Standardisation of river classifications:

Framework method for calibrating different biological survey results against ecological quality classifications to be developed for the Water Framework Directive

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STAR stream types and sampling sites

(Paper version)

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1.) Aims and Scope

Aim of this report is to document the process of sampling site selection (Workpackage 5), which is the preposition for the "core Workpackages" 7 (core stream types) and 8 (additional stream types) of STAR.

Furthermore, a first list of the sites to be sampled in STAR is presented both as a database accessible via the internet and as a paper version. All partners, who will participate in the fieldwork of STAR, contributed to this report by selecting the sampling sites (in many cases in close collaboration with national authorities) and by providing the relevant information to the Workpackage leader. The list presented in this report is still somewhat incomplete, since those partners, who start sampling in autumn 2002, have not completed samplings site selection. However, the list presented on the project homepage will continuously be updated.

Based on the list of sampling sites, the first sampling workshop, which was hold in May in La Bresse (France), and intense discussions in the expert panels, which are responsible to describe the sampling methods to be applied in detail, it is now possible to provide a detailed matrix of samples to be taken.

2.) Methods to select stream types and sampling sites

The process of sampling site selection was composed of the following steps:

- On the kick-off meeting in December 2001 the participants agreed about general outlines for sampling site selection.
- At the end of January 2002 the Workpackage leader sent a detailed request to all partners participating in the sampling, including standardized forms for describing stream types and sampling sites (Annex 2).
- On the first management subcommittee meeting in March 2002 details of the sampling site selection process were further discussed, based on the experiences with the first phase of the selection process. This lead to a second circular by the Workpackage leader (Annex 3).
- Based on the above mentioned guidelines the partners selected their sampling sites and provided the Workpackage leader with the necessary information.
- The Workpackage leader stored the information in an Access database and made them accessible via the internet.

Simultaneously, an intense discussion concerning the sampling protocols for the individual taxonomic groups was performed. This was mainly done through the discussion forum on the project homepage and was supplemented by the first sampling workshop, which was hold in May 2002 in La Bresse

(France). A second workshop with a limited number of participants was hold in Denmark in June 2002; aim of this workshop was mainly to discuss and to train the specific problems occurring when sampling lowland streams.
The above mentioned discussion lead to a number of minor alterations of both the sampling protocols for the individual taxonomic groups and of the overall sampling design. The consolidated sampling protocols are documented on www.eu-star.at and are not included into this report. The general sampling design is specified in this report including the above mentioned alterations (paragraph 5).

3.) The STAR stream types

3.1) Overview

In STAR, two different kinds of stream types are investigated (Table 1):

- Two “core stream types” (85 sampling sites altogether, 30 of which have not been specified so far)
- 13 additional stream types (194 sampling sites altogether, 24 of which have not been specified so far)

The concept of the “core” and “additional stream types” resulted from the different objectives of STAR.

In general, the “**core stream types**” are defined in a very broad way. They are “stream types on a higher level”, which are characterized by size class, altitude class and flow type, but are not necessarily located in the same Ecoregion or even in geologically homogeneous areas. Nevertheless, we are considering them to be sufficiently homogeneous so that variation in faunal composition caused by natural differences is not increasing variation caused by anthropogenic disturbance. The core stream type sampling sites will mainly serve the intercalibration of sampling methods and the “linking of organism groups”. Additionally, they will be used to extend and validate existing assessment systems such as AQEM. Two core stream types have been selected and already specified in the Description of Work:

Core stream type 1: Small, shallow mountain streams.

- To be sampled in: UK, D, CZ, A
- Characterization:
    - catchment area of 10 - 100 km^2
    - altitude range of 200 - 500 m (sampling site and at least large parts of catchment area)
    - ecoregions 8 (D), 9 (A, CZ, D) and 10 (CZ)
    - Predominantly silicious catchment geology.
- Some of the sites already have been sampled in the proceeding project AQEM. However, these sites are limited to a maximum of 20% per country.
- The sampling sites as a whole cover different stressors but it was avoided that too many different situations are investigated in a single country (for replication reasons). Therefore, stressors have been distributed between countries:
    - CZ: organic pollution (3 unstressed sites, 11 polluted sites)
    - A: degradation in stream morphology (3 unstressed sites, 7 degraded sites)
    - D: degradation in stream morphology (3 unstressed sites, 7 degraded sites)
- Using only the selected stressor (either organic pollution, or degradation in stream morphology, or acidification/toxic) the following minimum number of sampling sites have been selected per stream type:
    - 3 reference sites (not impacted by any stressor)
    - 3 sites probably "good status" (5 in CZ)
    - 2 sites probably "moderate status" (4 in CZ)
    - 2 sites probably "poor" or "bad status"

Core stream type 2: Medium-sized lowland streams.

- To be sampled in: UK, D, DK, S
- Characterization:
    - 100 - 1000 km^2 catchment area
    - below 200 m altitude (sampling site and at least larger parts of the catchment area)
    - Ecoregion: 14, 18
    - no special conditions such as lake outlets, short sections with an unusually high current (moraines)
    - For all questions of methodological intercalibration the substrate of lowlands rivers is crucial. Very different sampling strategies have to be applied in sand-bottomed streams and those with stony substrates. The dominant substrate should be consistent a least within a country. We selected: sandy-bottomed streams in Denmark and Germany; gravelly bottomed streams in the UK and Sweden. Some of the sites have

already been sampled in the proceeding project AQEM. However, these sites are limited to a maximum of 20% per country.

- The sampling sites as a whole cover different stressors but it was avoided that too many different situations are covered in a single country (for replication reasons). Therefore, stressors have been distributed between countries:
    - UK, S: organic pollution
    - DK, D: degradation in stream morphology
- Using only the selected stressor (either organic pollution or degradation in stream morphology) the following minimum number of sites have been selected per stream type:
    - 3 reference sites (not impacted by any stressor)
    - 3 sites probably "good status"
    - 2 sites probably "moderate status"
    - 2 sites probably "poor" or "bad status"

The **additional stream types** have been defined more precisely by mainly using criteria specified in system A of the Water Framework Directive:

- stream sizes based on catchment area (10-100 km^2, >100-1000 km^2, > 1000 km^2)
- altitude classes (< 200 m, 200-800 m, > 800 m; or average tree-line, respectively)
- geology classes (silicious formations, calcareous formations, organic formations)
- ecoregion
- additional "system B" features

The stream types mainly serve the development of assessment methods for stream types, on which little is known (e.g. extension of the AQEM system). These assessment methods should preferably be stressor-specific. In addition, the data serve the same purposes as for the core stream types.
In general, the additional stream types have not been selected on forehand; they have been designated by the partners sampling additional stream types in the first phase of the project. Additional stream types have been selected in Austria, the Czech Republic, Germany, France, Greece (four types), France, Italy (two types), Portugal, Sweden and the UK. Coherent to the "core stream types", only a single stressor is investigated per country (see Table 1).
Using only the selected stressor (either organic pollution, or degradation in stream morphology, or acidification/toxic) the following minimum number of sites should be selected per stream type:

- 3 reference sites (not impacted by any stressor)
- 3 sites probably "good status"
- 2 sites probably "moderate status"
- 2 sites probably "poor" or "bad status"

Generally, the number of sampling sites specified above is the absolute minimum. Many partners have selected larger number of sampling sites (Table 4).

3.2) Description of the additional stream types

The additional stream types to be sampled in STAR are described more detailed in the following paragraphs. An overview is given in Table 1, followed by short descriptions.

Table 1: The STAR stream types. Column "ecoregion": number acc. to ILLIES (1978). Column "geology class": cal = calcareous, sil = siliceous, org = organic, alluv = alluvial deposits. Column "major degradation factors": M = degradation in stream morphology, O = Organic pollution, A = acidification, G = general degradation (not specified). Please notice that the additional stream type in the UK has not been finally selected.

