ATLANTIC SALMON TRUST

SMALL STREAMS CHARACTERISATION SYSTEM – Survey Manual

Prepared for The Atlantic Salmon Trust, The River Annan Trust & District Salmon Fishery Board and the Strangford Lough & Lecale Partnership

by

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Version: AST-SSCS-1.3
Date: July 2015

Atlantic Salmon Trust – Small Streams Characterisation System

Survey Manual – AST-SSCS-1.2

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Background

In recent years, in the UK and Ireland, there has been increasing interest in the conservation and management of small streams. They are essential to the health of the wider aquatic ecosystem and of fish populations throughout river catchments. But, because of their size, small streams are particularly vulnerable, both to general pressures and to specific problems.

A sea-trout workshop, organised by the Atlantic Salmon Trust in February 2011, clearly identified the need for the monitoring and protection of such streams and concluded that a greater focus was required on the significance of small streams for sea-trout production. These provide important spawning habitats, but are easily blocked by impassable culverts, farm crossings and minor land use changes and can be adversely affected by very minor land management practices. They are also poorly protected by existing legislation. The workshop agreed that research is needed to quantify the contribution such streams make to sea-trout recruitment. There is also a need to identify both actual and potential sea-trout spawning streams, and to draw attention to the need to protect them.

During the workshop, it was suggested that a definition of a small stream might be any stream less than 6 m in width. However, a more satisfactory definition is probably any first or second-order hill stream or any small self-contained coastal stream, which discharges directly into the ocean. Although small streams have been identified as contributing to failures to meet EU Water Framework Directive standards in larger river catchments, such watercourses are rarely classified as "water bodies" under the terms of the WFD. As such, they do not receive the formal monitoring priority and protection they need.

In response to the above recommendations and under the general theme of managing small streams for fish in a changing environment, two subsequent workshops were organised to discuss small streams in upland and lowland / urban areas. These meetings were held in Carlingford, Co Louth, Ireland, 27th and 28th November, 2012 and York, England, 6th and 7th March 2013, the latter dealing primarily with lowland and urbanised small streams. The conclusions and recommendations from these meetings were subsequently presented to a meeting in Brussels later in 2013, organised by the European Environmental Bureau and the Freshwater Habitats Trust. Hyperlinks to reports on these meetings are available in this manual (see *Useful Hyperlinks* on p38).

It was clear from the Carlingford Small Streams Workshop that the care and attention urgently required by burns and streams is most likely to come from volunteers and key catchment based interest groups. There was also much support for the role that citizen science might play in monitoring such streams.

Having identified the need to equip interest groups with the skills to monitor and assess the health of streams in their particular catchments, AST approached the Strangford Lough & Lecale Partnership and the River Annan Trust & District Salmon Fishery Board, with a view to agreeing on such a programme.

This training manual represents the completion of the first phase of this joint partnership. In conjunction with a training programme, it provides volunteers with the required skills and training to walk and monitor the small streams in their particular location, both small mountain streams and discrete coastal streams. The objective is not to intentionally seek out pollution points but to objectively assess the current status of the streams. In many ways identifying and highlighting the presence of pristine streams or burns that have been little impacted by agricultural or forestry practices is as important as identifying problems in damaged or degraded streams. The initiative is based on a simple premise: that obtaining high-quality information on the condition of our small streams and burns is key for fishery managers to put in place plans to protect the high quality watercourses and improve the problematic areas.

The programme in many ways is similar to the Adopt-a-Stream Programme in Canada. Our colleagues in the Atlantic Salmon Conservation Fund and the Adopt-a-Stream Programme have been very helpful in commenting on drafts of the manual and we would encourage those concerned with the protection and management of small streams to visit their websites, which are packed full of practical and useful information – see *Useful Hyperlinks* (p38).

We trust that this manual will prove useful not alone to those interested in the welfare of our sea trout but to all those with concerns for the welfare of the migratory species which depend on the health and well-being of the myriad of small streams that pepper our mountain landscapes and our coastal margins.

Introduction

Small streams (known as first and second-order streams) comprise over 75% of the length of the total river network – typically these are less than 3 m wide. They are key spawning areas for trout. The health of this delicate network of small streams that are the very life-blood of your fishery is increasingly seen as being very important. Reversing the neglect of small streams is now widely seen as a priority. Improved conditions for trout will also ensure lots of other 'beneficial uses' or 'ecosystem services' for the catchment stakeholders generally.

This manual and accompanying training sessions aim to engage catchment stakeholders in the active examination of these spawning streams. Volunteer groups may even be able to assess reaches in their catchments that the official state agencies do not have the resources or time to examine in fine detail. Ideally, this information will then be fed on to the government agencies that have the aim of restoring all waters to good ecological status under the formal 'programmes of measures' for the Water Framework Directive.

The aim is to engage local catchment champions in characterising their streams using the insects and other macroinvertebrates plus the aquatic plants that inhabit these small streams and by identifying obvious blockages to fish migration from and to the sea. The aim of this guide and training programme is to build a certain expertise in assessing the risks of pollution and other impacts on sea trout / trout in such streams. Obviously the more accurate and reliable the information gathered by voluntary groups engaging with the Small Streams Characterisation System (SSCS) the better the final outcome. Thus, accurate recording of, for example, the number of readily distinguishable 3-tail mayfly and 2-tail stonefly types found in pond net samples, for example, is critical. Producing accurate and reliable reports will be vital in liaising with the official environmental protection agencies and fisheries protection bodies.

The method is a new approach that is designed for use by non-specialists. The system is based on training participants to be able to accurately gauge the balance between pollution-sensitive versus the pollution-tolerant insects and macroinvertebrates in the stream. The assessment of physical barriers to fish migration is also potentially very important in this new approach to improving the health of the 'capillaries' of the river network – i.e. important spawning reaches that contribute significantly to the sea trout / trout populations.

Health and Safety When Sampling Small Streams or Rivers

Nowadays health and safety should be top of the list for everyone, no matter how routine the activity. Working in and near water requires your attention to safety matters.

Typical risks that should be considered before carrying out small stream surveys and their associated control measures are shown in the table below. This table does not represent a complete risk assessment and should be considered as supplementary information only. Assessors should adhere to the health and safety policy/procedures of their own organisation, club, trust or employer as appropriate. Common sense and respect for conditions – especially following heavy rain when streams can be flooded – require particular attention. Remember - health and safety matters!

Activity	Risk Control	Measure
Lone sampling	Accident with no support. Assault	Carry a mobile phone; inform someone of movements and planned return times.
Working in water	Hypothermia	Wear appropriate clothing; avoid becoming wet; bring spare set of clothes; take shelter when appropriate.
Working in water	Harmful substances and Weil's Disease	Wear appropriate personal protective equipment (PPE) such as footwear and gloves and follow good hygiene procedures; ensure no wounds are exposed to raw water. Be aware of risk of Weil's Disease.
Working in water	Drowning	Although small streams are generally shallow, drowning should always be considered as a risk when working in water and life jackets or buoyancy aids should be worn at all times. Operators should not work in water deeper than knee-deep.
Working in water	Slips and trips	Care is needed on wet surfaces and when entering and leaving the stream. A staff or pond net handle should be used to provide support and balance while walking and also to test for deeper pools in turbid waters.
Working adjacent to roads	Strike by moving vehicle	Wear appropriate high-visibility PPE. Park vehicle in appropriate location.
Working in remote areas	Danger of hypothermia /drowning	Operators should work in pairs in remote areas.
Summer sampling	Sunburn	Use appropriate protection factor sun cream.

