer, we're going to end up with one national system which may or may not be replicated between European nations. So we have to get the maximum amount of interest and information out of that. And if we think of something like phosphorus, although a very large amount of phosphorus is transported through load and rivers through storm events attached to sediments, probably 70% of the load, on average, comes in to most rivers systems that don't have big sewage works, in storm events. In low flow events, that's when we have redox change in sediment surfaces and we end up with internal phosphorus release from accumulated sediment stores in the river. So actually just for one determinant, for phosphorus, both base flow and high flow events are equally important and for the benthic biota, perhaps the internal release of phosphorus is more important. Certainly for the plants, what's in the sediments is more important than what is in the

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water column. So actually you need both. You need the complete composite picture of the behaviour of the pollutants in relation to hydrological conditions of the basin and the sediment transfer conditions. Because certainly in the work that we've done it's the flow and it's the sediment that are the drivers. So if you get a representative sample of how the sediment is moving in the system and a representative sample of the hydrological conditions you'll get a representative sample of the pollutant movement. And this is what we're to aim for in those systems. And I'll still say that we don't need to have different systems for different pollutants.

15min14- **Peter von der Ohe**
In a risk-based project, we came to the conclusion that it would be nice to include that with a modeling of hydrology, so to say, in the basement. So you can say which catchments are more important based on the base flow. I think it could help also to trace back or determine at which point you have to sample if you have a heavy rain in one area then it would be some delay in the outflow and you can also predict when you have highest concentrations.

15min43- **Tom Gallé**
But there is also an aspect of traceability of local emissions. The further away you are from a certain emission point you decrease your chances to really still be able to detect that. This is also about scales, about the flashiness of the signal so everything is linked.

16min09- **Marc Stutter**
Don't forget that we're dealing with not just the water quality itself, but some kind of integrated ideally catchment management that is the land plus the water so that I think we can possibly offset some problems with costly monitoring of the water body as a kind of end point in the system with some good auditing of the land. And by doing that we're kinda getting directly at what we need to know about, as well. And that's part of managing the land and the water together.

16min45- **Graham Harris**
Just to go back to Penny's paper, you were talking about charophytes in your broads and so on. It struck me, you know you made the point that you didn't quantify loads from the agriculture itself. It seemed to me that if you'd done as Jeremy and actually looked at the context and looked at what the likely impacts would be, then there are, as I would say, some 'no regrets' things you could do without actually having a good qualification of what the loads were. It's sometimes quite clear what you actually need to mitigate in order to get any improvement in the situation itself. I think there are situations where even a lack of data isn't actually a problem.

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17min28- **Penny Johnes**

I think this is partly to do with knowledge transfer because in both of those case studies there were very good reasons why they didn't look at the catchment. In the Barton Broad case study it is because they are still wedded to the data that came out of America in the 1970's that said if you switch off the sewage treatment works the lake becomes clean. Think of Lake Washington and all the various other case studies and the assumption was the European situation would be the same. But of course our agricultural systems are 10 times more intensive than the American systems.

I often go and lecture in America and am very often asked whether I've got the decimal point in the right place when I show them the concentrations we have in Europe. It's quite glamorous being the bad boy of the world and standing there saying, "yes, our waters really are that dirty." But that science didn't transfer when it came across the Atlantic. Rather like western agriculture doesn't transfer very well to the semi-arid environments of Australia that Graham was talking about before. And so the reason the Barton Broad team didn't look at the catchment is they didn't think anything was coming out of the catchment. They weren't worried about nitrogen because they're all limnologists and they assumed it was phosphorus limited and they thought all the phosphorus was coming from the sewage works. And both of those assumptions were wrong. So that is a question of knowledge transfer. We resolve that by making sure the good science understanding gets out there to the practitioner community.

In the case of Bosherston Lily Pools, they also assumed that it's phosphorus and not nitrogen that was driving the system but they actually, as a land owner, only owned the lake, the lakeshore and the woodlands around it and they didn't actually own the catchment. And there is still, to this day, no legislation available in the UK that would allow them to go in and stop the farmers from farming. And that remains a problem at that site. So with all the investment at the bottom end of the system, the rubbish bin work that Brian Moss describes where all the debris from the agriculture practices collects, the lake, they can't actually get back to the source areas. And until we change the legislation they will never be able to do that.