To be sampled in:	*Stream type*	*Size class*	*Altitude class (m.a.s.l.)*	*Ecoregion*	*Geology class*	*Major degradation factors*
A	Small crystalline streams of the ridges of the Central Alps	10-100 km^2	200-800 m	4	sil	M
CZ	Small streams in the central Czech highlands (Danube river basin)	10-100 km^2	200-800 m	9	sil	M
D	Small Buntsandstein streams	10-100 km^2	200-800 m	9	sil	G
F	small and shallow headwater streams in Western France	>100-1000 km^2	200-800 m	8	cal	O
GR	Calcareous small sized mountain streams in Western, Central and Southern Greece	10-100 km^2	200-800 m	6	cal	O
GR	Silicious medium sized streams on the Aegean Islands	> 1000 km^2	200-800 m	6/7	sil	O
GR	Silicious medium sized mountain streams in Northern Greece	>100-1000 km^2	> 800 m	6	sil	O
GR	Calcareous medium sized streams in Western Greece	>100-1000 km^2	200-800 m	6	cal	G
I	Small sized streams in the southern calcareous Alps	10-100 km^2	> 800 m	4	cal	M
I	Small sized calcareous streams in the Central Apennines	10-100 km^2	200-800 m	3	cal	G
P	Medium sized streams in lower mountainous areas of Southern Portugal	>100-1000 km^2	< 200 m	1	sil	O
S	Swedish additional stream type	>100-1000 km^2	200-800 m	14	sil	O

Small crystalline streams of the ridges of the Central Alps

Country: Austria

Stream size based on catchment area: 10-100 km^2

Altitude class: 200-800 m

Geology class: silicious formations

Ecoregion: 4

Bioregion: Ridges and foothills of the Central Alps

Stressor investigated: degradation in stream morphology

Mostly high to medium gradient streams which flow in V- to U- shaped valleys. Especially in the upper courses extensive pool-riffle sequences mark the general appearance of this naturally constrained brooks. The substrate consists mainly of boulders, blocks, bedrock and cobbles. Near the shoreline as well as in current-reduced zones as pools, gravel and sandy material is deposited. Diatoms and mosses colonise the stony substrate depending on the gradient of light, which is often limited by dense deciduous/coniferous native forest. Considerable numbers of debris dams due to the high autumnal input of organic substances can be regarded as typical. Extensive wetland areas are scarcely found, although some spring fed tributaries occur frequently along the valley bottom and can contribute significantly to taxa richness.

Average river width can reach up to 10 m, the mean current velocity is about 0.3 to 0.8 m/s, mean depths varies between 10 and 40 cm. Chemical features have not been measured yet, but conductivity comprises relatively low values. The discharge regime can be generalised as nivo-pluvial to summer-pluvial.

In Austria this river type is widely distributed within the alpine area. Human impacts concern mainly river regulation efforts like straightening, bank fixation, plastering, retention of bed load and impounding. Damming and water abstraction for power generation purposes cause severe ecological problems within vast stretches of residual flow. Organic pollution, although evidently especially in regions of agricultural uses (mostly cattle breeding), represents a minor problem.

Small streams in the central Czech highlands (Danube river basin)

Country: Czech Republic

Stream size based on catchment area : >10-100 km^2

Altitude class: 200-800 m

Geology class: silicious formations

Ecoregion: 9

Stressor investigated: degradation in stream morphology (channelisation, bank and bed fixation, scouring, removal of shoreline vegetation)

Regional delimitation of the stream type is defined as an intersection of ecoregion Central highlands, Variscan (Hercynic) subprovince and the Danube River basin. Altitude range is shifted in comparison with the WFD categories to 200-500 m a.s.l. In near-natural conditions, the streams are characterised by sinuate to maendering channel in a meander or U-shaped valley or plain floodplains.

Cobbles and gravels dominate bed sediments but occurrence of finer materials reflects natural erosion and deposition processes, which form riffle-pool sequences. Patches of woody debris, POM or phytobenthos cover enhance habitat heterogeneity, usually associated with higher diversity of stream organisms.

Natural land cover in the floodplain is deciduous woody vegetation, which is in lower altitudes frequently substituted by agricultural areas. Typical feature of small streams surrounded by arable area is simple tree line on the banks reducing variability in lateral dimension of channel form.

Naturally high heterogeneity of current velocity and grain size of bed sediments is frequently reduced by channel straightening, scouring, bank fixation and torrent modification. In STAR, the study of this stream type will be dominantly focused on assessment of morphological degradation but this stressor is usually combined with organic pollution and eutrophication. For assessment, species preferring habitats degraded by regulations and trophic structure of aquatic communities are important. Although the majority of streams in the Czech Republic have at least some feature of morphological degradation, it is possible to find straggly distributed near-natural stretches.

Small Buntsandstein streams

Country: Germany

Stream size based on catchment area : >10-100 km^2

Altitude class: 200-800 m

Geology class: silicious formations

Ecoregion: 9

Stressor investigated: organic pollution, degradation in stream morphology (channelisation, bank and bed fixation, scouring, removal of shoreline vegetation)

Buntsandstein streams are resembling the “cores stream types 1” but are usually dominated by meso-lithal (fist to hand-sized cobbles) and sand, with a constrained or sinuate channel, running in a V-shaped or trough valley. Organic substrates cover up to 15% of the bottom. Buntsandstein regions generally have a low watercourse density (approx. 0.7 km/km^2) and a well-balanced runoff regime. Because sandstone erodes easily, erosion and deposition processes are very important. A prevalent change of riffles and pools is representative.

The water is characterized by low nutrient loads, a BOD_5 below 2mg/l, low conductivity and water hardness as well as pH values around 7.2. The wide floodplain is dominated by deciduous forest, and is flooded several times a year. The occurring of standing water bodies (side arms, backwaters) is dependant on the valley shape.

Buntsandstein streams feature a comparative high biodiversity. The macrobenthic fauna comprises rheophilous (for example *Dinocras cephalotes*) and limnophilous (for example *Ephemera danica*) taxa; the latter mainly occur in lentic zones with sand deposits near the shore or behind CWD accumulations. This stream is wide-spread throughout the Central European highlands; most streams are impacted by morphological degradation or acidification. Only fragments of near natural stretches are left.

Small and shallow headwater streams in Eastern France

Country: France

Stream size based on catchment area : >100-1000 km^2

Altitude class: 200-800 m

Geology class: calcareous formations

Ecoregion: 8

Stressor investigated: organic pollution

This stream type is characterized by sand of coarse grain size and fist to hand-sized cobbles. The latter are more or less covered with silt (i.e. thin organic particles), depending on the level of pollution. The channel has a sinuate to meandering form, and is situated in a meander valley or a plain floodplain. Organic substrates cover between 5% to 70% of the bottom and are mainly constituted by macrophytes (e.g. water lily). The latter slow down the water current velocity. Therefore, although the channel is characterised by riffle/pool reaches, pools are three or four times more longer than riffles.

The water is characterised by low to high nutrient loads, a BOD_5 between 3 to 25 mg/l, a COD (Chemical Oxygen Demand) varying from 5 to 12 mg/l, Conductivity values between 350 to 1500 $\mu S/cm^2$, and pH values around 7.8.

The wide alluvial plain is dominated by pasture land, and the bank vegetation is mainly constituted by tall herbs and/or deciduous wood vegetation (unmanaged vegetation with a complex structure). Standing water bodies (natural ponds) occur regularly, as well as artificial fish ponds. However, the latter are not directly connected to the main channel.

This stream type is mainly degraded by agricultural practices, such as intensive cattle breeding.

Calcareous small sized mountain streams in Western, Central and Southern Greece

Country: Greece

Stream size based on catchment area: 10-100 km^2

Altitude class : 200-800 m

Geology class: calcareous formations

Ecoregion: 6

Stressor investigated: organic pollution

This stream type is characterised a substrate mainly composed of boulders and pebbles; the channel is usually sinuate. Organic substrates cover between 5% and 10% of the bottom and comprise small amounts of CWD (logs, debris dams). Originally, standing water bodies were frequently occurring in the floodplain. The wide floodplain is dominated by deciduous woody vegetation (*Platanus* sp., *Salix* sp.) and is flooded from November to March. The water is generally characterised by low nutrient loads and pH values around 8.

