



## EXPLORING THE HABITAT OF A STREAM

### TEACHING PROTOCOL

**GRADE LEVEL:** Secondary - High School

**DURATION & LESSON STRUCTURE**

Engage – Sparking curiosity → 1 school lesson (45 min)  
Explore – Field diagnosis, outdoor investigation → 2 lessons (90–100 min)  
Explain – Making sense of findings → 1 lesson (30–45 min)  
Elaborate – Connecting to restoration solutions → 1 lesson (30–45 min)  
Evaluate – Reflection and reinforcement → 1 lesson (45–50 min)

### INTRODUCTION:

A **habitat** is the living environment for many organisms — as plants, fungi, microbes, invertebrates, fish, and other wildlife — in rivers and streams.

It is shaped by both **abiotic (non-living)** and **biotic (living)** factors. Abiotic factors include water, sand, nutrients, and sunlight, while biotic factors include organic food items, as algae, aquatic plants, dead wood, and detritus, as well as other species that represent competitors or predators.

The typical habitats provided by rivers and floodplains do not occur elsewhere. They are dynamic, hence often changing across time and space. Without these typical and dynamic habitats, the diverse organisms living there cannot survive. When seeing a stream, our first impressions — water clarity, vegetation, or stream bed form — may reveal first clues about its health.

Understanding how physical characteristics (e.g., flow velocity, substrate, sunlight) relate to biological features (e.g., invertebrate or plant diversity, biological processes) helps us evaluate human impacts, and also supports identifying effective **restoration measures**.

In this lesson, students will assess the ecological health of a local stream by analyzing various physical and biological parameters, developing their understanding of stream ecosystems and human impacts on aquatic habitats through observation, data collection, and analysis.

**LEARNING OBJECTIVES:**

Students will be able to:

- 1 Identify and describe key abiotic and biotic characteristics of stream habitats.
- 2 Assess the physical characteristics of a stream by field observation and simple measurements.
- 3 Evaluate how human activities affect habitat features.
- 4 Interpret field data to conclude about ecological health.
- 5 Propose restoration measures for improving stream habitats.

# TEACHING FRAMEWORK BASED ON THE 5E INSTRUCTIONAL MODEL

## 1. ENGAGE - Sparking curiosity (45 min, indoor)

**AIM:** To raise students' curiosity about stream habitats, the biodiversity they support, and how human activities can alter them.

### ACTIVITY 1 – VISUAL DISCOVERY: “HEALTHY VS. DEGRADED STREAMS”

**PURPOSE OF THE ACTIVITY:** To stimulate curiosity and observation skills by comparing natural and modified stream environments, helping students recognize visible indicators of ecosystem health and signs of human impact.

**INSTRUCTIONS FOR STUDENTS:** Compare two contrasting photos or short drone clips:

- Healthy stream characteristics (keywords): clear water, diversity of flow velocities, meandering stream course, diverse vegetation in the stream and on banks, etc.
- Degraded stream characteristics (keywords): polluted water, visible waste, straightened/channelized course; concrete banks; lack of vegetation

#### GUIDING QUESTIONS

- What differences can you observe between the two streams?
- Which one do you think supports more habitats for organisms? Why?
- What signs show human alterations and impacts?

**TEACHER SUPPORT**

- Use the *Restore4Life interactive visualization* for Exploring the habitat of a stream topic.
- Highlight visual cues: meanders, riparian vegetation, water clarity, flow and substrate diversity.
- Use a mix of local and regional examples.

### ACTIVITY 2 – LOCAL CONNECTIONS: “OUR STREAMS” DISCUSSION

**PURPOSE OF THE ACTIVITY:** To connect the topic to students' personal experiences and local environment, encouraging them to reflect on how human activities and natural features influence the health of nearby streams.

**INSTRUCTIONS FOR STUDENTS:** Share experiences or memories of nearby streams — fishing, walking, swimming, or observing wildlife.

#### GUIDING QUESTIONS

- Have you noticed some features of the stream changing over time?
- Are there signs of pollution, waste, erosion, or construction?
- Why do you think stream health matters to people and wildlife?

