

A. Citizen Science - Minimum Evidence Considerations

Some thoughts from Prof Malcolm Newson and other members of the Catchment Data User Group on the capacity for citizen science to address different catchment monitoring topics and levels of certainty in evidence.

Element (WFD)	'style' of evidence	'minimum' evidence Credibility and/or alert	'adequate' evidence Promotes investigation	Conclusive (court) evidence Legally compliant/convincing
Hydromorphology: channel	Dimensions and forms (numerical); inferring processes (more qualitative or comparative)	Avoiding 'excitable' evidence of channel change, the observations (if measured) or photos of locals, esp. after floods, often yields an alert.	Lack of published geomorph. info. For most catchments means 'minimum' quickly becomes 'adequate'. The upgrade is largely a matter of severity rather than data quality.	The Fluvial Audit suite of assessment techniques is now established, if only for protected sites. However, site-specific problems can be addressed in court by a further upgrade from 'minimum' and 'adequate'
Hydromorphology: flow	Flow indices from measured or extrapolated flow records; can be semi-quantitative or qualitative at extremes	Citizen science unreliable at flow variables: fixated on spot levels, not durations. TAG advice on flow impacts may be more useful. Common Law checks on upstream water abstraction useful ->	Some hydrological information via publically-available sites at EA/NRW/SEPA. Simple observation of high flow damage or low-flow drying/droughting may be acceptable	Citizen science groups may need professional hydrology advice to assemble e.g. flow duration, hydrographs, rainfall and runoff trends. Reservoir pressure groups have gone this route. Q ₉₅ hugely contentious.
Phys/chem: nutrients	Algal blooms etc. are visual alerts but do not have a single quantitative cause. Long, high resolution chemical sampling best.	Blooms can be alerting, algal growth on bed material may need long-term dated photography or habitat survey forms.	Formal long-term data on habitat quality, water colour or fish deaths.	Will largely resolve from agency WFD chemical investigations (but see 'catchment controls below).
Phys/chem: metals	Impacts can be qualitative/spatial in mined catchments: there are visual indicators of pollution. However, health and other thresholds demand numerical data.	Visual indicators: 'spooky' lack of vegetation and fish. Often citizens regard the evidence as an historical inevitability: unlike other pollution threats.	Can be protagonist campaign groups who get a few metals analyses of soil or water. Often an opportunistic sampling access route – 'the regulators weren't here'.	Will largely resolve from agency WFD chemical investigations (but see 'catchment controls below).
Phys/chem: temperature	No alternative to long, high resolution	Simple, undisciplined, 'thermometer dipping' on a dog walk or	Committed observers' records by citizens who calibrate their	n/a – we do not have legal controls on water temperature except d/s

	measurement (both air and water)	similar. Land use differences appear by this route.	thermometers and also record flow levels and air temperatures.	of power stations. Am checking as thought temp was in FWFD for salmon and trout so is it in WFD?
Phys/chem: oxygen	Fish kills and other anoxic signals may alert but numerical data for compliance issues Photos of sewage fungus could be supportive and help engagement	Fish kills only.	Fish kills only	DO is a difficult measurement problem: stability/calibration problems formerly faced by pH. Realistically only agencies can cope. Agree but photographic evidence of fish kill could be valid evidence in own right
Chem: listed toxics	Fish kills and other anoxic signals may alert but numerical data for compliance issues	n/aI consider photographic evidence for some chemicals is valid eg chemicals that cause a clear deposition of something on stream bed and death of inverts etc (Water treatment works accidental leakage of chemical etc	n/a as adjacent	Formal sampling routines only. Photos could prove useful supporting info in some cases
Bio: macrophytes	Holmes methodology an encouragement to amateur observers; good visual handbooks e.g. Haslam.	No recorded experience of an alert via simple macrophyte observations. This is not an acute, but a chronic problem.	Those trained by Nigel Holmes will be able to alert and inform on long-term trends.	Agencies generally not good at the sort of evidence required in court. WFD information gathering helpful for targets. NE may have relevant info from SSSI assessments
Bio: inverts	Simple ID threshold: Family v Species. 'RiverFly' a champion of simple indicators – can act as legal alert. Numbers v diversity debates. Observed v Expected methodologies.	Enthusiastic observers may have data but 'RiverFly' has educated on the basic parameters.	Regular 'RiverFly' systems, e.g. via Rivers Trusts, can establish both river 'health' and, vitally, acute impacts from pollution.	Agencies have big O:E databases and use inverts as a regular indicator for court. EA pioneering an invert siltation methodology.
Bio: algae	Specialist area: requires strict sampling and microscopic analysis. However, visual	Difficult in this category of evidence.	Some combination of visual observation and links to e.g. university analysis under	Agencies now have models for O:E systems to evaluate algae to interpret pH and nutrients.