The macrobenthic fauna is characterised by rheophilous taxa with only a small proportion of limnophilous taxa, the latter occurring in lentic zones near the shore or behind CWD accumulations (fallen leaves and fine roots). Typical taxa are *Perla* sp*., Nemoura* spp. (Plecoptera), *Rhithrogena* sp*., Heptagenia spp.*, *Caenis* spp. (Ephemeroptera), *Hydropsyche* spp., (Trichoptera), *Gomphus* spp., *Ophiogomphus sp., Calopteryx sp.* (Odonata), Elmidae (Coleoptera), *Melanopsis* sp. and *Unio* sp., (Mollusca). This stream type has been degraded slightly from organic pollution and agricultural activities, as well as catchment urbanisation.

Silicious medium sized streams on the Aegean Islands

Country: Greece

Stream size based on catchment area: > 1000 km^2

Altitude class: 200-800 m

Geology class: silicious formations

Ecoregion: 6 and 7

Other characteristic features: Strong hydrologic fluctuations

Stressor investigated: organic pollution

This stream type is characterised by coarse substrate (boulders to pebbles) and a sinuate channel form. Organic substrates cover small patches of the bottom and the amounts of CWD (logs and a few debris dams) are causing meanders and other channel features. The water is characterised by low nutrient loads, and pH values around 7.5. The wide floodplain is dominated by deciduous woody vegetation (*Platanus* sp.) and is flooded a few times a year. Standing water bodies (side arms, backwaters) occur at the river mouth areas.

The macrobenthic fauna is characterised by rheophilous as well as limnophilous taxa, the latter occurring in lentic patches near the shore or in organic microhabitats. Typical taxa are *Amphinemura* sp., *Perla* sp., *Nemoura* spp. (Plecoptera), *Caenis* spp. (Ephemeroptera), *Hydropsyche* spp., (Trichoptera), *Epallage fatime, Aeschna sp.* (Odonata), *Elmis* spp. (Coleoptera) and *Ancylus* sp. (Mollusca). This stream type has been degraded from urbanization and agricultural and touristic activities.

Silicious medium sized mountain streams in Northern Greece

Country: Greece

Stream size based on catchment area: >100-1000 km^2

Altitude class: > 800 m

Geology class: silicious formations

Ecoregion: 6 and 7

Stressor investigated: organic pollution

This stream type is characterised by pebbles of fine to coarse grain size and a sinuate to meandering channel form in a meander valley or a plain floodplain. Organic substrates cover between 10% and 30% of the bottom and comprise small amounts of CWD (debris dams). The water is generally characterised by low nutrient loads (but higher than the other Greek river types) and pH values around 7.5. The wide floodplain is dominated by coniferous and deciduous woody vegetation and is flooded several times a year. Standing water bodies (side arms, backwaters) occur regularly even distant from the river mouths.

The macrobenthic fauna is characterised by rheophilous as well as limnophilous taxa. Typical taxa are *Taeniopteryx* sp., *Perla* sp., *Isoperla* sp. *Nemoura* spp. (Plecoptera), *Baetis* sp., *Heptagenia* spp., *Caenis* spp. (Ephemeroptera), a large number of Trichoptera species, *Aeshna* sp., *Calopteryx* sp., *Gomphus* spp., *Ophiogomphus sp.* (Odonata), *Limnius* spp. and *Elmis* spp. (Coleoptera), *Physa spp.* and *Ancylus spp.* (Mollusca). This stream type has been degraded from agricultural activities, urbanization and devastation of floodplain vegetation. Natural fragments occur in high altitude areas.

Calcareous, medium sized streams in Western Greece

Country: Greece

Stream size based on catchment area : >100-1000 km^2

Altitude class: 200-800 m

Geology class: calcareous formations

Ecoregion: 6

Stressor investigated: organic pollution, degradation in stream morphology (channelisation, bank and bed fixation, scouring, removal of shoreline vegetation)

This stream types is characterised by sand bottoms and a sinuate channel form. Gravel and pebbles occur only in the upstream sections. Organic substrates (mainly macrophytes) cover sometimes almost 100% of the bottom. The water is characterised by medium to high nutrient loads and pH values around 7.5. The wide floodplain is dominated by planted olive trees and reed vegetation, and is flooded from November to April. Standing water bodies (side arms, backwaters) occur rarely at the upper part of the river.

The macrobenthic fauna is characterised more by limnophilous and less by rheophilous taxa. Typical taxa are a few specimen of Trichoptera and Plecoptera (close to headwaters), Ephemeroptera, *Calopteryx* sp., (Odonata) and Coleoptera. This stream type has been degraded almost completely due to extended regulation (scouring, straightening, impoundments, stagnation, removal of CWD as well as agriculture, pasture, olive presses, fishculture in the catchment). Small near-natural fragments occur in the headwaters.

Small-sized streams in the southern calcareous Alps

Country: Italy

Stream size based on catchment area: 10-100 km^2

Altitude class: > 800 m

Geology class: calcareous formations

Ecoregion: 4

Stressor investigated: degradation in stream morphology (channelisation, bank and bed fixation, scouring, removal of shoreline vegetation)

This stream type is characterized by a high slope and a small floodplain. Mineral microhabitats cover most of the stream bottom, biotic microhabitats are marginal. The natural vegetation in the floodplain is composed of coniferous and deciduous forest. The annual hydrologic regime is permanent and current velocities and discharges are low. Most of the macroinvertebrate community belongs to the orders Ephemeroptera, Diptera, Plecoptera and Trichoptera. This stream type is distributed in Italy in the calcareous Alps. The most important degradation factor for this stream type is stream morphology alteration (torrent modification, transverse structures, bank and bed fixation, straightening, removal of CWD), together with hydrological changes. Most of the streams belonging to this type have been altered.

Small sized calcareous streams in the Central Apennines

Country: Italy

Stream size based on catchment area: 10-100 km^2

Altitude class: 200-800 m

Geology class: calcareous formations

Ecoregion: 3

Stressor investigated: general degradation

This stream type is characterised by gravel to cobble substrate, and a sinuate channel form in a U-shaped valley. Organic substrates are widely represented and comprise considerable amounts of CWD (logs, leaf debris) and living parts of terrestrial plants. The water is characterised by medium pH values (> 7.5) and high conductivity levels. In the floodplain deciduous woody vegetation is widely present. The annual regime is usually permanent, even if under extreme conditions some sites can run dry in summer.

The macrobenthic community is diversified and it is dominated by Ephemeroptera taxa. Typical taxa are *Choroterpes* spp., *Habrophlebia* spp., *Caenis* spp., *Siphlonurus* spp., *Electrogena* spp., *Ecdyonurus* spp. and *Baetis* spp. (Ephemeroptera), *Leuctra* spp. (Plecoptera), Hydropsychidae, Hydroptilidae and Limnephilidae.

This stream type is typical in central Italy. Water quality ranges from very good to polluted mainly by sewage, pasture and agriculture. Some of the catchments are characterised by the presence of ore deposits.

Medium sized streams in lower mountainous areas of Southern Portugal

Country: Portugal

Stream size based on catchment area: >100-1000 km^2

Altitude class: < 200 m

Geology class: silicious formations

Ecoregion: 1

Stressor investigated: organic pollution

The stream type “medium streams of the lower mountainous areas” is distributed in siliceous areas of Southern Portugal mainly in the Guadiana-basin. Some similarities were found with medium-sized streams of the low mountainous regions in Northern Portugal. Due to the climatic and relief conditions those streams can undergo strong changes in flow, showing high peaks in winter and summer dry periods. The valley tend to be U-shaped. The mean water depth is around 40cm and the mean stream width under 7m. The riverbed is covered with stones and gravel. Many streams belonging to this type show still a good ecological status. However, unimpacted stretches are very seldom due to the traditional use of the narrow floodplain strip for agriculture.