Biosecurity

The Problem

Invasive, non-native species can have a damaging impact on native plants, animals and ecosystems by spreading disease, competing for habitat and food and direct predation.

Plants that grow profusely can block waterways while some animals can damage riverbanks. Anyone who uses waterways may be unknowingly helping to spread invasive species from one water body to another in equipment, shoes and clothing.

Three Simple Steps

1. Check: All clothing and equipment should be thoroughly inspected and any visible debris (mud, plant or animal matter) should be removed and left at the water body where it was found. Particular attention must be paid to the seams and seals of boots and waders. Any pockets of pooled water should be emptied.

2. Clean: Equipment should be hosed down or pressure-washed on site. If facilities are not available, equipment should be carefully contained, e.g. in plastic bags, until such facilities are available. Washings should be left at the water body where the equipment was used, or contained and not allowed to enter any other watercourse or drainage system (i.e. do not put them down the drain or sink). Where possible, clean equipment should be dipped in disinfectant solution (e.g. Virkon) to kill diseases, but note this is unlikely to kill non-native species.

3. Dry: Thoroughly drying is the best method for disinfecting clothing and equipment. Boots and nets should be hung up to dry. Equipment should be thoroughly dry for 48 hours before it is used elsewhere. Some non-native species can survive for as many as 15 days in damp conditions and up to 2 days in dry conditions, so the drying process must be thorough.

Additional Actions & Resources

- Make sure you are aware of the priority non-native species, particularly in the area you are working.
- Good biosecurity is everyone's responsibility.
- More information can be found on the Non-Native Species Secretariat (NNSS) website: www.nonnativespecies.org/ and http://invasivespeciesireland.com/

The Survey

Suitable field equipment is essential in order to get the best results from this system. Correct sampling technique is important in order to accurately sample macroinvertebrates. Personal health and safety precautions are obviously important when working in water and biosecurity measures to prevent the spread of unwanted invasive non-native species are also important.

Field Equipment

The following is a recommended list of equipment required for conducting the AST-SSCS survey:

- Aquatic pond net (1 mm mesh and 25 cm net frame recommended)
- Shallow white plastic tray
- 1 litre snap cap plastic containers to hold macroinvertebrate sample
- Protective gloves with long sleeves
- Pocket magnifying glass
- Tweezers or forceps
- Petri dishes
- Plastic pipettes
- Spray bottles for removing the macroinvertebrate sample from the net (optional)
- Labels for bottles
- Black indelible markers
- Pens
- Pencil
- Macroinvertebrate Identification Charts
- Camera or Smart Phone Camera ideally with GPS (location services turned on).
- GPS (Geographical Positioning System)
- 70% industrial methylated spirits (IMS) (in spray bottle and in 5 litre container for retaining samples)
- Disinfectant for boots, clothes and equipment
- Specimen containers (for ID purposes of individual species)
- Field sheets
- Measuring tape (stream width and depth + height of weirs, etc)
- Stopwatch or smart phone clock app
- Clipboard
- An appropriate Ordnance Survey Map

Suitable waterproof clothing is also required – plus boots (preferably hip waders) and a life jacket or buoyancy aid if alone or working in fast flowing or deep water (see previous safety guidance).

Taking a Sample

Sampling of the stream insects and other macroinvertebrates is done using a pond net. The open net is held into the flow facing upstream while the operator disturbs the stones and cobbles immediately in front of the open net with his or her foot – kicking and dislodging the substratum and allowing the current to wash the insects and other macroinvertebrates into the net, or actively sweeping through the disturbed areas if the current is too slow to wash them in. The operator walks back and forward in a zig-zag pattern stopping at intervals to kick and paying particular attention to any riffled cobbled or stony areas where the most sensitive stoneflies and mayflies are most likely to be found. A 3-min sample is usually adequate. The sample is then placed onto a tray and cleaned of detritus and sand/gravel by decanting a number of times through the net or using a bucket to allow active cleaning of mosses and leaf material. The final result for examination should be the live insects and macroinvertebrates that can be easily seen for identification and counting purposes on a clean tray. If the stream substratum is primarily comprised of mud and silt it may be necessary to shorten the sample time in order to avoid having a tray simply full of fine mud and to spend more time cleaning the material and allowing the silt/mud to settle in the tray.

Data Recording Sheet

It is important when collecting field data that standardised data recording sheets are used. This ensures that data is recorded in a similar format by all surveyors and assists with future comparisons, analysis and ensures the site can be revisited in the future. A site location and general characteristics data sheet is outlined over the page.

1. Where Are You Sampling?

Stream or River Name:	
Description of Sampling Site:	
Location (Lat/Long, OS Map Grid Ref, GPS, Postcode):	
Date and Time of Sampling:	
Names of Samplers:	

2. Describe the Stream and its Surroundings

Width of Channel when Full (m):	
Current Wet Width (m):	
Average Depth at Sample Site (cm):	

Principal Type of Substratum Sampled: Ring the Boxes that Apply to the Site
(+ = Present; ++ = Moderate; +++ = Dominant.)

Cobble/ Large Stones	+	++	+++		Degree of Siltation: (Is silt released when you take a kick sample?)			
Gravel	+	++	+++		Clean	Slight	Moderate	Heavy
Sand	+	++	+++					
Silt or Mud	+	++	+++					

Depth of Mud on Bottom:

No Mud:	<1 cm:	1–5 cm:	5–10 cm:	>10 cm

Do Cattle or other Farm Animals have access to the stream?

Full Access (no fencing)	Semi-Controlled Drinking Point	No Animal Access
Comment:		

Which of these describe the land next to the stream bank – circle all that apply

	Present	Moderate	Abundant
Grassland	+	++	+++
Tillage Crops	+	++	+++
Urban	+	++	+++
Forest	+	++	+++
Bog/Heath/Moorland	+	++	+++
Other (describe)			