#### TEACHER SUPPORT

Facilitate elaboration of a simple structured mind map titled “Stream Health” on the board:

In the center, write *Stream Health*, and draw branches for main aspects such as:

- Water quality (clarity, smell, pollution)
- Habitat structure (plants, substrate, shading)
- Living organisms (fish, insects, plants)
- Human influence (pollution, waste, construction, recreation)

As students share their experiences, write their ideas around these branches. This visual map helps students to connect their prior knowledge with the topic, and to recognize the multiple factors that may affect stream health. Encourage students to think about both natural and human factors.

#### ACTIVITY 3 – BRAINSTORMING: “WHAT MAKES A GOOD HABITAT?”

##### PURPOSE OF THE ACTIVITY:

Helping students to activate their prior knowledge and to identify the key components of a healthy stream habitat. By distinguishing between abiotic and biotic factors, they begin to understand how these elements interact to support diverse life, and why these may indicate overall ecosystem health.

##### INSTRUCTIONS FOR STUDENTS:

Share experiences or memories of nearby streams — fishing, walking, swimming, or observing wildlife.

##### GUIDING QUESTIONS

- What living and non-living habitat characteristics are important?
- How do water flow, vegetation, and stream bed structure and sunlight exposure influence organisms?

##### TEACHER SUPPORT

- Write student ideas on flipchart under “Abiotic” and “Biotic.”
- Keep the list visible for use during the Explore phase.

## 2. EXPLORE – Hands-on learning activity (outdoor, 90–100 min)

**AIM:** To observe, measure, and document stream habitat features and assess human impacts through hands-on fieldwork.

In this step, students become field researchers. They visit a local stream to observe, measure, and record its key physical and biological features. Working in small groups, they assess the stream's habitat quality, identify signs of human influence, and collect data using the [Stream Habitat Assessment Worksheet](#). Through direct observation, they learn how abiotic and biotic factors interact to shape a healthy aquatic ecosystem.

### GUIDING QUESTIONS

- What parameters can we measure to assess stream health?
- **PHYSICAL PARAMETERS:**
  - **Stream sinuosity**
    - How much does the stream naturally curve?
    - Why is meandering important?
    - What indicates human alteration?
  - **Flow characteristics**
    - How fast is the water moving?
    - Are there different flow patterns?
    - How does flow affect habitat?
  - **Lateral connectivity/flooding**
    - Can the stream access its floodplain?
    - Are there natural flood zones?
    - How do floods affect stream health?
  - **Profile depth**
    - How deep is the stream?
    - Are there variations in depth?
    - Why is depth diversity important?
- **BIOLOGICAL PARAMETERS:**
  - **Bank structure & vegetation**
    - What types of plants grow on banks?
    - How stable are the banks?
    - What role do roots play?
  - **Riparian vegetation**
    - What plants grow near the stream?
    - How diverse is the vegetation?
    - What benefits do plants provide?
  - **Substrate composition**
    - What materials make up the stream bottom?
    - How diverse are substrate sizes?
    - What lives in/on the substrate?

## KEYWORDS:

sinuosity, meanders, lateral connectivity, longitudinal connectivity, erosion, deposition, riparian vegetation, buffer zone, epifauna, algal bloom.

- How do human activities affect stream ecosystems?

Guide students to explore connections:

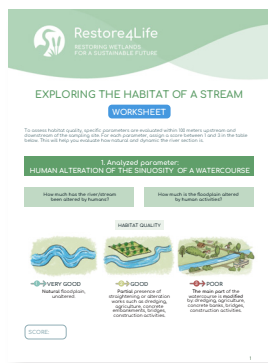
- Flow affects substrate distribution
- Bank vegetation influences stability
- Shading impacts water temperature
- Sinuosity affects flow patterns
- How vegetation affects habitat complexity and nutrient cycling
- How flow affects: substrate composition, bank erosion, vegetation establishment, habitat diversity