The macroinvertebrate community includes mainly Plecoptera (*Perla madritensis, Leuctra geniculata*) Ephemeroptera, Trichoptera (*Agapetus sp.*), Odonata (*Boyeria irene*) and Diptera (Blephariceridae, Athericidae). The water conductivity is normally under 200µS/cm and the pH is close to 7.0.

4.) Criteria for selecting sampling sites

All partners used the same scheme to select their sampling sites. The main guidelines were:

- Although it is not always possible to discriminate between the impact of different stressors, preferably sites impacted only by a single stressor have been selected (e.g. a site with a very natural morphology but impacted by pollution).
- For each stream type sites of different degradation classes must be sampled. Therefore, a pre-classification of the sites is necessary (ranging from "possibly high status" to "possibly bad status"). For the definition of "reference conditions" (high status) see chapter 4.1.
- Every assessment system tries to detect differences in the river community caused by human impact and not by natural variability. It is, therefore, very important that the differences in the sampling sites result from stressors and not from naturally different substrates, altitudes or geology.
- The sampling sites should be representative for the stream situation to be assessed, the "survey area", which might cover a section of several hundred metres stream length up to a complete catchment area of a small stream. E.g., the site must reflect the habitat composition of the survey area. Examples: If the survey area is predominantly free of debris dams it should be avoided to sample the only accumulation of dead wood. If the river is not channelised in most of its length the only channelised section is unsuitable for the sampling.
- Accessibility of sampling sites is crucial, particularly for fish sampling in the medium-sized lowland streams, where heavy equipment might be required. All partners had to find a compromise between "representativeness" and "accessibility", which was particularly difficult in reference situations.
- The partners had to make sure on forehand that it is possible to receive the necessary permissions for sampling. In many countries this is especially difficult for fish sampling.
- STAR strives for an integration of the project sampling sites into the "intercalibration network", for which each EU member state must nominate a number of sites. To prevent people of re-inventing the wheel many partners selected sites, which are planned to be part of the intercalibration network.

4.1) Criteria for the selection of "ideal" references sites in STAR

An ideal reference stream should fulfill all requirements necessary to allow a completely undisturbed fauna and flora to develop and establish itself. Therefore, "reference sites" should not only be characterised by clean water but also by undisturbed stream morphology and near-natural catchment characteristics. Though it is impossible to find sites in such a pristine condition for many stream types, certain criteria should be met by "realistic" reference sites wherever possible.

In the following section primary criteria, i.e. those that should always be met by reference sites are underlined. The other criteria are seen as highly desirable but not essential if no other "perfect" reference sites can be found. The list is based on AQEM CONSORTIUM (2002) but was extended to include parameters relevant for the establishment of an undisturbed fish-, macrophyte- and phytobenthos community to develop.

Basic statements

- The reference condition must be politically palatable and reasonable.
- A reference site, or process for determining it, must hold or consider important aspects of "natural" conditions.
- The reference conditions must reflect only minimal anthropogenic disturbance.

Land use practices in the catchment area

- In most countries there is anthropogenic influence within the catchment area. Therefore, the degree of urbanisation, agriculture and silviculture should be as low as possible for a site to serve as a reference site. No absolute minimum or maximum values have been set for the defining reference conditions (e.g. % arable land use, % native forest); instead the least-influenced sites with the most natural vegetation are to be chosen.

River channel and habitats

- The reference site floodplain should not be cultivated. If possible, it should be covered with natural climax vegetation and/or unmanaged forest.
- Coarse woody debris should not be removed (minimum demand: presence of coarse woody debris).
- Stream bottoms and stream margins must not be fixed.
- Spawning habitats for the natural fish population (e.g. gravel bars, floodplain ponds connected to the stream) should be present.
- Preferably, there should be no migration barriers (effecting the bedload transport and/or the biota of the sampling site).
- In streams types, in which naturally anadromous fish species would occur, the accessibility of the reference site from downstream is an important aspect for the site selection.
- Only moderate influence due to flood protection measures can be accepted.

Riparian vegetation and floodplain

- Natural riparian vegetation and floodplain conditions must still exist making lateral connectivity between the stream and its floodplain possible; depending on the stream type, the riparian buffer zone should be greater or equal to 3 x channel width.

Hydrologic conditions and regulation

- No alterations of the natural hydrograph and discharge regime should occur.
- There should be no or only minor upstream impoundments, reservoirs, weirs and reservoirs retaining sediment; no effect on the biota of the sampling site should be recognisable.
- There should be no effective hydrological alterations such as water diversion, abstraction or pulse releases.

Physical and chemical conditions

There should be:

- No point sources of pollution or nutrient input affecting the site.
- No point sources of eutrophication affecting the site.
- No sign of diffuse inputs or factors which suggest that diffuse inputs are to be expected.
- "Normal" background levels of nutrient and chemical base load, which reflect a specific catchment area.
- No sign of acidification.
- No liming activities.
- No impairments due to physical conditions; especially thermal conditions must be close to natural.
- No local impairments due to chemical conditions; especially no known point-sources of significant pollution, all the while considering near-natural pollution capacity of the water body.
- No sign of salinity.

Biological conditions

There should not be any:

- Significant impairment of the indigenous biota by introduction of fish, crustaceans, mussels or any other kind of plants and animals.
- Significant impairment of the indigenous biota by fish farming.
- Intensive management, e.g. of the fish population.

5.) Overview of samples to be taken at the individual sites

The first phase of the project was used for intensive discussions about the best methodology for sampling the individual taxonomic groups and about details of the sampling design. The consolidated sampling protocols are presented on the discussion forum of the project homepage and are not included into this report. However, since some minor changes in sampling design have been made, an update of the number of samples to be taken for the individual taxonomic groups is presented here.

The changes resulted from:

- The fact that the replicate sampling programme, which is a data source for the error estimation process, has been moved from the sampling workshops (Workpackage 6) to the overall sampling programme (Workpackages 7 and 8). This resulted in a larger number of macroinvertebrate samples to be taken in the core and additional stream types.
- The slightly different allocation of stressors to sites, as described in chapter 3.1.
- The larger number of sampling sites, which is due to additional national funding (Greece) or extra work performed by some partners, who have selected more sampling sites than originally required (Germany, Czech Republic).
- The UK partner will sample an additional stream type instead of core stream type 1, since no sufficient number of suited sampling sites were available. The additional stream type has not finally been selected so far.

Table 2: Number of samples to be taken in the **core stream types** with the different sampling protocols. Sampling site numbers for Austria, Denmark and UK preliminary.