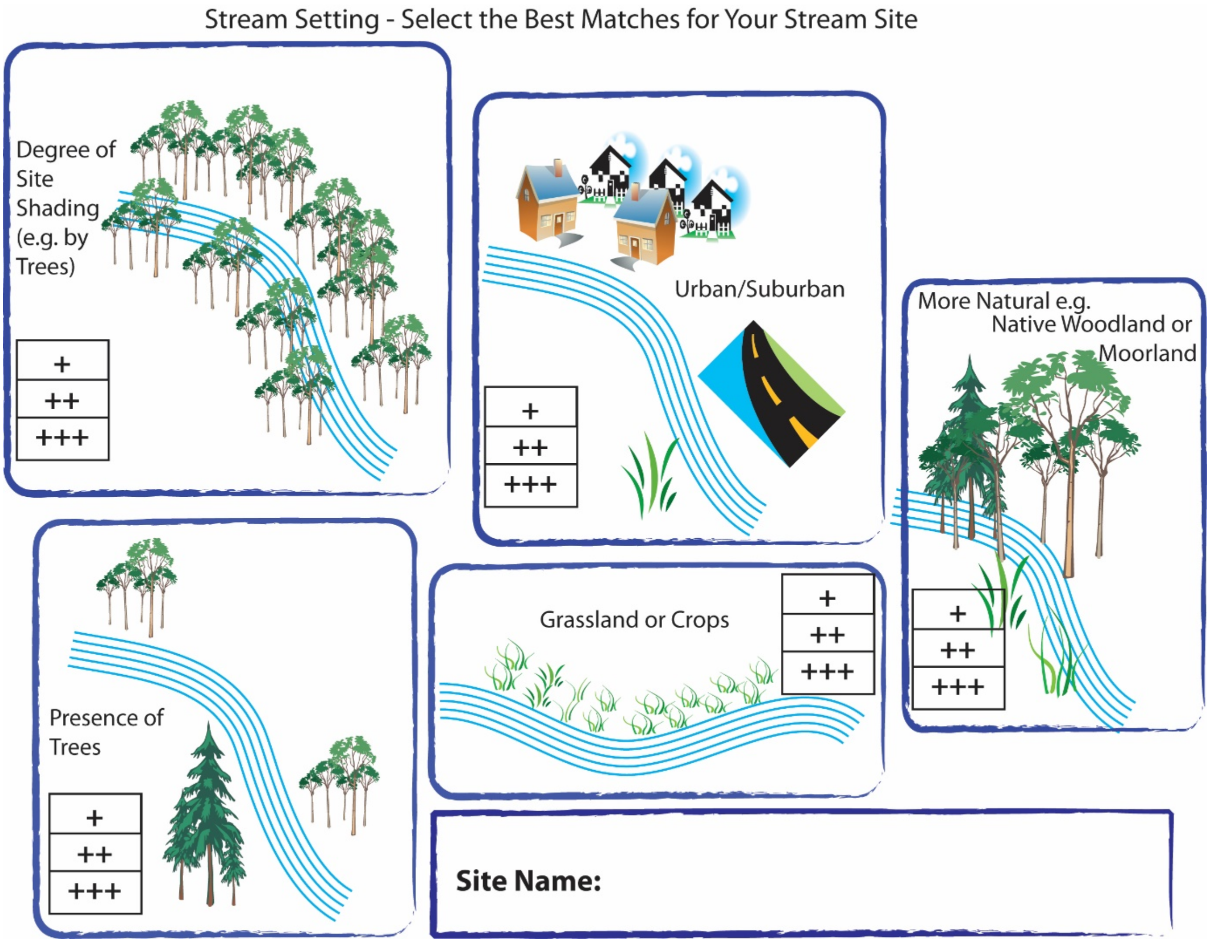
(Circle one of the +, ++, +++ (present, moderate, abundant) boxes in one or more of the panels to indicate the dominant land uses – leave blank if not applicable.)

Water Clarity and Velocity – circle one choice on each row

Water Clarity:	Clear	Slightly Turbid or Coloured	Very Turbid or Coloured
Water Velocity:	Fast	Moderate	Slow
Riffle Glide Pool?	Riffle	Glide	Pool

Rubbish?

Can you see any rubbish in the stream?	None	Present +	Moderate ++	Abundant +++



(Circle one of the +, ++, +++ (present, moderate, abundant) boxes in one or more of the panels to indicate the dominant land uses – leave blank if not applicable.)

3. Identifying Stream Macroinvertebrates

The Small Streams Characterisation System is based on five key groups of macroinvertebrates – most are insects but snails, worms and the water louse are also included. The five groups are:

1) Mayflies or up-wing flies,
2) Stoneflies,
3) Caddis flies,
4) GOLD+ a group that includes snails, worms and true fly larvae (diptera) plus flatworms and leeches and the final group is
5) *Asellus* the water louse.

The most important thing is to be able to distinguish one type from another – the number of different types found within each of the five main groups is the key to scoring the sample.

The principle behind the system is that some species are very sensitive to pollution while others are quite tolerant. The large stoneflies such as *Perla* are perhaps the most sensitive while bloodworms (midge or chironomid larvae) have a form of red-coloured haemoglobin that allows them to survive in very low levels of oxygen found in polluted conditions.

The scoring system deliberately omits the two most commonly found and most abundant macroinvertebrates – the *Baetis* family (known as *olives* to anglers) and *Gammarus* (shrimp) which are found widely in all but the most acidic waters. Beetles are also omitted. These are not counted in the scoring system but feel free to note their occurrence in your samples.

The scoring system used by **The Small Streams Characterisation System** ranges from 0 to 32. The score is calculated very simply and depends on the number of types within each group and also how abundant they are within the groups. If you can tell one mayfly from another (even without being able to put a Latin or formal name on them) or one stonefly from another and you can put them into an abundance category you can score your local stream and assess if your stream is healthy. You can also judge the risk of the stream failing to meet its water framework ecological status. Users are encouraged to learn the Latin species names of the key insects, as it will help to bring an additional level of precision into the stream assessments that you carry out. The system stacks up well against the formal water framework methods used by government agencies such as SEPA (Scotland), the EA/NRW (England and Wales) and NIEA (Northern Ireland) and the EPA (Republic of Ireland).

The five groups are shown below with some illustrations as examples. More detailed keys and guides are listed in the suggested reading list. The Field Studies Council in particular has some excellent identification aids. (There are some differences in species found in Ireland and Great Britain but taxonomic level in the SSCS means that it should work well regardless of where it is applied.)

Group 1: Mayflies (Ephemeroptera) – 3-Tails

Ecdyonurus: (False or Late March Brown, Green Dun, August Dun, Large Brook Dun)



Ecdyonurus: (False or Late March Brown, Green Dun, August Dun, Large Brook Dun). Flat stone-clinger. Very broad head and thorax immediately behind the head. Long spreading tails. Can be quite large – up to 22 mm. Wing buds will be evident in larger specimens. Backward projection on the first segment behind the head (but can be difficult to see in smaller specimens without a good hand lens). In fast-flowing riffles on or under stones. Nymphs should be present all year. A very sensitive indicator of water quality – if missing from a suitable fast-flowing riffled stretch something is wrong. Size up to 15 mm.

Rhithrogena (Olive Upright)



Rhithrogena semicolorata: (Olive Upright) Belongs to the same family as *Ecdyonurus*. Not quite as broad as *Ecdyonurus*. Distinctive central black spots on the femur. Characteristic swimming movement – it swims upwards actively and then floats downwards. Sensitive to pollution but may be missing from later summer samples due to its life cycle. Adults emerge mostly in May & June (Olive Upright). Should be found in winter and spring stream samples. Size up to 12 mm.

Group 1: Mayflies – 3-Tails (*continued*)

Heptagenia (Yellow May Dun, Yellow Hawk)

Heptagenia: *(Yellow May Dun, Yellow Hawk).* Closely related to *Ecdyonurus* and *Rhithrogena* and can be difficult to tell apart – its head and first segments are narrower than *Ecdyonurus* and it does not have the characteristic *Rhithrogena* spot on its femur. No backward projection on first segment. Size up to 15 mm.

Ephemera Danica (The Mayfly)

Ephemera Danica (The Mayfly). The largest of the mayflies. Found in slower flow reaches and only in hard, alkaline waters. It burrows into silty or sandy substrates. (In this photo there are also two freshwater shrimps: *Gammarus* – which are very common but, like *Baetis*, it is **not** included in the scoring.) Size up to 30 mm.

Serratella ignita (Blue Winged Olive)

Serratella ignita: (Blue Winged Olive) Striped legs and tails. Watch it as it curls its tail over its head. Poor swimmer. Long middle tail separates it from Baetis and its family. Length up to 14 mm.