	indicators exist as in blooms and biofilms.		microscope may be adequate.	
Bio: fish	Simplest of all and widely accessible via angling (but that route notoriously unreliable). E-fishing an accepted norm; can involve volunteer labour. Observed v Expected models questioned. Fish counters/tagging beyond amateurs.	Fish kills an obvious route but 'no catching' has led to scepticism about angler observations (there are links to rental payments and illegal catches). Not an acceptable source.	Some angling clubs and syndicates keep 'proper' data and the informal data on brown trout fishing catches can be very useful: the 'discerning angler'.	Possibly, with the exception of fish kills, only open to agency upstream migration/smolt migration quantitative measures alongside e-fishing for juveniles and broodstock collection. O.v.E comparisons can be used. Use of photos of fish kills

Element (non-WFD)	'style' of evidence	'minimum' evidence Credibility and/or alert	'adequate' evidence Promotes investigation	Conclusive (court) evidence Legally compliant/convincing
Flood Risk Management	'Exact' and auditable engineering design and probability analysis, combined with financial assessment of damage. Flood warning (cf protection) is different.	Post-flood public outcry feeds in an unmanaged and unusable unstructured 'data'. Insurance claims also unreliable. Media often a vehicle for 'alert' but reveal the above 'data'. Formal and informal flood warning systems increasingly feasible.	Flood levels, often recorded on monuments and buildings, recorded flow routes and some indication of velocity. Properly-assessed damage claims. Informal flood warning for flood-prone communities increasingly feasible/encouraged.	Hydrological analysis, probability analysis and cost-benefit analysis.
Catchment controls/ Diffuse pollution	Rigour introduced by accountability/blame. Confidentiality issues. Overlap with local authorities via FRM and development control. Otherwise, observations (e.g. sediment sources in runoff events) vital.	Observations of poor land use and management: 'shock horror' photos of bad farming, forestry, urban development, where officially licensed. Observations under extreme conditions where licensing assumed 'normal' conditions	Prolonged or costly off-site (downstream) impacts such as silted roads or flood channels. This evidence may only arise via the hydromorphology WFD route.	Work in progress at all agencies. The Common Law of Riparian Rights is 'always there' but requires a huge investment by a victim to create a precedent!
Holistic habitat assessment	Twenty years of effort now to establish professional approaches (RHS/SERCON). Other, less formal recording systems exist. Repeatability and continuity issues.	Lots of well-intentioned river bank walkers have informal observations which have yet to be formalised. Serendipitous occasions reveal big qualitative databases.	There are citizen science systems via the Rivers Trusts and RAFTS that enable a formal contribution to agency regulation.	Not yet established as a formal regulatory route, despite the WFD ecological requirements. Possibly will enter via national reporting systems but only if finance allows continued baseline surveys.

Feacal Pollution Photos of overflows taking place, sewage fungus, no of occurences of overflows or discharges, smell could all be useful background info to trigger an EA survey. Need to include faecal pollution as this is one of the harder nuts to crack! I also do consider that dated geo referenced photos could possibly be admissible evidence when supported by the appropriate sample results. In relation to a consented discharge if these showed a clear breach of the consent conditions the photos themselves could prove sufficient although EA would be unlikely to proceed on this basis alone.