19min22- **Jeremy Wilkinson**

It's not all about legislation, though. I saw a presentation by Bob Harris a few weeks ago and one of the things he pulled out from some of his involvement with stakeholder groups and things was that they had four quadrants where you legislate where you have to – where they won't – and there is the voluntary aspect. I can't remember how it worked. It's not all about forcing the farmers to do what they're supposed to do. Surely there are other ways of doing these things. The other thing was, something we've heard from numerous of our speakers over the last couple of days, that you need to look at things on a case-by-case basis. There are a few sayings about making assumptions in Australia and one of them is that, take the word assume; ASS U ME. When you assume you make an ass out of you and me. Now, I just being provocative. So don't take that too personally. I put a poster out there about a best practice framework for monitoring and evaluation in

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South Australia. One of the key things about that is it is an information gathering activity. You draw together your specialists and your stakeholder groups, and you do a workshop and you gather all the information about a system and you get a really good idea before you start to think about any sort of monitoring about how the systems working, what the key issues are, you produce your conceptual diagram where you're getting all your idea and you get everyone working together and talking. And it helps you to overcome these problems of knowledge transfer, making assumptions about how the system works before you go in there and do anything. By all means, use your a priori information. But at the same time, get involved with the local people and the local specialists and gather the information you need.

And another point, you also spoke about national monitoring networks. I think I'd go for devolution. Is a national monitoring network appropriate? Only if it's designed to be adaptive and takes into account all of the local factors so that your actual monitoring program, in term of spatial consideration, the pressures, the determinants, whether you're monitoring base flow or high flow, are all taken into account so that you're actually targeting your activities very closely to what you know about how the system works or it's geared towards helping you improve your knowledge of the system's processing and behaviour.

22min15- **Sacha De Rijk** (?), Deltares
I'd like to go back to the techniques Dr. Hardcreek has been monitoring, but would it be helpful to use techniques that measure over a certain time slot, for instance progressive sampling technique for six weeks, at least for estimating loads. Maybe more complicated for maximum concentrations and ecotoxicology. For the load it will be kind of a…

22min50- **Penny Johnes**
You're talking about time integrating sampling, which you can do and has been done in quite a number of programmes in the past. The problem is that, if you are looking a sediments and sediment volume, that is fairly conservative once you start tipping your samples into this accumulating bucket that you're going to collect in six weeks time. But with nutrients they are very often unstable and some of the fractions are unstable within an hour of collection. So by the time you bring it back to the laboratory you may have a very different sample of what came through that window than you would have had if you had taken the individual samples back and analyzed them at the time. Which tends to be the way with nutrients, which are not conservative. Then we tend to use integral sampling rather than time integrated sampling. But you can do it. You're quite right.

(Maybe for persistent substances).

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23min33- **Graham Harris**

Well it depends on the time constants of the process that you're interested in and the biological response. I think it's pretty clear that we, I keep talking about this framing issue I've heard the in the last day and a half, there is a kind of an assumption that things happen slowly over large scales. Hence we have a monitoring system that collects data infrequently at fairly large spatial scales. I think everything that we're beginning to learn and we've heard a little bit about in the last day and a half is on the contrary: things happen quite quickly at small scales and have large scale ramifications. And the problem of doing integrated sampling is that you never actually get process understanding of the peak that was somewhere trapped in the middle of your long-term sample. There are lots of biological reasons why that peak is going to be important. And to continue to be provocative from yesterday morning, my concern with the water framework directive is that, you're building a house of cards, because you're building something which tends to average over particular spatial scales which averages over particular temporal scales. You're not getting the kind of process information you need in order to build these models. And it really scares me. I heard somebody say, I think this morning, well we know the model is no good but we have to start somewhere. My much preferred course of action would be to actually start with the data and start with the real world. There are too many people who think the model comes before reality. Whereas, my view, the model should try to capture some aspect of reality and not force it. My real concern is coming from outside, you've built this incredible piece of bureaucratic superstructure on a pile of assumptions on the way the world works. And I think the more we look at new technologies the more we get new data the more we critically look at the data we've got, the more we realize the kinds of time and space scales we're working on are not appropriate. And that's, I think, a real worry. Jeremy's idea of sort of devolving things to local people who work at local scales, as has been done in Australia with regional catchment management boards who look after individual catchments. There are various ways of devolving governance and everything else. The bottom line is that you're not going to get the outcome until your process understanding and you get the data at the right scale to resolve the phenomena that are driving what's going on.