Caenis (Angler's Curse) accumulates silt from its habit of silt burrowing. It is one of the smaller mayflies. A poor enough swimmer. One species (*Caenis rivulorum, above*) has a distinct banding (black-white). Gill cover overlaps the body. Size up to 8 mm.

Group 2: Stoneflies (Plecoptera) – 2-Tails

Perla



Perla: *(Creeper)* is the largest of the Stoneflies reaching up to 35 mm in length. It is highly sensitive to pollution. It is similar to ***Dinocras*** which is much blacker in colour and lacks the yellow last segment. Both species have distinct gills between the legs.

Amphinemura. Often with silty particles attached. Wider than Leuctra and usually lighter in colour and shorter than *Protonemura*.

Leuctra: (Willow Fly, Needle Fly) The most common stonefly – narrow growing to 11 mm. Present all year round. More tolerant of pollution than most of the other stoneflies.

Protonemura: (Early Brown). Darker and larger than ***Amphinemura***. Often missing in the summer months as are many of the stoneflies. Size up to 12 mm.



Isoperla: (Yellow Sally). Medium sized (up to 18 mm) Olive green on top and pale yellow beneath.

Distinguishing the different stonefly types can be perplexing enough. The most important thing to remember is to simply count the NUMBER of different types that you can distinguish and give a rough indication of the abundance of each one. The score will be calculated correctly (even if you do not get all the names correct). Nonetheless it is worthwhile honing your taxonomic skills by delving into the many keys and guides that are available. This manual is only a starting point.

Mayflies *versus* Stoneflies

The aquatic nymphs of mayflies typically have three tails. Stonefly nymphs have two tails. As they are nymphs of insects they have six legs similar to adult insects. As the nymphs increase in size, wing buds may be obvious as they approach emergence as adult mayflies or stoneflies.

Examining live specimens is better than looking at samples preserved in alcohol.

The movement patterns of living insects can be very distinctive and a great help in identifying specimens in your tray.

Two tails or Three Tails?
Be aware that kick sampling can result in damage to the animals being collected – legs and tails may be missing or damaged – so be careful that you are not confusing a mayfly that has a missing tail with a stonefly which typically will have two tails.

Ecdyonurus (False or Late March Brown, Green Dun)

Perla (Creeper)

The Stone Clingers

The flattened nymphs of the mayfly family Heptageniidae such as *Ecdyonurus* (*False or Late March Brown, Green Dun*), *Heptagenia* (Yellow May Dun) and *Rhithrogena* (Olive Upright) are particularly sensitive to pollution and as they are also widely distributed in streams of all types they are a very useful indicator of pollution. Some, such as *Rhithrogena,* may be absent during the summer months but *Ecdyonurus* should be present all year round. They live in fast-flowing water so they are not to be expected in ponds or slow-flowing stretches. *Heptagenia* is less common but can be found in slower flow areas too. In preference you should sample in stony riffled stretches where the water is turbulent and likely to produce these most pollution-sensitive species.

Stoneflies are usually found in the faster flowing reaches, clinging to stones. They are also sensitive to pollution. The life cycle of many stoneflies is such that they may not be found in standard kick samples during the summer months.

Group 3: Caddis Flies – (Trichoptera) Cased and Caseless



Hydropsychidae: (Grey Flag) Grey-purple with first three segments darkened. Gills beneath. Swims side to side. In stressed conditions can be infected by a fungus. Very common in streams. Up to 20 mm.


Rhyacophila: (Green Sedge, Sand Fly) Green-coloured. Gills to the side. Characteristic top to bottom swimming movement. Up to 20 mm.

Polycentropidae. Free living. Typically yellow to orange in colour. No ventral or side gills. Up to 25 mm.

Hydroptilidae: (Micro Sedge). Tiny micro-caddis with purse-like cases. Approx. 5 mm.

Sericostomatidae: (Welshman's Button). Fine sand cases curved and tapered. Case bends rather than cracks. Up to 22 mm.

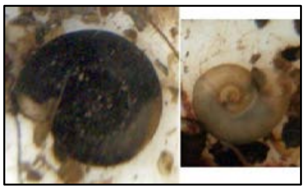
Goeridae with two 'ballast' stones either side. Be careful not to confuse with **Glossosomatidae:** (Tiny Grey). Up to 18 mm.



Limnephilidae: (Cinnamon Sedge). The largest caddis family. A wide variety of cases from stones or bits of vegetation. Rougher than, for example, **Sericostomatidae** cases. (**Phyrganeidae** (Dark Peter, Murrough) have neater cut-plant cases plus yellow and black banding on the larvae when removed from its case). Size up to 25 mm.

Group 4: GOLD+ Gastropods, Oligochaetes, Diptera + Leeches and Flatworms

Snails



Planorbis Snails. Flattened spirals. Associated with slower flowing water and vegetation. Width ranging from 5 to 22 mm (5 mm high).

Lymnaea. Up to 25 mm x 11 mm wide. The shell is tapered and it does not have a 'lid' or operculum at the opening (this is in contrast to *Potamopyrgus* and *Bithynia* which do).

Potamopyrgus. Almost black when alive. Much smaller than Lymnaea (5 mm x 3 mm). Can be quite abundant.

Worms (Oligochaeta)

Lumbriculidae: Medium-sized worms (Oligochaetes) with green and red variegation. Likes sandy areas. Can be difficult to distinguish from the **Naididae** / **Tubificidae**. Up to 40 mm in length.

Eiseniella. A relation of the earthworm but smaller – rolling it on your finger you will see its square cross-section. Often associated with mosses. Size up to 60 mm in length.

Naididae (formerly **Tubificidae**). Smaller worms. Reddish or pale coloured. In cases of severe organic pollution these may be the only invertebrate remaining. The sample net can be quite clogged up with the sheer numbers. Typically 30–40 mm.

Group 4: GOLD+ (*continued*) Gastropods, Oligochaetes, Diptera + Leeches and Flatworms

Diptera (fly larvae)

Simulidae: (Reed Smut). Blackfly larvae are filter feeders using two filter fans of bristles. Too many of them on stream vegetation is not a sign of healthy conditions. They may stick to the sampling tray and if present in very large numbers their sticky threads can trap other macroinvertebrates even larger Gammarus. They move slowly with a looping movement. The head capsule is narrower than the bulbous rear end which attaches to the substratum. Up to 10 mm.

Dicranota. This is a **tipulidae** or member of the Daddy-Long-Legs family. Usually grey/white with darker banding and two bristly appendages at the rear and five pairs of 'prolegs'. It whips back and forward when swimming. Up to 25 mm.

Chironomus (Buzzer, Duck-Fly). This is a large red larva of a non-biting midge family **Chironomidae** (Midges). The ventral gills separate this red chironomid from all others. It has a very high indicator value – the red pigment allows it to survive in low oxygen conditions caused by organic pollution. If you cannot see the gills on the second last segment it is just a 'chironomid'. It is a big family: some red, some green, or whitish and they have a range of tolerances. Size up to 25 mm.

Group 4: GOLD+ (*continued*) Gastropods, Oligochaetes, Diptera + Leeches and Flatworms

Flatworms

Flatworms: These glide along the bottom of the tray. The presence of large numbers, especially in fast-flowing water is a sign of poor water quality.