	Core stream type 1											*Core stream type 2*										
	number of sites	*AQEM*	*AQEM replicate samples*	*RIVPACS*	*RIVPACS replicate samples*	*other inv. methods*	*other methods replicate samples*	*phytobenthos*	*macrophytes*	*fish*	*RHS*	*number of sites*	*AQEM*	*AQEM replicate samples*	*RIVPACS*	*RIVPACS replicate samples*	*other inv. methods*	*other methods replicate samples*	*phytobenthos*	*macrophytes*	*fish*	*RHS*
Austria	10	20	6	20	6			10		10	10											
Czech Republic	14	28	6			28	6	14	14	14	14											
Denmark												10	20	12			20	12	10	10	10	10
Germany	12	20	4	20	4			10	10	10	10	13	20	4	20	4			10	10	10	10
Sweden												16	20	6			20	6	10	10	10	10
UK												10	20	6	20	6			10	10	10	10
Total number of samples	36	68	16	40	10	28	6	34	24	34	34	49	80	28	40	10	40	18	40	40	40	40

Table 3: Number of samples to be taken in the **additional stream types** with the different sampling protocols. “repl. samples”= replicate samples, to be taken for the error estimation programme. Sampling site numbers for Portugal and UK preliminary.
Greece additional type 1 = Calcareous small sized mountain streams in Western, Central and Southern Greece; Greece additional type 2 = Silicious medium sized mountain streams in Northern Greece; Greece additional type 3 = Silicious medium sized streams on the Aegean Islands; Greece additional type 4 = Calcareous medium sized streams in Western Greece; Italy additional type 1 = Small sized streams in the Southern calcareous Alps; Italy additional type 2 = Small sized calcareous streams in the Central Apennines.

		number of samplig sites	*AQEM*	*AQEM repl. samples*	*RIVPACS*	*RIVPACS repl. samples*	*other inv. methods*	*other methods repl. samples*	*phytobenthos*	*macrophytes*	*fish*	*RHS*
Austria		10	20	6	10	6			5			5
Czech Republic		10	20	6			10	6	5	5	5	5
France		12	24	6			24	6	10	10	10	10
Germany		20	40	4	12	4			5	5	5	5
Greece	add. type 1	23	69	6	20	6			10	10	10	10
	add. type 2	26	78									
	add. type 3	23	69									
	add. type 4	8	24									
Italy	add. type 1	10	20	6			20	6	10	10	10	10
	add. type 2	13	26	6			20	6	10	10	10	10
Portugal		10	20	6	20	6			10	10	10	10
Sweden		15	30	6			14	6	7	7	7	7
UK		14		6		6						
Total no. of samples		194	440	58	62	28	88	30	72	67	67	72

6.) List of the STAR sampling sites

The following compilation lists all sites, which have been selected by the STAR partners. A more detailed description of all sites including more parameters can be viewed on www.eu-star.at.

Please note that the sampling site selection process has not been completed in those countries, who will start sampling in autumn 2002 (Portugal, UK, Denmark). The sampling sites selected in these countries will be presented on www.eu-star.at as soon as the selection process has been finished.

Table 4 (over leaf): The STAR sampling sites. Please notice that sampling sites for the following stream types have not finally been selected and are not listed here: Core stream type 1 in Austria; core stream type 2 in Denmark and the UK; additional stream types in Portugal and the UK.
Column “estimated degradation class”: 5 = possibly high status; 4 = possibly good status; 3 = possibly moderate status; 2 = possibly poor status; 1 = possibly bad status.

Country and stream type	Site name	River	River system	Ecoregion	Catch ment area [km^2]	Estimated degradation class	Has the site been sampled in AQEM?	preferred sampling season (1)	preferred sampling season (2)
Czech Republic	Luborca	Luborca	Danube	10 Carpathian	21	5	no	spring	summer
core stream type 1 (Czech Republic)	Rychtarov	Velka Hana	Danube	9 Central Sub-alpine Mountains	27	5	no	spring	summer
	Ruprechtov	Mala Hana	Danube	9 Central Sub-alpine Mountains	30	5	no	spring	summer
	Biskupice	Cerny potok	Danube	10 Carpathian	24	4	yes	spring	summer
	Suchovske mlyny	Velicka	Danube	10 Carpathian	26	4	yes	spring	summer
	Mlynky	Sudomericky potok	Danube	10 Carpathian	19	4	no	spring	summer
	Vicov	Okluka	Danube	9 Central Sub-alpine Mountains	44	4	no	spring	summer
	Brezinky	Nectava	Danube	9 Central Sub-alpine Mountains	30	4	no	spring	summer
	Kandia	Sumice	Danube	9 Central Sub-alpine Mountains	44	3	no	spring	summer
	Zvole	Olesna	Danube	9 Central Sub-alpine Mountains	28	3	no	spring	summer
	Myslejovice	Drahansky potok	Danube	9 Central Sub-alpine Mountains	27	3	no	spring	summer
	Novy Dvur	Usobrnsky potok	Danube	9 Central Sub-alpine Mountains	34	3	no	spring	summer
	Zbraslavec	Umori	Danube	9 Central Sub-alpine Mountains	22	2	no	spring	summer
	Cerna Hora	Bykovka	Danube	9 Central Sub-alpine Mountains	31	1	no	spring	summer
Germany	Wehebachtalsperre	Weißer Wehebach	Maas	8 Western Sub-alpine Mountains	14,7	5	yes	spring	summer
core stream type 1 (Germany)	Neuludwigsdorf	Elbrighäuser Bach	Weser	9 Central Sub-alpine Mountains	9,3	5	yes	spring	summer
	Kalltalsperre	Kall	Maas	8 Western Sub-alpine Mountains	19,5	4	no	spring	summer
	Eicherscheider Berg	Platißbach	Maas	8 Western Sub-alpine Mountains	10,1	4	no	spring	summer
	Oberprether Mühle	Prether Bach	Maas	8 Western Sub-alpine Mountains	14,9	4	no	spring	summer
	Linneperhütte	Linnepe	Rhein	9 Central Sub-alpine Mountains	12,1	4	no	spring	summer
	Wiesen	Wolfferter Bach	Maas	8 Western Sub-alpine Mountains	22,5	3	no	spring	summer
	Niedersalwey	Salwey	Rhein	9 Central Sub-alpine Mountains	15,7	3	yes	spring	summer
	Wemlighausen	Marienwasser	Weser	9 Central Sub-alpine Mountains	16,9	3	no	spring	summer
	Feudingen	Lahn	Rhein	9 Central Sub-alpine Mountains	21,2	3	no	spring	summer
	Dreis-Tiefenbach	Dreisbach	Rhein	9 Central Sub-alpine Mountains	26,2	2	yes	spring	summer
	Breitenhagen	Rahmede	Rhein	9 Central Sub-alpine Mountains	28,2	1	yes	spring	summer
core stream type 1 (Germany)	Stepenitz near Putlitz (BB)	Stepenitz	Elbe	14 Central Lowlands	182	5	yes	spring	summer
	Eltingmuehlenbach near Greven (NRW)	Eltingmühlenbach	Ems	14 Central Lowlands	164	5	yes	spring	summer
	Rhin near Raegelsdorf (BB)	Rhin	Elbe	14 Central Lowlands	260	5	yes	spring	summer
	Oertze N of Poitzen (NS)	Örtze	Weser	14 Central Lowlands	200	5	no	spring	summer
	Aue E of Wildeshausen (NS)	Aue	Weser	14 Central Lowlands	100	4	no	spring	summer
	Lachte W of Lachendorf (NS)	Lachte	Weser	14 Central Lowlands	440	4	no	spring	summer
	Berkel SE of Vreden (NRW)	Berkel	Issel	14 Central Lowlands	240	4	no	spring	summer
	Boehme S of Vierde (NS)	Böhme	Weser	14 Central Lowlands	260	3	no	spring	summer
	Karthane near Muehlenholz/Karthan (BB)	Karthane	Elbe	14 Central Lowlands	290	3	no	spring	summer
	Dinkel near Heek (NRW)	Dinkel	Issel	14 Central Lowlands	100	3	no	spring	summer
	Issel N of Loikum (NRW)	Issel	Issel	14 Central Lowlands	200	2	no	spring	summer
	Stever near Hullern (NRW)	Stever	Rhein	14 Central Lowlands	560	2	no	spring	summer
	Dinkel at Gronau (NRW)	Dinkel	Issel	14 Central Lowlands	180	1	yes	spring	summer
Sweden	Uppströms Hamrångefjärden	Hamrångeån		14 Central Lowlands		5	no	autumn	spring
core stream type 2 (Sweden)	Nedom nordtjärnsälven	Nittälven	Norrström	14 Central Lowlands	125	5	no	autumn	spring
		Silverån	Emån	14 Central Lowlands	100	5	no	autumn	spring
		Trösälven	Göta älv	14 Central Lowlands	100	4	no	autumn	spring
	Mynning Burån	Pajsoån	Norrström	14 Central Lowlands	197	4	no	autumn	spring
	Uppströms sävefors	Sävälven	Göta älv	14 Central Lowlands		4	no	autumn	spring
	Rif Kojan	Sandån	Norrström	14 Central Lowlands	153	4	no	autumn	spring
	Vid Nyhammar	Norrboån	Norrström	14 Central Lowlands	250	4	no	autumn	spring
	Hålldammsforsen	Sverkestaån	Norrström	14 Central Lowlands	492	3	no	autumn	spring
	Brattforsen	Hörksälven	Norrström	14 Central Lowlands	119	3	no	autumn	spring
	Nedströms Storåkvarn	Storån	Norrström	14 Central Lowlands	800	3	no	autumn	spring
	Grängeshyttan	Rastälven	Norrström	14 Central Lowlands	294	3	no	autumn	spring
	Nedströms Hannasjön	Kilaån	Kilaån	14 Central Lowlands	140	2	no	autumn	spring
	Svärta gård	Svärtaån	Svärtaån	14 Central Lowlands	372	2	no	autumn	spring
		Borkhultsån	Söderköpingsån	14 Central Lowlands	118	2	no	autumn	spring
	I höjd med Sala	Sagån	Norrström	14 Central Lowlands	857	2	no	autumn	spring