26min13- **Wolfgang Ahlf**

Yes, I would like to add something to the framework. I have the feeling we have at the moment we have the background and the ecotoxicological point of view that we are looking on fate and effect in our systems different compounds, different chemicals, whatever, assuming that at the end there is an equilibrium, maybe, between different compartments. That's obviously rubbish. If we open our mind a little bit to lifecycle thinking, then maybe we are looking on environmental impact, then we need to know inventory. How much is in the system and how is the dynamic? So that maybe we need a new framework or an addition – complementary to risk assessment. It's more than risk assessment. So maybe that will be helpful.

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27min 13- **Graham Harris**
Well, one scary message I picked up this morning is that, coming from Australia where we have a relatively small number of people in a big space, we don't have the kinds of problems in our rivers that you guys clearly have with organics with POPS, with pharmaceuticals, and estrogen mimics. I mean, if that number was right, 2 g[1] a day out of a small sewage treatment plant. I mean, you can do whatever you want to catchment land and use all the rest of it and your rivers are still going to be buggered. Because what is the biology going to do to a couple of thousand pharmaceuticals with a load of a couple of gs a day whistling down it? In a way, not only do you have multiple stressors, but the other scary thing is you obviously got a few hundred or more unknown stressors in there too. So it is hardly surprising that, if your data is a bit 'crook', but also you've got a whole bunch of exotic organics and pharmaceuticals and things whistling down your rivers. I was reflecting on the fact that, thank God I live somewhere in England where the water comes off the moors and there are not too many people between me and the source and I live in Tasmania where exactly the same thing. There is a mountain at the back where the water comes from. The fact that you are living in situations where you are drinking people's waste and 70% of the flow in some rivers is waste water. That strikes me as being, not only from a human health point of view, but from an ecological health point of view, something that you need to know much more about.

28min51- **Tom Gallé**
Which leads to another question that occurred to me: do we have the right metrics to characterize the ecosystem health? So this is the first one. Maybe referring also back to what Mark said about ortho-phosphate, which is not a really good metric for eutrophication. But I am still a little bit surprised that more integrative metrics like gross primary production or ecosystem respiration, are not used across more as an approach because they also make a better link between the biological indicators.

29min36- **Marc Stutter**
Yeah, I think you're right. I think the whole system integrating things such as metabolism would be a good way to go. I think concentrating on a single indicator species is a bit dangerous. And some of the bioassay work has really quite dangerous extrapolations and simplifications from the single pollutant, Complex mixtures being in the real world. But not quite sure how to turn some of these more, perhaps metabolism, how to turn that into a tool that could form a national monitoring framework if that is what we require to get our answers. It is just difficult implementation.

30min30- **Graham Harris**
I think if I had one message from the last couple of days, is that you're all being too terribly nice to each other. I mean, there are a lot of papers about methodology, about

[1] Graham Harris refers to kgs of load, which is due to an error of magnitude in that presentation. Nevertheless even with gs the ambient exposure is several hundreds of ng/l for several pharmaceuticals in the cited river

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evermore baroque and arcane statistical techniques for dealing with inadequate data. For evermore elaborations of the framework directive, where is what I think what you actually need to do is be much more critical about your basic assumptions about what the hell you're actually doing. My criticism of the workshop is that we haven't had enough time for discussion. I mean, I ran that workshop in Windermere in April, and I got people from around the world and I briefed people before they came, and I said, "I do not want you to give me a paper on your latest neat bit of work in river X. I want you to come and tell me what you don't know." And we actually had a very interesting three days. There were only 10 or 11 papers in three days – an awful lot of time for conversation – but we managed to tease out a huge amount of stuff that people worried about at 3am but generally didn't talk about. And it seems to me what the EC ought to be doing is a) being much rougher with each other in terms of basic assumption and is your model adequate and why are you doing it anyway. But I think you also ought to being going back to tours and saying, for goodness sake, what is it that we don't know, rather than endless elaborations of a framework that we all know has got flaws. Be a little less nice to each other. The academic tradition is that within the four walls of this room you can criticize people without questioning their parentage. You should feel able to do that because quite clearly, as a number of people acknowledge, a lot of this stuff ain't working at the moment. And there are an awful lot of reasons for that. You should be looking much more critically at what you are doing, even roughing a few people up in public on occasion just to get them to think really critically about what it is they're trying to do.