Leeches

Leeches: The characteristic looping movement and suckers make these easy to spot. There are two or three common types: stripy ***Glossiphonia*** (above), Dark Red/purple ***Erpobdella*** and the narrow ***Piscicola*** the fish leech with a distinctive wide head.

Group 5: Asellus

Asellus: (Water Louse) is the aquatic equivalent of a woodlouse and is easily identified. It is quite tolerant of organic pollution. If found in fast-flowing riffles especially it is not a good sign. (Its natural habitat is in slow or still water.) It is important to record its absence, as a site without any *Asellus* is automatically awarded 6 points of the total score. Size up to 15 mm.

Baetis – is not counted

Baetis: (Dark Olives, Pale Watery) Note the short middle tail. ***Baetis*** is very common and abundant. It will often be the most abundant type in your tray unless the river is very acidic. The most common *Baetis* species in particular is quite tolerant of pollution – *B. rhodani* (Large Dark Olive). It can be difficult enough to separate the different species – because of this ***Baetis*** is **not** included in the scoring system. Up to 12 mm.

Gammarus – is not counted

Gammarus: (Freshwater Shrimp) is very common in most rivers and streams apart from very soft acidic water. Fast moving, swims on its side – easily identified. Size up to 17 mm.

4. Calculating the Small Streams Characterisation System Score

The steps to calculating the SSCS score are straightforward; however, it is not a simple linear calculation. The final score must take account of both sensitive (e.g. *Ecdyonurus* / March Brown) and pollution-tolerant (e.g. Chironomids / blood worms) macroinvertebrates. The presence of high concentrations of pollution-tolerant macroinvertebrates reduces the final score, while a high abundance of sensitive creatures increases the score towards its maximum.

Manual Calculation Method

1. Fill in the field sheet for each small stream site sampled. Record the numbers of each type of invertebrate found in the sample. Take care to fill in the relative abundance (A to E) for each type recorded. If you can identify other types within a group that are not listed on the field sheet place these in the 'other' slot which is provided for each group.
2. For each of the five groups add up the number of types found within the group and write this into the group total box.
3. The relative abundance A to E is based on a 3-minute kick sample with a pond net. Letters are used on the field sheet in order to avoid confusion with real numbers. The numerical equivalent is then calculated by summing the total abundance within each of the five groups using the third column in the table below. (This is all automated in the spreadsheet method.)

Relative Abundance Code	Estimated numbers for each type (3-minute sample)	Numerical relative abundance (used for final calculation)
Absent	0	0
A	1–5	1
B	6–20	2
C	21–50	3
D	51–100	4
E	100+	5

4. For each of the groups place the number of types and the relative abundance sub-score into the flow chart. This will generate a score for each of the five scoring groups. This needs some care in order to get an accurate final score (and again it is automated in the spreadsheet version).
5. The score is compared with the cut-off values – less than 18 it is likely that the stream is polluted. If greater than 19 the stream is not at risk. Scores of 18 and 19 are indeterminate.

Spreadsheet Method

The score is calculated automatically in the accompanying spreadsheet – an Excel spreadsheet version will be provided to participants during the training courses.

The data are transferred from the field sheet to the spreadsheet and the score is calculated. The precise calculation method can be deduced from the spreadsheet formulae.

To become familiar with the scoring system it is best to practice the completion of the scoring tables before heading into the field. Print or photocopy the field sheets or use the spreadsheets, to practise the recording and scoring methods across a range of possible outcomes. Include samples with a high concentration of very tolerant macroinvertebrates and those sensitive to a drop in water quality.

A set of blank field sheets is included as a separate appendix. Multiple copies of these should be printed out – one per station – for use in field surveys.

Online field sheets and a central database are planned for the future based on the widely used *Indicia* system.

Stream or River Name:	
Description of Sampling Site:	
Location (Lat/Long, OS Map Grid Ref, GPS, Postcode):	
Date and Time of Sampling:	
Names of Samplers:	

Group 1 MayFlies – 3-Tails – Ephemeroptera	Abundance Category (A-E)*	Estimated Number of individuals	Relative Abundance**
Ecdyonurus (False or Late March Dun, Green Dun)			
Rhithrogena (Olive Upright)			
Heptagenia (Yellow May Dun)			
Ephemerellidae (Blue Winged Olive, Yellow Evening Dun)			
Caenis (Angler's Curse)			
Ephemera danica (The Mayfly)			
Other Ephemeroptera (add below)			

Relative Total Abundance

Number of Types

Group 1 Sub-Score

Group 2 Stoneflies – 2-Tails – Plecoptera	Abundance Category (A-E)*	Estimated Number of individuals	Relative Abundance**
Leuctra (Willow Fly Needle Fly)			
Isoperla (Yellow Sally)			
Amphinemura			
Perla (Creeper)			
Dinocras (Creeper)			
Protonemura (Early Brown)			
Other Plecoptera (add below)			

Relative Total Abundance

Number of Types

Group 2 Sub-Score

* Abundance Categories A: 1–5, B: 6-20, C: 21-50, D: 51-100, E: 100+ – ** Relative Abundance (for summing for flow chart) A = 1, B = 2, C = 3, D = 4, E = 5

Group 3 Caddis Cased and Uncased

Group 3 Caddis Cased and Uncased	Abundance Category (A-E)*	Estimated Number of individuals	Relative Abundance**
Hydropsychidae (Grey Flag)			
Polycentropidae (Brown Checkered Summer Sedges (USA))			
Rhyacophilidae (Green Sedge, Sand Fly)			
Philopotamidae			
Limnephilidae (Cinnamon Sedge)			
Sericostomatidae (Welshman's Button)			
Glossosomatidae			
Lepidostomatidae			
Other Trichoptera (add below)			
Relative Total Abundance			
Number of Types			
Group 3 Sub-Score			

Group 4 GOLD+

Group 4 GOLD+	Abundance Category (A-E)*	Estimated Number of individuals	Relative Abundance**
Snail 1, e.g. *Lymnaea*			
Snail 2, e.g. *Potamopyrgus*			
Snail 3, e.g. *Planorbis*			
Snail 4, e.g. Ancylidae			
Snail 5, Other			
Worm 1, e.g. Lumbriculidae			
Worm 2, e.g. *Eiseniella*			
Worm 3, e.g. Naididae (a.k.a. Tubificidae)			
Non-biting Midge Larvae (Chironomidae)			
Biting Midge Larvae (Ceratopogonidae)			
Red *Chironomus* (Blood Worm, Buzzer, Duck Fly)			
Blackfly Larva (Simuliidae)			
Tipulidae (Daddy-Long-Legs)			
Leeches			
Flatworms			
Relative Total Abundance			
Number of Types			
Group 4 Sub-Score			

* Abundance Categories A: 1–5, B: 6-20, C: 21-50, D: 51-100, E: 100+ – ** Relative Abundance (for summing for flow chart) A = 1, B = 2, C = 3, D = 4, E = 5

Group 5 Asellus

	Abundance Category (A-E)*	Estimated Number of individuals	Relative Abundance**
Asellus (Water Louse)			

Group 5 Sub-Score

Final AST SSCS Score***

The Most Common Species (NOT USED IN SCORING)

	Abundance Category (A-E)*
Baetidae (Olives, e.g. Large Dark Olive) 3-tails – Mayflies with SHORTER middle tail	
Gammaridae (Shrimp-like – Swims on its side)	