Country and stream type	Site name	River	River system	Ecoregion Name+No	Catchment area [km2]	Estimated degradation class	Has the site been sampled in AQEM?	preferred sampling season (1)	preferred sampling season (2)	Extra sampling season
Austria	uh. Steinbrecher	Stainzbach	Danube	4 Alps	11,1	5	no	spring	summer	
Small crystalline streams of the ridges of the Central Alps	bei Kramermirtl	Wildbach	Danube	4 Alps	20,8	5	no	spring	summer	
	bei Guntschenberg	Weisse Sulm	Danube	4 Alps	67,7	5	no	spring	summer	
	bei Marhofberg	Stainzbach	Danube	4 Alps	28,5	4	no	spring	summer	
	oh. Schoberberg	Wildbach	Danube	4 Alps	32,7	4	no	spring	summer	
	bei Kleingraden	Schwarze Sulm	Danube	4 Alps	65,1	4	no	spring	summer	
	bei Haderberg	Stullneggbach	Danube	4 Alps	27,9	3	no	spring	summer	
	bei Grünberg	Stullneggbach	Danube	4 Alps	25,8	3	no	spring	summer	
	bei Köflach	Gradnerbach	Danube	4 Alps	17,4	2	no	spring	summer	
	oh. Köflach	Gradnerbach	Danube	4 Alps	17,3	1	no	spring	summer	
Czech Republic	Valsovsky dul	Huntava	Danube	9 Central Sub-alpine Mountains	27	5	no	spring	summer	
Small streams in the central czech highlands	Horni Zleb	Sitka	Danube	9 Central Sub-alpine Mountains	55	5	no	spring	summer	
	Belkovice	Trusovicky potok	Danube	9 Central Sub-alpine Mountains	45	5	no	spring	summer	
	Techanov	Oslava	Danube	9 Central Sub-alpine Mountains	34	4	no	spring	summer	
	Sloup	Luha	Danube	9 Central Sub-alpine Mountains	27	4	no	spring	summer	
	Ruzove udoli	Nemilka	Danube	9 Central Sub-alpine Mountains	22	4	no	spring	summer	
	Bedrichov	Oskava	Danube	9 Central Sub-alpine Mountains	38	3	no	spring	summer	
	Sumvald	Drazuvka	Danube	9 Central Sub-alpine Mountains	21	3	no	spring	summer	
	Dlouha Loucka	Trebuvka	Danube	9 Central Sub-alpine Mountains	15	2	no	spring	summer	
	Borsov	Trebuvka	Danube	9 Central Sub-alpine Mountains	37	1	no	spring	summer	
France	Ource at Menesble	Ource	Seine	8 Western Sub-alpine Mountains	67	5	no	spring	autumn	
Small shallow headwater streams	Aube downstream Dancevoir	Aube	Seine	8 Western Sub-alpine Mountains	295	5	no	spring	autumn	
	Rognon at Andelot "le pont rouge"	Rognon	Seine	8 Western Sub-alpine Mountains	250	4	no	spring	autumn	
	Aujon upstream Giey-sur-Aujon	Aujon	Seine	8 Western Sub-alpine Mountains	60	4	no	spring	autumn	
	Rognon at Montot-sur-Rognon	Rognon	Seine	8 Western Sub-alpine Mountains	380	4	no	spring	autumn	
	Saônelle downstream Villouxel	Saônelle	Meuse	8 Western Sub-alpine Mountains	57	4	no	spring	autumn	
	Ornain upstream Gondrecourt-le-château	Ornain	Seine	8 Western Sub-alpine Mountains	115	3	no	spring	autumn	
	Meuse between Bourg-Sainte-Marie and Bourmont	Meuse	Meuse	8 Western Sub-alpine Mountains	255	3	no	spring	autumn	
	Anger downstream Jainvillotte	Anger	Meuse	8 Western Sub-alpine Mountains	90	3	no	spring	autumn	
	Madon at Hagécourt (pont bleu)	Madon	Rhin	8 Western Sub-alpine Mountains	218	2	no	spring	autumn	
	Meuse between Daillecourt and Bassoncourt	Meuse	Meuse	8 Western Sub-alpine Mountains	98	2	no	spring	autumn	
	Mouzon at Sartes	Mouzon	Meuse	8 Western Sub-alpine Mountains	200	2	no	spring	autumn	
Greece	TSOURAKI	TSOURAKI	ALPHEIOS	6 Hellenic Western Balkans		5	yes	spring	summer	winter
Calcareous small sized mountain streams	KOKKINOS	KOKKINOS	MORNOS	6 Hellenic Western Balkans		5	no	spring	summer	winter
in Western, Central and Southern Greece	GADOURAS	GADOURAS	GADOURAS	6 Hellenic Western Balkans		5	no	spring	summer	winter
	GORGOPOTAMOS	BRIDGE	SPERCHEIOS	6 Hellenic Western Balkans		5	no	spring	summer	winter
	KOPANAKI	PERISTERA	PERISTERA	6 Hellenic Western Balkans		4	no	spring	summer	winter
	TSOURAKI 1	TSOURAKI	ALPHEIOS	6 Hellenic Western Balkans		4	no	spring	summer	winter
	KATO PTERI	KERONITIS	KERONITIS	6 Hellenic Western Balkans		4	no	spring	summer	winter
	RETHI	FONISSA	FONISSA	6 Hellenic Western Balkans		4	no	spring	summer	winter
	SELA	VOLINEOS	VOLINEOS	6 Hellenic Western Balkans		4	no	spring	summer	winter
	GADOURAS 1	PAR. GADOURAS	GADOURAS	6 Hellenic Western Balkans		4	no	spring	summer	winter
	AGHIOS FLOROS	PAR. PAMMISSOS	PAMISSOS	6 Hellenic Western Balkans		4	no	spring	summer	winter
	MIRO	PERISTERA	PERISTERA	6 Hellenic Western Balkans		3	no	spring	summer	winter
	SMOKOVO	ONOXONOS	PINIOS	6 Hellenic Western Balkans		3	yes	spring	summer	winter
	TSIVLOS	KRATHIS	KRATHIS	6 Hellenic Western Balkans		3	no	spring	summer	winter
	DAFNES	MEGANITIS	MEGANITIS	6 Hellenic Western Balkans		3	no	spring	summer	winter
	MIRTIA	DIHALOREMA	DIHALOREMA	6 Hellenic Western Balkans		3	no	spring	summer	winter
	AGHIA SOFIA	MOKESTIANOS	MOKESTIANOS	6 Hellenic Western Balkans		3	no	spring	summer	winter
	DAMASTA	PAR. KIFISSOS	KIFISSOS	6 Hellenic Western Balkans		3	no	spring	summer	winter
	POLIDROSOS	PAR. KIFISSOS	KIFISSOS	6 Hellenic Western Balkans		3	no	spring	summer	winter
	FRAGKISTA	KERASOHORITIKOS	ACHELOOS	6 Hellenic Western Balkans		3	no	spring	summer	winter
	GORGOPOTAMOS	GORGOPOTAMOS	SPERCHEIOS	6 Hellenic Western Balkans		3	no	spring	summer	winter
	APTERA	KILIARIS	KILIARIS	6 Hellenic Western Balkans		2	no	spring	summer	winter
	KALAMI	KILIARIS	KILIARIS	6 Hellenic Western Balkans		1	no	spring	summer	winter