32min47- **Jeremy Wilkinson**
That is a point well made. And if I can refer to our own internal experiences; Tom is good at roughing people up. He is good at calling a spade a spade. Maybe I've been too nice to people too. There is an avoidance of stirring things up too much. You think well if we upset some people by complaining about the way they do some thing then they'll stop talking to us and the whole process of communication breaks down. So there is a lot of, maybe that's a European issue. Perhaps in Australia it is easier to go up to someone and say, "what are you up to mate? What you are doing is absolute rubbish!" And say, "what do you think I should do?" without taking it personally.

33min38- **Graham Harris**
Tell me to shut up if I go on too long. I actually think we've got a problem with the whole innovation system and it certainly true in the UK where I'm heading a lab and I see how this works. We desperately need funding. It's a very competitive environment. We're resource limited. It is going to get worse. There is a budget in the UK coming down next week and look out. It will have some pain in it. With a result that when you put in a grant or you try and publish a paper, of course it is all about reputation and impact factors, you can only be so little bit extra innovative than the last one. Otherwise it won't get funded. If you put in a radical proposal to a research council in the UK, they'll knock it back.

(Same in Germany)

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So a whole thing is set up at the moment for incremental change. And if you look at the trends in the globe, you look at population resources, environment, energy…incremental change, my friends, is not quick enough.

34min42- **Marc Stutter**
Well actually what we're being asked to do is policy relevant science and to me that almost means science that policy makers are comfortable with which is not really what we need. We need a bit more of kind of, put the wind up them a bit.

34min59- **Graham Harris**
But the whole system is set up – Only because I'm 10 days from my retirement age, I don't put in grant proposals anymore. I don't need money and students. I can do the kind of lateral thinking that you heard me give yesterday. It doesn't bother me. I don't have a reputation anymore (haha).

But the bottom line is that most people, mid career, are driven by grants, money, students, papers, outputs, all that stuff, and there is a limit on the speed of which we can innovate. And that is something I think has become a serious issue in the western world. The same is true is Australia. I had a grant proposal knocked back once because it was too innovative, the letter said. So I framed the letter.

35min53- **Marc Babut**
Back to the question you raised about whether the metrics we're developing are appropriate for characterizing ecosystem health. I am wondering if the question is relevant. Ecosystem health, to me, is the wrong concept, an inappropriate concept. It would mean that an ecosystem is represented as an organism. But it is not. It is not an organism struggling to maintain its homeostasis. It is the same with ecological status, it's exactly the same issue. So the problem is not to develop the right metrics. The problem is to set the appropriate goals.

36min45- **Wolfgang Ahlf**
Just an addition, and we have to be honest to ourselves, because we are talking sometimes about ecological resilience and in principle we are talking about engineer resilience. Is it what we've disturbed then to help a little bit. So coming back to the status it already was, but that is not ecological.

37min12- **Marc Stutter**
It's correct that the goals are the right thing we need to sort out first. But it's just really a kind of juggling act. We all know that we would like good ecosystem health and status. But in many cases we're not going to get there, we are never going to get nitrates down where they need to produce food. So we need to recognize that certain catchments are always going to fail these targets and we need to set appropriate targets. And if we look

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towards a system, something like provision of ecosystem goods and services as a whole, you could juggle those as to say production of food for humans was an ecosystem goods and service. So you just have some trade-offs you have to juggle. You have to live with areas that are degraded, perhaps.

38min06 **Tom Gallé**
Any other philosophical contributions from the audience?

Marc Stutter
Or technological solutions to take it out of the water once it's there?

38min20- **Jeremy Wilkinson**
A comment about the agriculture, briefly. Reading the programmes for measure of Delfland board, one of the objectives, on of the directions, more appropriately, is that they are expecting there to be a reduction of nitrogen from agricultural land through two mechanisms. One is through expansion in population and a change in land use. So you are actually reducing the amount of agricultural land. Erwin can correct me on this if I am wrong. And the other aspect is a conversion to more organic styles of farming – no till farming, where your use of chemicals is much more careful and better managed, I suppose.