Final Characterisation:	≤ 17	18-19	≥ 20
	At Risk	Indeterminate	Not at Risk

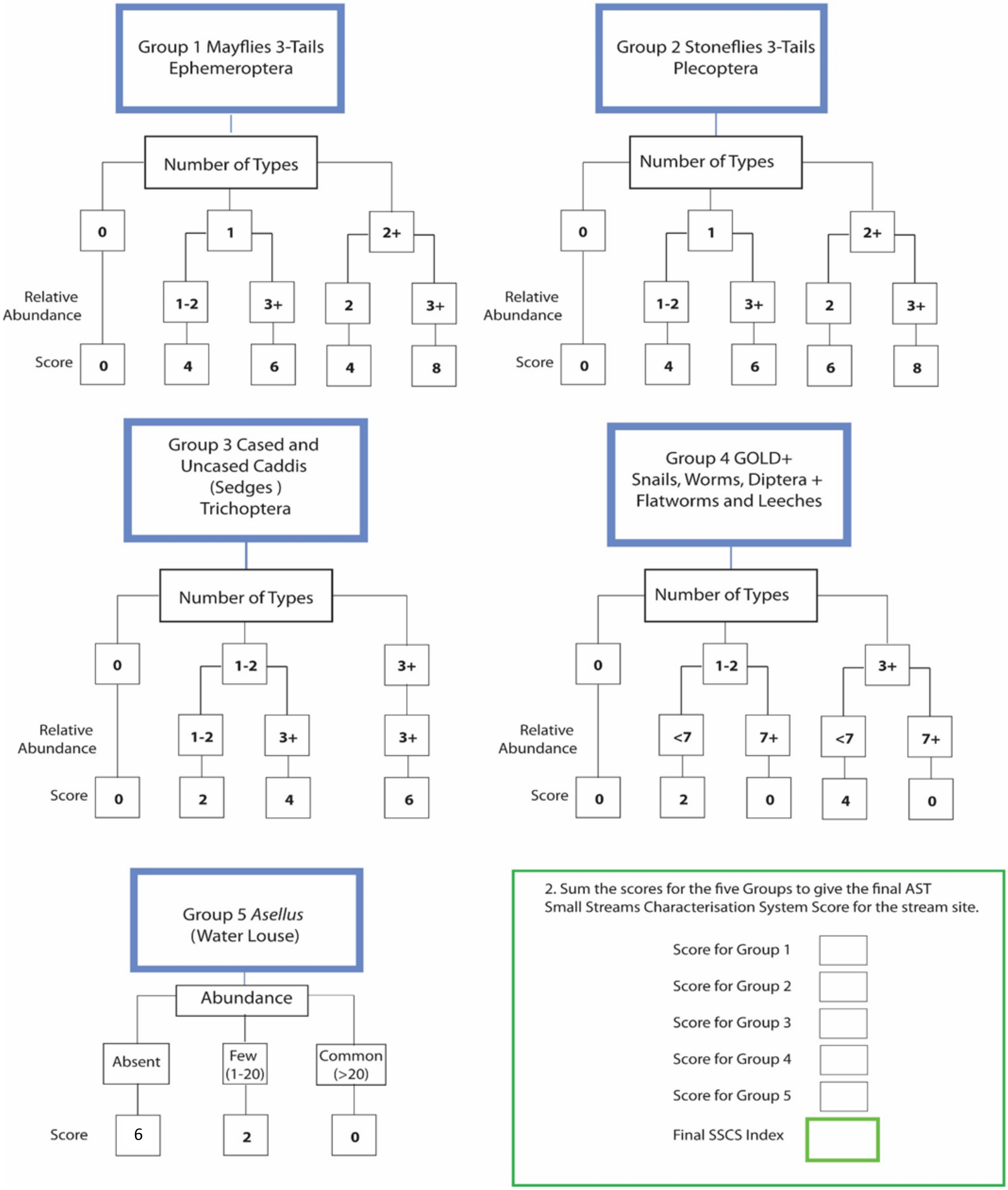
* Abundance Categories A: 1–5, B: 6-20, C: 21-50, D: 51-100, E: 100+ – ** Relative Abundance (for summing for flow chart) A = 1, B = 2, C = 3, D = 4, E = 5

*** See next page for the manual calculation flow chart – circle the number of types in each group and their total relative abundance from the three macroinvertebrate sheets (sub-scores for each of the five groups must be included) to get the final AST SSCS Score for the stream site.
Place this final score in the AST SSCS Score box to give the final result and ring the final characterisation: ‘At Risk’, ‘Indeterminate’ or ‘Not at Risk’ depending on the score value on the scale from 0 – 32.
A spreadsheet is available to automatically calculate the AST SSCS Score but it is important to understand the underlying logic of the flow chart.

Flow Chart for Manual Calculation of AST-SSCS

Stream Location:
Date:

1. Calculate the Group Scores by circling the appropriate boxes: first the number of types found in each Group and then the relative abundance to arrive at the individual Group Scores. Then sum these in the box on the bottom right.



5. What Types of Aquatic Plants are found in the Stream?

At the same site as the invertebrate sample is collected it would be useful to assess the aquatic plants which are present. The plant communities can provide useful information on the health of the watercourse and help to identify specific water quality problems.

Surveyors should record three broad types of aquatic plants growing in the stream.

1. **Mosses and Liverworts**
2. **Filamentous Algae**
3. **Flowering Plants**

It is not necessary to distinguish between the different species.
Only record plants in the stream – ignore bankside specimens.
For mosses, liverworts and higher plants record the abundance of submerged types separately to those that emerge above the water surface.

- **Filamentous algae are probably the most useful indicator of enriched conditions.**
- **Excessive amounts of filamentous algae indicate too much phosphate and nitrate in the system.**
- **Over-abundance of submerged plant biomass leads to oxygen stress at night (when photosynthesis stops, CO_2 is released and respiration continues using up oxygen from the water).**

Over the page there is a data recording sheet for the aquatic plant recording. Once completed these sheets should be attached to the site location data sheets to keep them all together.

Mosses and Liverworts

		Present	Moderate	Abundant
Mosses and Liverworts below water surface	Not Observed	+	++	+++
Mosses and Liverworts above water surface	Not Observed	+	++	+++

Filamentous Algae

		Present	Moderate	Abundant
Filamentous Algae	Not Observed	+	++	+++

Higher Plants (Flowering Plants)

		Present	Moderate	Abundant
Higher Plants emerging out of the water	Not Observed	+	++	+++
Higher Plants submerged beneath surface of stream	Not Observed	+	++	+++

(Circle one of the not observed, +, ++, +++ (not present, present, moderate, abundant) boxes in one or more of the panels to indicate the plant type present.)

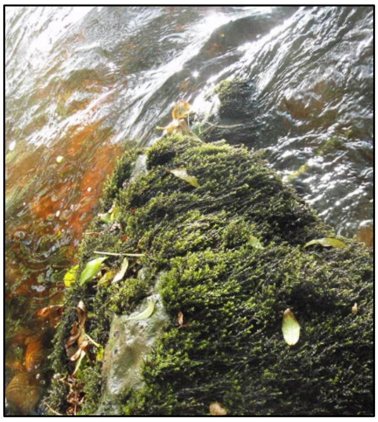
Examples of Mosses and Liverworts, Filamentous Algae and Higher Plants in Streams

Mosses and Liverworts







Filamentous Algae








Higher Plants

6. Hydromorphology: Estimating the Potential to Block Fish Passage

Most fish species migrate during their life time. Many types of fish, particularly salmon and trout, may travel long distances and will strive to spawn in all available suitable streams and rivers. Structures which may block their migration routes, both upstream and downstream, will influence what fish are present in any watercourse. A lack of fish may suggest obstruction is present. A walkover survey can be easily undertaken to locate and describe any structures that are present.