## MEASUREMENT TOOLS AND TECHNIQUES TO COLLECT DATA:

- **PHYSICAL MEASUREMENTS:**
  - Depth stick/meter for profile
  - Flow meter/floating object for velocity
  - GPS/maps for location marking
- **DOCUMENTATION TOOLS:**
  - Field notebooks
  - **Habitat Worksheet**
  - Cameras
- **ASSESSMENT METHODS:**
  - Visual surveys
  - Transect measurements
  - Photo documentation

## TEACHER SUPPORT

- Brief students proper and safe use of tools.
- Demonstrate how to record data using the **Stream Habitat Assessment Worksheet**.
- Assign roles: observer, measurer, recorder, photographer, safety officer.
- Ensure each group investigates a 100-meter stream section (upstream/downstream).



## STUDENT ACTIVITIES

- Evaluate over a distance of 100 meters both upstream and downstream of the sampling area the extent to which the analyzed parameters are met for a natural stream.
- Collect data on **worksheet**

### 3. EXPLAIN – Making sense of the experiences (outdoor, 30-45 minutes)

**AIM:** To interpret and analyze field data, identify patterns, and link physical and biological features to overall habitat quality.

#### GUIDING QUESTIONS

- How do we interpret each parameter?
- How do different parameters relate to each other?

In this phase of the learning experience, students analyze their stream habitat assessment data while the teacher facilitates discussions and guides pattern identification.

The teacher provides reference materials showing typical healthy stream conditions, which students use to compare their results.

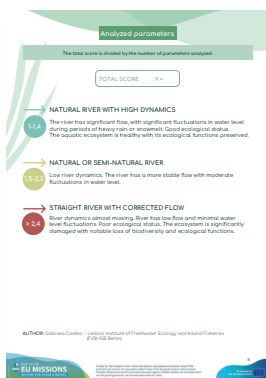
Through this guided analysis, students develop evidence-based conclusions about stream health, supporting their findings with specific field data. For example, they might determine poor habitat quality based on bank erosion evidence, lack of vegetation diversity, and uniform substrate composition. The teacher's role is to ask probing questions that help students think critically about their data and justify their conclusions with evidence, fostering both scientific thinking skills and understanding of stream ecology.

#### TEACHER SUPPORT

- Display data tables and group photos.
- Discuss each parameter and scoring scale.
- Guide interpretation: "What do these numbers tell us about stream health?"
- Support students in making evidence-based conclusions.
- Compare records from upstream and downstream sections.

#### MATERIAL NEEDED:

**Worksheet** (page 6) for interpreting the collected data



#### 4. EXTEND / ELABORATE – Expanding understanding (30-45 minutes)

**AIM:** To connect field results to restoration measures and explore how Nature-Based Solutions (NbS) can enhance stream habitats.

##### **GUIDING QUESTIONS**

- What factors most strongly influence this stream's health?
- What actions could improve stream habitat quality?
- How could observed impacts on stream health be addressed by mitigation or restoration actions?
- What measures could improve shading, flow and sediment diversity, or stream bank habitats?
- Which actions need community or authority involvement?

In this learning phase, students expand their understanding by connecting their stream assessment to broader environmental contexts. The teacher introduces examples of successful stream restoration projects, emphasizing nature-based solutions that work with natural processes. These measures might include using native vegetation for bank stabilization, creating natural buffer zones, or restoring floodplain connectivity - all approaches that support nature's own mechanisms for maintaining healthy streams.

Students work collaboratively to propose habitat improvement strategies using nature-based solutions, like ecological restoration approaches. The teacher guides them in documenting realistic action plans, considering both immediate improvements and long-term solutions for a wetland area. Students learn to consider how human activities impact stream health and explore practical, nature-inspired solutions that enhance ecosystem resilience while benefiting both environment and community.