39min21- **Erwin Meijboom**, Delfland Waterboard
Yeah, I think you're right with the first one. We've actually have looked at the socio-economic of the most densely populated area of the Netherlands we are in. So we have to say, will we urbanize further? So that means reduction of farmland. But, evidently we will be faced with other problems, which we don't know yet. On the second one, I want to relate to what Graham said. It is also a political problem because we, in our program of measures, we will put millions and millions in nature friendly banks and ecological maintenance of the waterways. But we really don't know what the effects will be. We are also look at farmers and also taking action by ourselves. Let's raise the question, what should we do as a political organization? We have to deal with the water framework directive goals. That is another discussion, but it is the same discussion in a local sense. So what we also put in the program of measures is we do more research and then we look at what kind of measures we will take. But then the circle is round. And maybe it is sort of a loop because if we want to do more research where do we put our efforts in and what will be the result? Also when you look at the discussions of yesterday, how do we have to do good research in this way?

41min13- **Jeremy Wilkinson**
I suppose it leads to a degree of cynicism about the whole process, ultimately. In regard to what Graham is saying about practical measures that you can take, simply by walking around your catchments and looking where the problems are. I'm not an advocate of science and research for the sake of it. Very often I think a lot of what we do is geared to

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chasing the objectives of keeping the income going and keeping our research groups alive and all the rest of it. If ultimately that doesn't lead to some concrete actions on the ground then we are wasting our time. What are we doing here? You just accessed my degree of cynicism.

42min09- **Nick Howden**, Bristol University
I just wanted to make a couple of points, really. We've been doing work, looking at the national scale for nitrogen budget for the whole of Great Britain. And what we found is that if we look over a period of around 25 years, we're in the situation now that the flux at the tidal limit going out into the ocean is going up. But the inputs have been going down for quite a while. So that the sort of time constants in the system for dealing with these problems at a national scale are going to be quite huge. We've been farming very intensively for 60, 70, 80 years. I think it is very unlikely, that even if we have a complete reversal now, that many catchments are going to recover in the next 10, maybe 20, maybe 30 years. We could be looking at the end of this century if we have a radical change now. I think the idea we are going to be able to implement ideas of measures and have them be successful quickly is dooming us to failure. This is something that will have to happen over many, many decades. There is a notion, it seems to me, that we find a technological fix and we sort out the problem. This isn't going to be like that, as we all know. But I think that there needs to be an element of realism in how long it is going to take us to reach these goals. I think it could be an awful lot longer than any of the political masters have really realized.

43min40- **Marc Stutter**
We need to kind of take people with us on this journey towards cleaning the system up – like the farmers and the people that do manage the land. You need be careful with that truth about the time lags of the system. I wonder whether, just relying on indicators of water quality alone, especially when we are communicating and coming up with behaviour changing and persuasive ways to work with landowners. Perhaps we should redress the balance with some immediate things like looking like they are beneficial to them or actually give that persuasive power – look we've actually stopped you from losing such and such euros of phosphorus and soil resource into the stream. Instead of saying phosphorus is going down in the stream, when it's not. Just pick something that is working.

44min30- **Nick Howden**
Yeah, I agree. It could be very important as to identify those things you can do immediately. But also those things for us to be very clear about, what it is going to take a long time. Because a lot of the farmers that I've talked to in the past, they all say 20 years ago we were all being told to do this, 10 years ago I was being told to do this and now you're telling me to do the same thing as I was doing 20 years ago. What is it that I should do? I think we've lost confidence from various quarters because of the mistakes of

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the past. But I agree that it is important to take people with you and that's a huge challenge.

45min08- **Graham Harris**
We have achieved a lot over the last 20-30 years, huge control of point sources. Look at most of the EPAs around the world, most of the water companies, they've got licenses on discharges of various toxicants and so on. You look costal harbors – levels of toxicants are going down. Now we're into the kinda of diffuse pollution problems, which have much longer time scales. If you say inputs are going down then that's a robust decision making approach that says we're not actually seeing much, we're not actually sure what the hell is going on but for Christ sake get the loads down. At least it is moving the thing in the right direction. In a way the planetary situation is a bit the same, we're already using more than the resources of one planet. Blind Freddy can see that we better start cutting resources. At regional scales, particularly, there are lots to be done to regards as sort of no regrets decisions. And if it takes 30 years to see any benefit well, that doesn't fit with governments and elections and financial returns of markets and things like that. But so what?