Country and stream type	Site name	River	River system	Ecoregion Name+No	Catchment area [km2]	Estimated degradation class	Has the site been sampled in AQEM?	preferred sampling season (1)	preferred sampling season (2)	Extra sampling season
Greece	DIPOTAMA	ARKOUDOREMA	NESTOS	7 Eastern Balkans		5	yes	spring	summer	winter
Silicious medium sized mountain streams	PRASINADA	PRASINADA	NESTOS	7 Eastern Balkans		5	yes	spring	summer	winter
in Northern Greece	THERMIA	DIAVOLOREMA	NESTOS	7 Eastern Balkans		5	yes	spring	summer	winter
	GORGONA	KOSSYNTHOS	KOSSYNTHOS	7 Eastern Balkans		3	yes	spring	summer	winter
	GERAKAS	KOSSYNTHOS	KOSSYNTHOS	7 Eastern Balkans		4	no	spring	summer	winter
	SMINTHI	KOSSYNTHOS	KOSSYNTHOS	7 Eastern Balkans		2	no	spring	summer	winter
	MIKI	KOMPSATOS	KOSSYNTHOS	7 Eastern Balkans		4	no	spring	summer	winter
	EHINOS	KOMPSATOS	KOMPSATOS	7 Eastern Balkans		1	no	spring	summer	winter
	MELIDIA	KOMPSATOS	KOMPSATOS	7 Eastern Balkans		4	no	spring	summer	winter
	BYZANTINE BRIDGE	KOMPSATOS	KOMPSATOS	7 Eastern Balkans		3	yes	spring	summer	winter
	KALIPEFKI	SKAMNIAS	SKAMNIAS	6 Hellenic Western Balkans		3	yes	spring	summer	winter
	DROSOPIGHI	LYGKOS	AXIOS	6 Hellenic Western Balkans		5	yes	spring	summer	winter
	DROSOPIGHI 1	LYGKOS	AXIOS	6 Hellenic Western Balkans		4	no	spring	summer	winter
	TRIPOTAMOS	LYGKOS	AXIOS	6 Hellenic Western Balkans		1	yes	spring	summer	winter
	MARINA	LYGKOS	AXIOS	6 Hellenic Western Balkans		1	no	spring	summer	winter
	FLORINA	FLORINIS	AXIOS	6 Hellenic Western Balkans		2	yes	spring	summer	winter
	MILIA	VENETIKOS	ALIAKMON	6 Hellenic Western Balkans		4	no	spring	summer	winter
	KRANIA	VENETIKOS	ALIAKMON	6 Hellenic Western Balkans		3	no	spring	summer	winter
	SPANOU	VENETIKOS	ALIAKMON	6 Hellenic Western Balkans		1	no	spring	summer	winter
	PIGADITSA	VENETIKOS	ALIAKMON	6 Hellenic Western Balkans		3	no	spring	summer	winter
	KIRAKALI	GREVENITIS	ALIAKMON	6 Hellenic Western Balkans		4	no	spring	summer	winter
	ELEFTHEROHORI	VENETIKOS	ALIAKMON	6 Hellenic Western Balkans		2	no	spring	summer	winter
	ZIAKAS	VENETIKOS	ALIAKMON	6 Hellenic Western Balkans		3	no	spring	summer	winter
	KRIMINI	PRAMORITSA	ALIAKMON	6 Hellenic Western Balkans		3	no	spring	summer	winter
	GREVENA	GREVENITIS	ALIAKMON	6 Hellenic Western Balkans		1	no	spring	summer	winter
	TRIKOMO	VENETIKOS	ALIAKMON	6 Hellenic Western Balkans		4	no	spring	summer	winter
Greece	PERASMATA	FONIAS	FONIAS	7 Eastern Balkans		5	yes	spring	summer	winter
Silicious medium sized streams on the Aegean Islands	GRIA VATHRA	TSIVDOGHIANNI	TSIVDOGHIANNI	7 Eastern Balkans		5	yes	spring	summer	winter
	ABELIKO	PAR. VOURKOU	VOURKOU	7 Eastern Balkans		5	no	spring	summer	winter
	KORONIDA	APOLLO	APOLLO	6 Hellenic Western Balkans		5	no	spring	summer	winter
	REVMATA	ASPROPOTAMOS	ASPROPOTAMOS	6 Hellenic Western Balkans		5	no	spring	summer	winter
	SARIZA	SARIZA	SARIZA	6 Hellenic Western Balkans		5	no	spring	summer	winter
	LENOSSAIOI	DIMOSARIS	DIMOSARIS	6 Hellenic Western Balkans		5	no	spring	summer	winter
	KOMITOS	KOMITOS	KOMITOS	6 Hellenic Western Balkans		5	no	spring	summer	winter
	ANTIAS	ANTIAS	ANTIAS	6 Hellenic Western Balkans		5	no	spring	summer	winter
	LALA	LALA	LALA	6 Hellenic Western Balkans		5	no	spring	summer	winter
	MANOLATES	PAR. KOKORREMA	KOKORREMA	7 Eastern Balkans		4	yes	spring	summer	winter
	KARINI	PAR. EVERGETOULAS	EVERGETOULAS	7 Eastern Balkans		4	no	spring	summer	winter
	MESI	APOLLO	APOLLO	6 Hellenic Western Balkans		4	no	spring	summer	winter
	DIONYSOS	PAR. PLATANOS	PLATANOS	6 Hellenic Western Balkans		4	no	spring	summer	winter
	APOIKIA	SARIZA	SARIZA	6 Hellenic Western Balkans		4	no	spring	summer	winter
	PITROFOS	PAR. MEG. POTAMOS	MEG. POTAMOS	6 Hellenic Western Balkans		4	no	spring	summer	winter
	PLATANISTOS	PLATANISTOS	PLATANISTOS	6 Hellenic Western Balkans		4	no	spring	summer	winter
	EGARES	EGARES	EGARES	6 Hellenic Western Balkans		3	no	spring	summer	winter
	BALOS	AMFILISSOS	AMFILISSOS	7 Eastern Balkans		2	no	spring	summer	winter
	VALANAS	TRIGONA	TRIGONA	7 Eastern Balkans		2	no	spring	summer	winter
	VOUNARIA	VOULGARIS	VOULGARIS	7 Eastern Balkans		2	no	spring	summer	winter
	KOUROS	APOLLO	APOLLO	6 Hellenic Western Balkans		2	no	spring	summer	winter
Greece	KONTRA	PAMISSOS	PAMISSOS	6 Hellenic Western Balkans		4	no	spring	summer	winter
Calcareous medium sized streams in Western Greece	AGHIOS FLOROS	PAR. PAMISSOS	PAMISSOS	6 Hellenic Western Balkans		4	no	spring	summer	winter
	LALA KATO	LALA	LALA	6 Hellenic Western Balkans		3	no	spring	summer	winter
	VRAHOPANAYITSA	PAMISSOS	PAMISSOS	6 Hellenic Western Balkans		3	yes	spring	summer	winter
	MELIGALAS	PAMISSOS	PAMISSOS	6 Hellenic Western Balkans		2	no	spring	summer	winter
	PLATI	PAMISSOS	PAMISSOS	6 Hellenic Western Balkans		2	no	spring	summer	winter
	ARIS	PAMISSOS	PAMISSOS	7 Eastern Balkans		2	no	spring	summer	winter
	MIKROMANI	PAMISSOS	PAMISSOS	7 Eastern Balkans		1	no	spring	summer	winter
	MESSINI	PAMISSOS	PAMISSOS	6 Hellenic Western Balkans		1	no	spring	summer	winter