Every potential fish obstruction is different but some parameters which you should consider when assessing a barrier are:

> Velocity and Depth are critical. Adult trout should have a minimum of 10 cm depth and velocities should be less than 2 metres per second (2 m/s). Values less than this depth or faster than this velocity represent a barrier to their passage. Passage is not possible for adult trout at depths less than 5 cm. If the minimum stream velocity at a sluice or weir is greater than 3 metres per second (m/s), trout cannot move upstream. (Stream velocity may be estimated by dropping an orange into the flow and timing how long it takes to travel downstream over a distance of, say, 5–10 m – at the slowest part of the stream cross section – i.e. the section which fish are most likely to be able to negotiate.)
>
> The flow pattern across the floor / base of a culvert is also of key importance as fish find it difficult and exhausting to swim against strong, laminar flows. Weirs, culverts or debris dams at narrow pipes or bridges can block fish passage. Dark passageways may also delay the free movement of fish upstream.
>
> Vertical drops, long slopes or stepped structures and the width of gaps in barriers are important in assessing barriers. A culvert with a lip that presents a drop of 40–100 cm or greater to the pool or stream below will be impassable for fish at low flow. In low flows predators can have a serious impact on fish attempting to migrate upstream when they are trapped in pools below such culverts. Rectangular culverts in line with the stream bed are preferable to pipes above the water surface. Where possible these should retain the natural stream bed.

It is the slowest velocities and deepest waters which will determine fish passage at most barriers. A simple guide to assess fish access is:

Maximum Depth	**Minimum Velocity**		
	>3m/s	2-3m/s	<2m/s
<5 cm	X	X	X
5-10 cm	X	?	?
>10 cm	X	√	√

X	Impassable to fish
√	Passable to fish
?	Potential barrier

It is important to remember that natural waterfalls may stop fish migration but these features should not be tampered with. A man-made barrier such as a culvert, concrete bridge sill or weir is not natural and if it is found not to allow free access for fish then this should be addressed if possible.

When collecting information with regard to a potential fish barrier please use the data recording sheet below. It is always a good idea to collect plenty of photographs of any barrier you are assessing.

Grid Reference / Location of Barrier (must be filled in)		
Man-made or Natural Barrier?		
Barrier Type:		Measurement
Weir/Dam or Sluice across full width of stream from bank to bank? **Is there a fish pass present?** **Have fish free access to it?** **Is the fish pass free of debris / other blockages?** **Is there a natural barrier in place?** **Does this adversely affect the upstream migration of adults?**	Height of weir from upper water surface to lower stream surface or downstream pool:	
Sloping or stepped weir or other structure	Length of Slope:	
Stream velocity	Water velocity at slowest flow point on stream cross-section. Too fast for fish passage?	______ (m/s) Yes / No
Maximum stream depth		<5 cm – 5-10 cm – >10 cm
Culvert with significant drop below it? **Does the culvert create a dark passageway, without light?**	Height of culvert 'lip' above water:	Yes / No If Yes:_______(m) Yes / No
Accumulated debris dams, e.g. at culverts	Likely to Block Fish passage?	Yes / No
Fords or groynes narrowing stream?	Width of Widest Gap:	___________ (m)
Shape of Culvert	Round Pipe / Rectangular opening	
Fallen Trees/ Landslides?		
Photo(s) Taken		Yes / No
Other Potential Barriers:		

The Sampling Strategy for the AST Small Stream Characterisation System

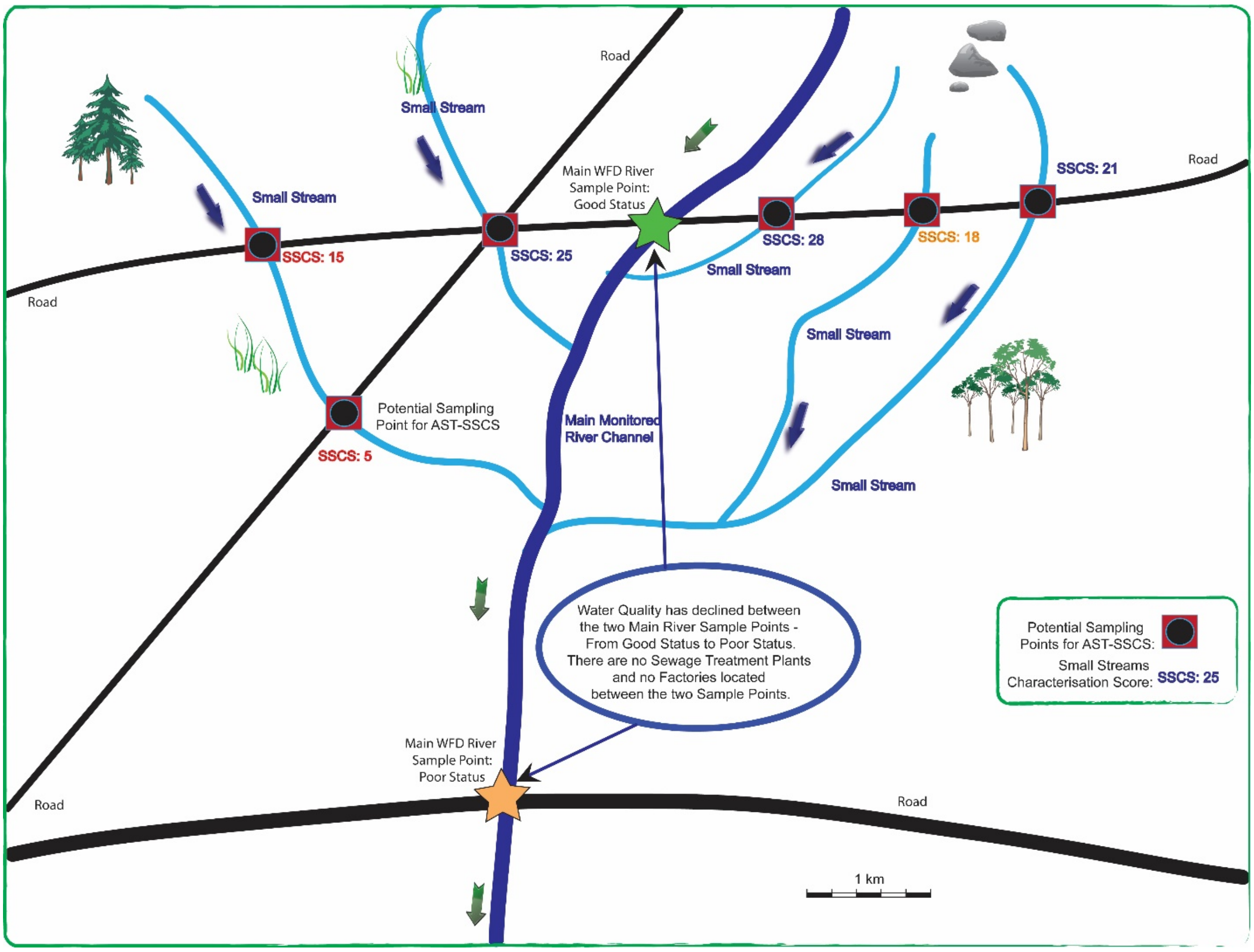
The AST Small Stream Characterisation System has a core aim of detecting problems that affect the survival of trout – whether freshwater brown trout or migratory sea trout.