46min17- **Nick Howden**
There was something else that occurred just recently that the national monitoring agency in England and Wales is very concerned about possible deterioration of the quality of river water body because of carbon budgeting for water companies' treatment works. Our rivers are in better status than they would be if effluent discharges were actually kept just to the absolute limit. So a lot of people are overperforming in their infrastructure, but that is actually costing them if you look at the carbon footprint of doing that. That's actually giving them a much bigger carbon footprint. So in the next sort of 15-20 years the pressure to reduce carbon footprints and energy consumption and providing a clean-up could actually provide us with further problems.

47min31- **Marc Babut**
I may have one point, I was struck by the number of presentations dealing with the uncertainty assessment. I think it is quite interesting to see that we have now around 100 approaches available to assess uncertainties of our results and outcomes. But there is still a big question there, which is what do we do with the uncertainty assessment in the perspective of decision making. We didn't address this issue at all. I guess it could be an issue for the next workshop.

48min18- **Tom Gallé**
We will have one on the uncertainties and scenarios. In terms of, maybe just one thing that was missing now is the link with ecotox – the multitude of pollutants we are facing. At the moment we're not really addressing it. The priority substance list is not really appropriate, we agree on that. But there are many other substances that we might have to take into consideration and we saw that we have different methods of addressing this

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with SPEAR and toxic unit approaches which are much more integrated, or the different batteries of tests. My questions would be, maybe come back to the metrics, shouldn't we concentrate on indicator substances? And it's something I've really been thinking about, because maybe we have some very specific regional contamination types which are often linked to an economic activity, mostly an old economic activity, but a lot of the contamination today in the world is quite similar, also because consumer products are getting more and more similar because there are normative rules behind that. I see a little bit of danger that we might have in 5-10 years time a priority substance list of 300 substances and everyone will be measuring like crazy and spending money like crazy and maybe six indicators would be enough. I don't know how you see that. But to me, in Luxembourg, it is obvious that you have a waste water treatment plant pressure, as Graham said, where you have simply a big waste water treatment plant input in the river. This is the problem, this pressure, this means that there is a whole cocktail of substances that can't be degraded in the treatment plant that come along with it so why don't we just take a kind of indicator and we have an uncertainty around that for all the substances come along with that. So I don't know if you see possibilities in that sense.

(Graham Harris leaves)

50min59- **Peter von der Ohe**

If I may say, I think there is a certain risk with that, if you only consider waste water treatment plants, there was an interesting approach in the Helmholtz Centre to look for coffee. Coffee is drunk also equivalent to the population and it does not so easily breakdown in the treatment plant and we could see how much is really coming out. But that could be one approach if there is difference in the age structure than maybe some have more pharmaceuticals consumed so you cannot really assume that the effects are the same on the system. And on with regard to agriculture, I see the problem that there are always new problems with pesticides. There is a good example that there are always new products coming out and they are not yet on the monitoring list so they always try to catch up to the monitoring and actually there is already and new one and you are measuring the old one from 10 years ago which are still in the system as well. But you are always looking for unknowns. And our own department "Effect directed analysis" is not doing anything else and looking for these unknowns. You see there is an effect but we don't know which one it is.

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52min13- **Wolfgang Ahlf**
I think we have to differentiate because we have global indicators like global warming potentials or POPs. Then we have intermediate/regional like acidification maybe that's one indicator. But on local scales, we have different fingerprints they are different from local input to other local input. It has to be considered.

52min54- **Marc Babut**
My own feeling is that the concept of priority substances is interesting when you are able to manage the source. But if it is just to use to set a limit in the environment there is no practical use. There was another quite good example in Sasha's presentation this morning with one of the PAH, because there is no way at the moment to reduce the source which is mainly due to traffic. Again, we might need other metric or indicators of toxic impacts, but for me the major need is not related to substance it is related to biological metrics. And then, if you see an adverse effect with these metrics you can look at the substances responsible for the effects and then manage them. But it is more or less the opposite procedure.

54min20- **Tom Gallé**
Which leads us again to this link between the tests, the bio-tests and the world out there, the wildlife, the ecological indicators. With the SPEAR approach and the Toxic Unit approach there seems to be a link for the dissolved substances. How far away are we away from this for sediments? Also if you think globally of sediments as food, being part of the food chain. How far away are we from an integrative (approach)?