Country and stream type	Site name	River	River system	Ecoregion Name+No	Catchment area [km2]	Estimated degradation class	Has the site been sampled in AQEM?	preferred sampling season (1)	preferred sampling season (2)	Extra sampling season
Germany	Aubach above Wiesthal	Aubach	Lohr/Main	9 Central Sub-alpine Mountains	39,5	5	no	summer		
Buntsandstein-streams	Ilme above Relliehausen	Ilme	Leine/Weser	9 Central Sub-alpine Mountains	47,9	5	no	summer		
	Aubach above Wiesthal	Aubach	Lohr/Main	9 Central Sub-alpine Mountains	39,5	5	no		spring	
	Ilme above Relliehausen	Ilme	Leine/Weser	9 Central Sub-alpine Mountains	47,9	5	no		spring	
	Orb below Bad Orb	Orb	Kinzig/Main	9 Central Sub-alpine Mountains	43,5	4	no	summer		
	Itterbach above Kailbach	Itterbach	Neckar	9 Central Sub-alpine Mountains	35,59	4	no	summer		
	Hafenlohr above Lichtenau	Hafenlohr	Main	9 Central Sub-alpine Mountains	53,8	4	no	summer		
	Bieber above Rossbach	Bieber	Kinzig/Main	9 Central Sub-alpine Mountains	25	4	no	summer		
	Orb below Bad Orb	Orb	Kinzig/Main	9 Central Sub-alpine Mountains	43,5	4	no		spring	
	Itterbach above Kailbach	Itterbach	Neckar	9 Central Sub-alpine Mountains	35,59	4	no		spring	
	Hafenlohr above Lichtenau	Hafenlohr	Main	9 Central Sub-alpine Mountains	53,8	4	no		spring	
	Bieber above Rossbach	Bieber	Kinzig/Main	9 Central Sub-alpine Mountains	25	4	no		spring	
	Klingbach below Hausen	Klingbach	Kinzig/Main	9 Central Sub-alpine Mountains	24,2	3	no	summer		
	Jossa below Sahlensee	Jossa	Sinn/Main	9 Central Sub-alpine Mountains	77,3	3	no	summer		
	Klingbach below Hausen	Klingbach	Kinzig/Main	9 Central Sub-alpine Mountains	24,2	3	no		spring	
	Jossa below Sahlensee	Jossa	Sinn/Main	9 Central Sub-alpine Mountains	77,3	3	no		spring	
	Orb in Bad Orb	Orb	Kinzig/Main	9 Central Sub-alpine Mountains	32,5	2	no	summer		
	Orb in Bad Orb	Orb	Kinzig/Main	9 Central Sub-alpine Mountains	32,5	2	no		spring	
	Aura in Burgsinn	Aura	Sinn/Main	9 Central Sub-alpine Mountains	58,3	1	no	summer		
	Aura in Burgsinn	Aura	Sinn/Main	9 Central Sub-alpine Mountains	58,3	1	no		spring	
Italy	Rio della Cascata at km 3,3	Rio della Cascata (K.10.15	Adige	4 Alps	4	5	no	spring	winter	
Small sized streams in mountainous areas in the Alps	Rio Gardena at km 2,3	Rio Gardena (I)	Adige	4 Alps	4	5	no	spring	winter	
	Rio Stolla at km 6,9	Rio Stolla (C.400.10)	Adige	4 Alps	34	5	no	spring	winter	
	Rio S. Nicolò at km 1,4	Rio S. Nicolò (B.25.80)	Adige	4 Alps	3	4	no	spring	winter	
	Rio Gardena at km 11,7	Rio Gardena (I)	Adige	4 Alps	117	4	no	spring	winter	
	Rio Funes at km 2,7	Rio Funes (B.300)	Adige	4 Alps	6	4	no	spring	winter	
	Rio di Camin at km 5,2	Rio di Camin (B.65.95)	Adige	4 Alps	15	3	no	spring	winter	
	Rio Stolla at km 9,4	Rio Stolla (C.400.10)	Adige	4 Alps		3	no	spring	winter	
	Rio Sesto at km 15,8	Rio Sesto (J.105)	Danube	4 Alps		2	no	spring	winter	
	Rio Gardena at km 4,4	Rio Gardena (I)	Adige	4 Alps	20	1	no	spring	winter	
Italy	Farma Iesa (SI) reference	Farma	Ombrone	3 Italy	93,66	5	no	spring	winter	
Small-sized, calcareous, 200-800m (Central Apennines)	Albegna Roccalbegna (GR) reference	Albegna	Albegna	3 Italy	40,78	5	no	spring	winter	
	Zancona loc. Zancona (GR) reference	Zancona	Ombrone	3 Italy	23,35	5	no	spring	winter	
	Merse Monticiano (SI)	Merse	Ombrone	3 Italy	131,44	4	no	spring	winter	
	Fiora Cellena (GR)	Fiora	Fiora	3 Italy	72,74	4	no	spring	winter	
	Fiora downstream quarry S. Martino sul Fiora (GR)	Fiora	Fiora	3 Italy	172,85	4	no	spring	winter	
	Zancona downstream loc. Le Vigne (GR)	Zancona	Ombrone	3 Italy	66,06	4	no	spring	winter	
	Merse upstream loc. Palazzetto (SI)	Merse	Ombrone	3 Italy	93,66	4	no	spring	winter	
	Feccia Monticiano (SI)	Feccia	Ombrone	3 Italy	66,06	3	no	spring	winter	
	Senna Piancastagnano (SI) SS 2	Senna	Tevere	3 Italy	53,13	3	no	spring	winter	
	Paglia Piancastagnano (SI) SS 2	Paglia	Tevere	3 Italy	72,74	3	no	spring	winter	
	Lente downstream Pitigliano (GR)	Lente	Fiora	3 Italy	59,52	2	no	spring	winter	
	Ente downstream Podere dei Frati (GR)	Ente	Ombrone	3 Italy	29,01	2	no	spring	winter	
	Fiora downstream farm S. Fiora (GR)	Fiora	Fiora	3 Italy	34,82	1	no	spring	winter	
Sweden	Between Gävleån and Dalälven	Älgångsån		14 Central Lowlands	>100		no	autumn	spring	
Additional stream type (Sweden)	Forsmarksån	Forsmarksån		14 Central Lowlands	375		no	autumn	spring	
	Skeboån	Harbroholmsån		14 Central Lowlands	257		no	autumn	spring	
	Tämnarån	Tämnarån		14 Central Lowlands	375		no	autumn	spring	
	Between Tämnarån and Forsmarksån	Strömarån		14 Central Lowlands	108		no	autumn	spring	
	Between Norrtäljeån and Åkersström	Penningbyån		14 Central Lowlands	104		no	autumn	spring	
	Broströmmen	Järsöströmmen		14 Central Lowlands	142		no	autumn	spring	
	Between Tyresån och Trosaån	Muskån		14 Central Lowlands	101		no	autumn	spring	
	Between Tyresån och Trosaån	Kagghamraån		14 Central Lowlands	96		no	autumn	spring	
	Norrtäljeån	Husbyån		14 Central Lowlands	242		no	autumn	spring	
	Norrström	Enköpingsån		14 Central Lowlands	164		no	autumn	spring	
	Norrström	Lövstaån-Knivstaån		14 Central Lowlands	120		no	autumn	spring	
	Norrström	Märstaån, före samhället		14 Central Lowlands			no	autumn	spring	
	Skeboån	Skeboån		14 Central Lowlands	483		no	autumn	spring	
	Broströmmen	Broströmmen		14 Central Lowlands	226		no	autumn	spring	