**MATERIAL NEEDED:** examples of successful wetland restoration projects, nature based solutions

##### **TEACHER SUPPORT**

Guide students in developing action plans which include **Nature-based Solutions** (reconnection of the floodplain with the river, bank stabilization using native plants, creating natural buffer zones, restoring stream meanders, adding woody debris for habitat, removal of the invasive plants, etc.) and **Community actions** (reducing pollution sources, managing storm water runoff, organizing clean-up events, educational activities and community awareness, social media outreach).

Use POSSIBLE SOLUTIONS FOR HUMAN PRESSURES ON RIVERS game from *People and aquatic ecosystem - Restore4Life teaching materials*.



## 5. EVALUATE – Reflection and reinforcement (45-50 minute, indoor)

**AIM:** In this final step, students review what they have learned about stream habitats, their condition, and restoration possibilities. They connect their field experiences to broader ecological concepts using an online interactive visualization and creative reflection. The goal is to put observations into larger contexts, and to transform them into awareness and action-oriented thinking.

### ACTIVITY 1 – INTERACTIVE LEARNING: “PEOPLE AND AQUATIC ECOSYSTEMS”

**INSTRUCTIONS FOR STUDENTS:** Explore the *Restore4Life Interactive Visualization* “People and Aquatic Ecosystems”.

Follow the visual story and interactive elements that show how rivers, wetlands, and human communities are connected.

Note examples of:

- How people benefit from healthy aquatic habitats through the various ecosystem services.
- How human activities can modify and affect these habitats.
- How restoration actions support self-regulating processes in streams, and hence contribute to ecosystem balance.

#### TEACHER SUPPORT

- Project the visualization in class, or let students explore it individually on tablets or computers.
- Encourage students to discuss what they recognized from their own field experience.

### ACTIVITY 2 – REFLECTION AND SYNTHESIS INSTRUCTIONS FOR STUDENTS:

Work in small groups to create a short visual or written output that summarizes your learning journey. Choose one format:

- A poster or digital collage titled “*Our stream story*” (before – now – future).
- A 3-slide mini-presentation highlighting your main findings and proposed improvements.
- A reflective paragraph answering:
  - What makes a stream habitat healthy?
  - How do people and nature depend on each other?
  - What can we do to protect and restore local streams?

#### TEACHER SUPPORT

- Provide time for groups to share their outputs.
- Offer brief feedback emphasizing understanding, creativity, and teamwork.
- Encourage students to display their work or upload digital reflections to the Restore4Life platform.

#### REFERENCES:

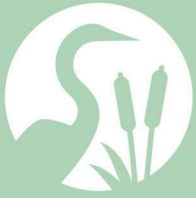
<https://scistarter.org/south-carolina-adopt-a-stream>

[https://www.yorkcountygov.com/DocumentCenter/View/6752/Adopt-a-Stream\\_Stream-Habitat-Assessment-form](https://www.yorkcountygov.com/DocumentCenter/View/6752/Adopt-a-Stream_Stream-Habitat-Assessment-form)

[https://www.expedio.ch/fileadmin/user\\_upload/expedio/Materialien\\_Lehrpersonen/Bach\\_Gewaesser-Beurteilung\\_Z2.pdf](https://www.expedio.ch/fileadmin/user_upload/expedio/Materialien_Lehrpersonen/Bach_Gewaesser-Beurteilung_Z2.pdf)

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# Restore4Life

RESTORING WETLANDS  
FOR A SUSTAINABLE FUTURE

## EXPLORING THE HABITAT OF A STREAM

### WORKSHEET

To assess habitat quality, specific parameters are evaluated within 100 meters upstream and downstream of the sampling site. For each parameter, assign a score between 1 and 3 in the table below. This will help you evaluate how natural and dynamic the river section is.

### 1. Analyzed parameter: HUMAN ALTERATION OF THE SINUOSITY OF A WATERCOURSE

How much has the river/stream  
been altered by humans?

How much is the floodplain altered  
by human activities?

#### HABITAT QUALITY



➡ 1 ➡ VERY GOOD

Natural floodplain,  
unaltered.



➡ 2 ➡ GOOD

Partial presence of  
straightening or alteration  
works such as dredging,  
agriculture, concrete  
embankments, bridges,  
construction activities.