55min02- **Peter von der Ohe**
If I also may jump in there, because I was also involved recently in a study that is very interesting from the BFG in Germany who collected sediment samples and extracted in the nematode community of these sediment samples and also extracted the concentrations of pollutants that are really close by these nematode communities. We were able, In a more empirical way to derive an index of SPEAR-nematodes communities which was again very well related to the bioavailable pore water concentrations that were predicted from the measured concentrations in these sediments. So I think that if you use the normal SPEAR, there would be almost no sensitive species in sediments. The SPEAR index would not work for sediments. That nematode community is maybe one way around it.

55min54- **Tom Gallé**
My thinking around having this link is that if you think catchment-wide and you think of sources and you think of the long time scales that it takes to get a catchment clean or to whatever reference state, sediments might be a very good indicator. Although they are very dynamic, they can show that very well. But what we miss is still really making these links. We are still a little bit more on the empirical side. Not getting really the link with ecology. Do some of the experts see some perspective.

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56min35- **Wolfgang Ahlf**
It was a lot done for benthos structure. So for benthos community were described for different geo-chemical habitats. But the link to toxicology, that's not well done. So I think the ecological side is not there. Because it was done for the water framework directive to describe a good ecological status.

57min01- **Peter von der Ohe**
I would partly disagree. What I just said is that the sensitive species are also living maybe on stones and plants and everything. I think for me, sediment is always a source of pollution to the water phase as exposing a real sensitive community. Because if you look at these species that are really only in the sediments, they're really tolerant, relatively compared to other species.

(Maybe historically)

Yeah, indeed. Already from the way of thinking that sediment without air, it is logical that they are more tolerant.

57min40- **Marc Stutter**
Let's at least make sure that all these relationships are derived using realistic conditions. The complexity of the sediment environment on the bed of a river is a redox states, different levels of organic matter getting incorporated at different times of the year, and the hydrodynamics. I mean to take that home and put it in a bottle, shake it up and overnight it's crazy. Let's try and do as much as we can in situ, DGT stuff is great way to carry that forward.

58min17- **Tom Gallé**
We filled our hour, the time is more or less up. The take home message is maybe that 2015 is not very realistic. (haha) To review, the whole process of what we're going to expect, the message of if we should review the goals, not in terms of giving up the goals, is quite essential here.

58min51- **Penny Johnes**
I think we might need to give up some of the goals. It's quite unattainable that probably most of north temperate Europe to attain the diffuse nutrient goals within the societal structures that we have at present. The actual thresholds are so much lower than where we are. We won't want to pay the cost of getting there. We can't afford to get rid of the people and aforest the whole of the landscape in order to get the concentrations for nitrate and nitrogen down to 2 milligrammes per litre. Where currently they're sitting at well over 15 across much of the UK, the Netherlands, Benelux, Denmark and so on. We won't want to pay the cost. We'll have to give up our motorcars, we'll have to stop farming. We're not tinkering around at the margins with trying to get farmers to move gates around and change the time the put fertilizer on. We'll be saying to some of our

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farmers you can't farm at all, if we want to hit those targets and society won't want to pay the cost. So we actually are going to need to, at some point, revisit those goals or we're going to have to use the disproportionate cost argument effectively to say that society doesn't want to pay the cost of achieving good ecological status in farming regions. We'll be able to do something, but we won't be able to do enough.

59min58- **Marc Stutter**
So we do need societal change. There are some positive examples, look at was smoking wiped out in the UK in about three years. People have stopped drink driving, wear seat belts in cars, things like that happen really quickly and those big mindset changes that we convince people. You can get there, hopefully.

60min23- **Tom Gallé**
With these encouraging words, (haha) we can close the workshop. It was nice having you here. I also enjoyed very much this discussion. I think it was very fruitful and lively and hope to see you maybe in another workshop. we will put a number of documents from the workshop online on our site so we are asking the different contributors for a pdf that we could put under the workshop so if people are interested to read some of the stuff that you have heard here that might be, in big parts at least, available soon, we don´t promise it will be tomorrow but in two weeks, maybe three weeks… remember http://www.life-m3.eu/.
We'll have three more workshops to come and there will also be more documentation on what we do, we'll be putting out some reports on what we analyze and also what our monitoring campaigns will be, and also the modelling and so on… so keep following us, you're all listed, you will notified also the next happenings.
Thank you for being here, thank you for contributing, good trip home and see you soon perhaps.

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