The small streams (<3 m in width) comprise over 70% of the total channel length in a typical catchment. This means that the chances of pollutants entering the system via the small, sub-3-metre-wide, streams is greater than directly into the main channel itself.

A Case Study

The illustration shows a hypothetical case study where there was a dramatic drop in water quality between two main-stem Water Framework Directive (WFD) monitoring points as shown by the results from the official government body that undertakes the WFD monitoring. Ecological Status has dropped from 'Good' to 'Poor' status indicating a major impact between the two stations.

It is known (in this hypothetical catchment) that there is no major wastewater treatment plant located between the two monitoring stations. The conclusion is that pollutants from a source or sources of 'diffuse' pollution enter the system downstream of the upper monitoring station.



Hypothetical catchment to illustrate sampling strategy for use of AST Small Stream Characterisation System

The local angling club members were trained up in the AST-Small Stream Characterisation System (AST-SSCS). They learned how to identify the five major groups of macroinvertebrates and were initiated in the need to look for potential barriers that prevent fish from migrating up and down the system. The training course also aimed to demonstrate the importance of filamentous algae as an indicator of excessive nutrient inputs and a basic distinction between mosses *versus* algae *versus* the higher flowering plants was learned. Over the next two weekends following the training course they took macroinvertebrate samples at all of the accessible road bridges on streams that join the main river channel between the two WFD monitoring stations (see map on previous page).

The results were very clear. They pinpointed the most westerly branch of the catchment as the culprit. The SSCS scores of 15 and 5 compared very poorly with the other four sites sampled at the same time. The macroinvertebrates in the western branch had obviously been seriously impacted. The evidence was used to inform the relevant official authorities of the possible location of a serious diffuse pollution problem.

Further investigation in the form of stream walks and more detailed assessment of road culverts and weirs forming potential barriers to trout movement is to be undertaken by the angling club. In general the water quality was good in the catchment apart from the western tributary 'black spot' but the number of sea trout in the main river seems too low and barriers to migration up to spawning streams is suspected as being an issue in some streams even though the water quality appears to be very good generally.

Keys and Aids for Identification of Aquatic Flora and Fauna

"A Key to the Major Groups of British Freshwater Invertebrates – FSC." http://www.field-studies-council.org/publications/pubs/a-key-to-the-major-groups-of-british-freshwater-macroinvertebrates.aspx (June 26, 2014).

"Caddis Fly Species Britain and Ireland." http://www.fba.org.uk/recorders/publications_resources/how_to/caddis/contentParagraph/01/document/BritishCaddisList.pdf

"Caddis Identification Ian Wallace." http://www.fba.org.uk/recorders/publications_resources/how_to/caddis/identification/contentParagraph/02/document/FBA Feb 2007 course supplementary larval identification notes.pdf

"Freshwater Name Trail – FSC." http://www.field-studies-council.org/publications/pubs/freshwater-name-trail.aspx

"Guide to the British Stonefly (Plecoptera) Families: Adults and Larvae – FSC."
"Key to Ephemeroptera." http://www.fba.org.uk/recorders/publications_resources/keys/mayfly/contentParagraph/03/document/MayflyKey_Comp.pdf

"Scientific Publications (SPs) | Freshwater Biological Association." https://www.fba.org.uk/scientific-publications-sps

A Key to the Adults and Nymphs of the British Stoneflies (Plecoptera), with Notes on their Ecology and Distribution. H.B.N. Hynes. Third edition, 1977 (reprinted 1993), 92pp. ISBN 978-0900386-28-2

FBA Scientific Publication 17. Stoneflies
FBA Scientific Publication 49: "Larvae of the British Ephemeroptera: a key with ecological notes", J. M. Elliott, U. H. Humpesch & T. T. Macan.

FBA Scientific Publication 53. Caseless Caddis Larvae (Trichoptera). A Revised Key to the Caseless Caddis Larvae of the British Isles, with Notes on their Ecology J.M. Edington & A.G. Hildrew. 1995 (reprinted 2005), 134pp. ISBN 978-0900386-55-8

FBA Scientific Publication 61. Case-bearing Caddis Larvae. Keys to the Case-bearing Caddis Larvae of Britain and Ireland. I.D. Wallace, B. Wallace & the late G.N. Philipson. 2003, 259pp.. ISBN 978-0900386-70-1

FBA Scientific Publication 66. Mayfly Larvae . Mayfly Larvae (Ephemeroptera) of Britain and Ireland: Keys and a Review of their Ecology. J.M. Elliott & U.H. Humpesch. 2010 (reprinted 2012), 152pp.. ISBN 978-0900386-78-7

FBA Scientific Publication 68. Freshwater Invertebrates. Guide to Freshwater Invertebrates. M. Dobson, S. Pawley, M. Fletcher & A. Powell. 2012, size 201 x 143 mm, 216pp., hardback. ISBN 978-0-900386-80-0

Key to Larvae of British Mayflies (Ephemeroptera) http://www.fba.org.uk/recorders/publications_resources/keys/mayfly/contentParagraph/03/document/MayflyKey_Comp.pdf

Key to Larvae of British Stoneflies (Plecoptera) Adults and Larvae
http://www.field-studies-council.org/publications/pubs/guide-to-the-british-stonefly-(plecoptera)-families-adults-and-larvae.aspx

Useful Hyperlinks

Atlantic Salmon Trust - Sea-Trout Workshop, February 2011: http://www.atlanticsalmontrust.org/assets/files/ast-sea-trout-workshop-feb-2011.pdf

IBIS /Atlantic Salmon Trust - Small Streams Workshop, November 2012: http://www.atlanticsalmontrust.org/assets/files/ast-sea-trout-workshop-feb-2011.pdf

Atlantic Salmon Trust / Environment Agency / Institute of Fisheries Management - Small Streams Workshop, March 2013: http://www.atlanticsalmontrust.org/library/library17.pdf

Report of the Workshop on the Protection and Management of Small Water Bodies – European Environmental Bureau: http://www.eeb.org/EEB/?LinkServID=52A9ED8B-5056-B741-DBB0D3CCEA34187D&showMeta=0

Adopt-a-Stream
http://novascotia.ca/fish/programs-and-services/funding-programs/adopt-a-stream/
http://www.streamkeeper.org/aasf/About.html and
http://manual.adoptastream.ca/sec1_1.html
http://adoptastream.ca/
http://globalnews.ca/video/1262316/adopt-a-stream-program-launches/

Atlantic Salmon Conservation Fund
http://salmonconservation.ca/en

Acknowledgements

The work of Jamie Ribbens and Angela Dalrymple, Galloway Fisheries Trust and of Donald Paterson, Consultant, in editing the manual and in the preparation of educational material for delivery of the Small Streams Characterisation Training Course, is gratefully acknowledged. Paul Coulson of the Institute of Fisheries Management and Stephen Kennedy of the Dibney River Trust, provided valuable assistance and feedback during field trials of the training material.