➡ 3 ➡ POOR

The main part of the  
watercourse is **modified**  
by: dredging, agriculture,  
concrete banks, bridges,  
construction activities.

SCORE:

## 2. Analyzed parameter: THE FLOW OF THE STREAM

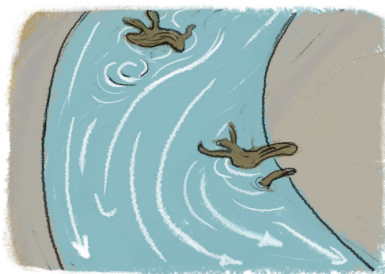
Note the width and velocity of the river. Does the river flow uniformly or does it have different flow velocities?

### HABITAT QUALITY



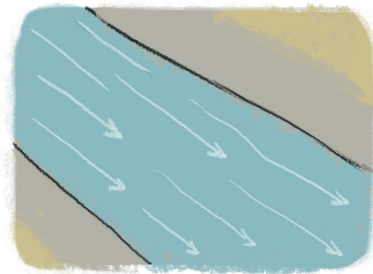
#### 1 → VERY GOOD

Watercourse **varying** in speed and flow direction.



#### 2 → GOOD

Water flow **moderate** in velocity and flow direction.



#### 3 → POOR

Water flow **uniform** in velocity and direction due to regularization (concrete banks).

SCORE:

## 3. Analyzed parameter: LATERAL CONNECTIVITY AND FLOODING

The lateral connectivity of a river refers to the ability of a river to interact and connect with areas adjacent to its banks. Observe how much room the river has to expand laterally in the floodplain during different flood seasons and how connected it is to lateral water bodies? See the presence of infrastructure that might limit this connectivity such as dikes, roads, agricultural land, etc.

### HABITAT QUALITY



#### 1 → VERY GOOD

Natural flow regime and free access to flooding riparian zones. River bed and floodplain with topography under natural conditions of floods, without restrictions of flood inundation over banks. Abundance of dead wood and woody branches along the floodplain, transported by large floods.



#### 2 → GOOD

Lateral flooding and connectivity **moderately controlled** by human activities. Flow regulation with moderate reduction in magnitude and natural flood frequency. Flooding occurs at least once every 10 years and floods more than 30% of the width of the riparian area. Moderate restriction to flooding due to dykes located between one and three times the river's width, or due to a moderately deep river channel.



#### 3 → POOR

Lateral flooding and connectivity **minimized** by human action. Flow regulation with severe reduction in the magnitude and frequency of natural flooding; flooding occurs only rarely, during very large floods, about once every 25 years. The measures have caused severe river regulation and have led to a reduction of flood-prone areas.

SCORE:

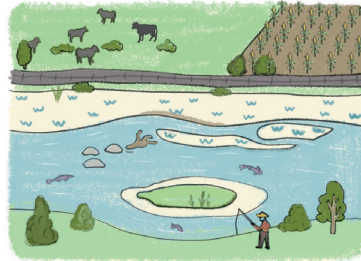
## 4. Analyzed parameter: THE DEPTH OF THE PROFILE

How much of the profile is artificially deep in relation to the area is the river bed?

### HABITAT QUALITY



Transverse profile: **very natural, very wide**, with high dynamics.



Transverse profile: **moderately modified**. Dike present on one banks.



**Highly modified** cross profile and deepened. Dikes present on both banks; regularization and channel regularization.



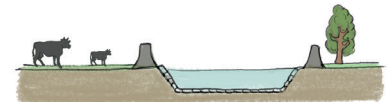
Transverse profile

**1 → VERY GOOD**



Transverse profile

**2 → GOOD**



Transverse profile

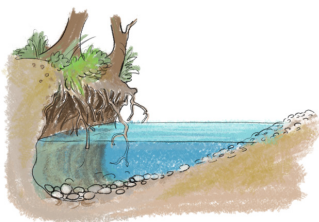
**3 → POOR**

SCORE:

## 5. Analyzed parameter: THE STRUCTURE OF THE RIVER BANK

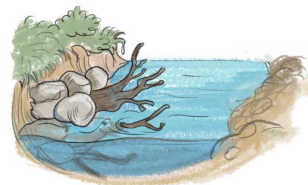
How is the structure of the bank?

### HABITAT QUALITY



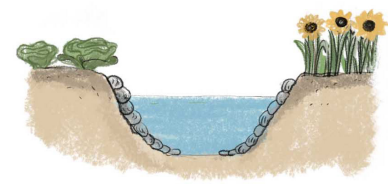
**1 → VERY GOOD**

**Meandering river** - Intact free-flowing rivers exhibit a dynamic steady state of their river bed: Bank erosion in one place is balanced by sediment deposition elsewhere. Vegetation on river banks prevents massive erosion, provides shade for some stream sections. Erodes, overhanging banks are often used by fish for shelter.



**2 → GOOD**

**Moderately meandering** watercourse with only local bank stabilization made up from natural materials, as stones and wood



**3 → POOR**

**Straight watercourse** with fully and uniformly stabilized banks

SCORE:



## 6. Analyzed parameter: BANK SHADING, VEGETATION VARIETY

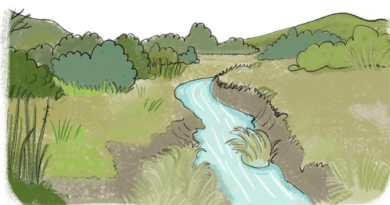
To what extent is typical riparian vegetation present?

### HABITAT QUALITY



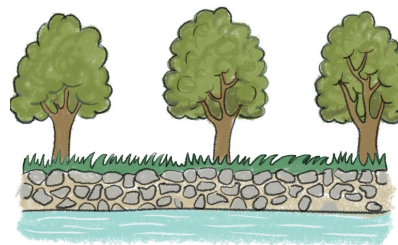
#### 1 → VERY GOOD

Healthy streams are mostly shaded by the canopies of nearby trees, and are accompanied by typical semi-aquatic vegetation, willows and bushes, depending on stream type. Healthy rivers show sequences of shaded, erosional banks and sun-exposed depositional banks, with a zonation of pioneer vegetation, bushes, softwood forest (willows and poplars), and hardwood forest, including climbing plants. No exotic species.



#### 2 → GOOD

Shading by riparian trees is often reduced, resulting in massive growth of perennial vegetation on banks, as e.g. reed. Human disturbances result in the moderate occurrence of wall rue (*Rubus* sp.), reed thickets, thorn scrub, ruderal invasive herbaceous shrubs (< 30% cover) and exotic species (10-30% cover), due to riparian land uses of moderate intensity.



#### 3 → POOR

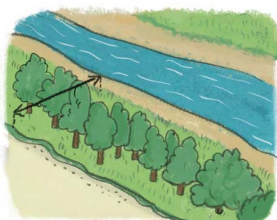
Bank vegetation strongly altered, dominated by herbaceous riparian vegetation, with >30% cover of exotic species, or even unvegetated artificial bank protection. Trees scarce or absent, hence little shading of the stream.

SCORE:

## 7. Analyzed parameter: RIPARIAN VEGETATION

How wide and diverse is the buffer zone of vegetation along the river banks?

### HABITAT QUALITY



#### 1 → VERY GOOD

Buffer zones on each banks with a width of at least three times the width of the river covered with rich and diverse specific vegetation, structured in several layers, as perennials, shrubs, and trees.



#### 2 → GOOD

Narrower buffer zone with a width of less than three times the width of the river moderately impacted by human activities, with reduced diversity of perennial vegetation, shrubs, and few trees.



#### 3 → POOR

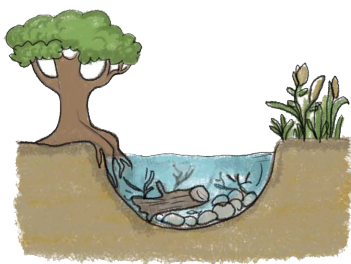
Narrow or missing buffer zone extending less than one river width on each bank, with little vegetation diversity, mostly lacking trees, and substantial impacts of human activities.

SCORE:

## 8. Analyzed parameter: SUBSTRATE OF EPIFAUNA

EPIFAUNA = benthic organisms living attached to the substrate on the river bottom.  
What types of materials form the substrate?

### HABITAT QUALITY



#### 1 → VERY GOOD

Large habitat diversity with different sediment fractions, as sand, gravel, stones, and additionally woody debris, submerged roots and plants.

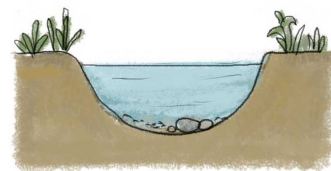
Significant variance of streambed depth.

All structures provide good habitats and hiding places for benthic macroinvertebrates and fish.



#### 2 → GOOD

Moderate habitat diversity with only few sediment fractions, as sand, gravel, stones, and only few woody debris, submerged roots and plants. Limited variance of streambed depth. Limited habitat and hiding place availability for benthic macroinvertebrates and fish.



#### 3 → POOR

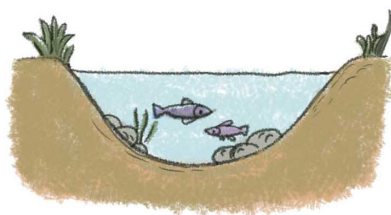
Low habitat diversity with only few 1-2 fractions, as sand, or stones, and hardly any woody debris, submerged roots or plants. Nearly no variance of streambed depth. Bad habitat and hiding place availability for benthic macroinvertebrates and fish.

SCORE:

## 9. Analyzed parameter: AQUATIC VEGETATION

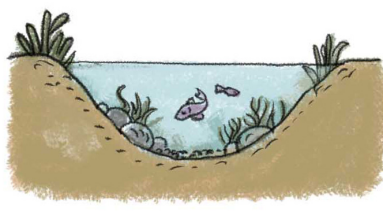
How much algae and how much aquatic vegetation is in the river?

### HABITAT QUALITY



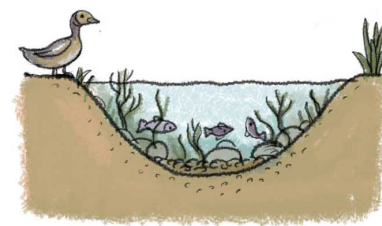
#### 1 → VERY GOOD

High water transparency; aquatic plant community diverse but low in areal coverage; low presence of planktonic or filamentous algae.



#### 2 → GOOD

Moderate water transparency; aquatic plant community with several species and dominant areal coverage; moderate presence of planktonic or filamentous algae.



#### 3 → POOR

Water transparency low due to green or brown colour produced by pollution, planktonic or filamentous algae. Either massive growth of submerged or emergent plants with only 1-2 species (in shallow water bodies), or no submerged vegetation due to low water transparency and artificially increased stream depth.

SCORE:

## Analyzed parameters

The total score is divided by the number of parameters analyzed.

TOTAL SCORE : 9 =

### → NATURAL RIVER WITH HIGH DYNAMICS

1-1,4

The river shows significant diversity in flow, depths, habitats and vegetation, with significant seasonal fluctuations of water level. Good ecological status.  
The aquatic ecosystem is healthy with intact ecological functions.

### → NATURAL OR SEMI-NATURAL RIVER

1,5-2,3

The river shows reduced but still good diversity in flow, depths, habitats and vegetation. Seasonal fluctuations of water level may be artificially somewhat reduced. Moderate ecological status with somewhat reduced ecological functions.

### → STRAIGHT RIVER WITH CORRECTED FLOW

> 2,4

The river shows only little diversity in flow, depths, habitats and vegetation. Seasonal fluctuations of water level may be artificially much reduced. Poor ecological status with only little ecological functions remaining.

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**Illustrations worksheet:** Anca Smărăndache