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USE OF SCALING METHODS FOR EF DETERMINATION IN SLOVENIA

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1. INTRODUCTION

→ water abstraction from the running waters:

drinking water

energetic use

technological purposes

irrigation

fish-farming

ECOLOGY : ECONOMY

Ⓒ interdisciplinary approach for EF determination
and each section of the stream should be treated
separately

2. DEFINITION AND BASIS FOR DETERMINATION OF EF

New Water Act 2002

ENVIRONMENTAL FLOW

is the quantity and quality of water which preserve ecological balance in the stream and in the riparian zone and do not worsen the ecological status of running waters

The starting points for selecting the criteria:

- the importance of preservation and protection running waters, their habitats with flora and fauna and diversity of organisms

- **Special attention should be paid to rare and endangered species respectively the groups important for the preservation of the ecological balance.**
- **EF should be determined before each impact in the river or in the area, which could have an influence on the structure and function of the river as the ecosystem.**
- **The necessary of all existing hydraulic, hydrological and ecological parameters on the sections concerned should be checked.**
- **For each change of quality and quantity of water in the river a new determination of EF is required.**

3. CRITERIA AND METHODS

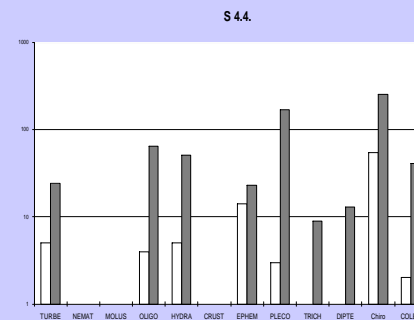
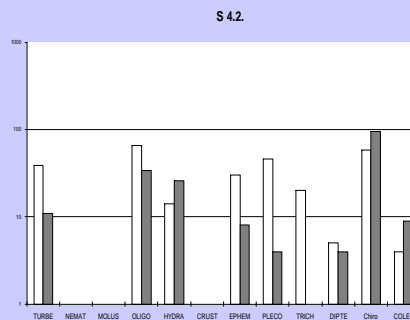
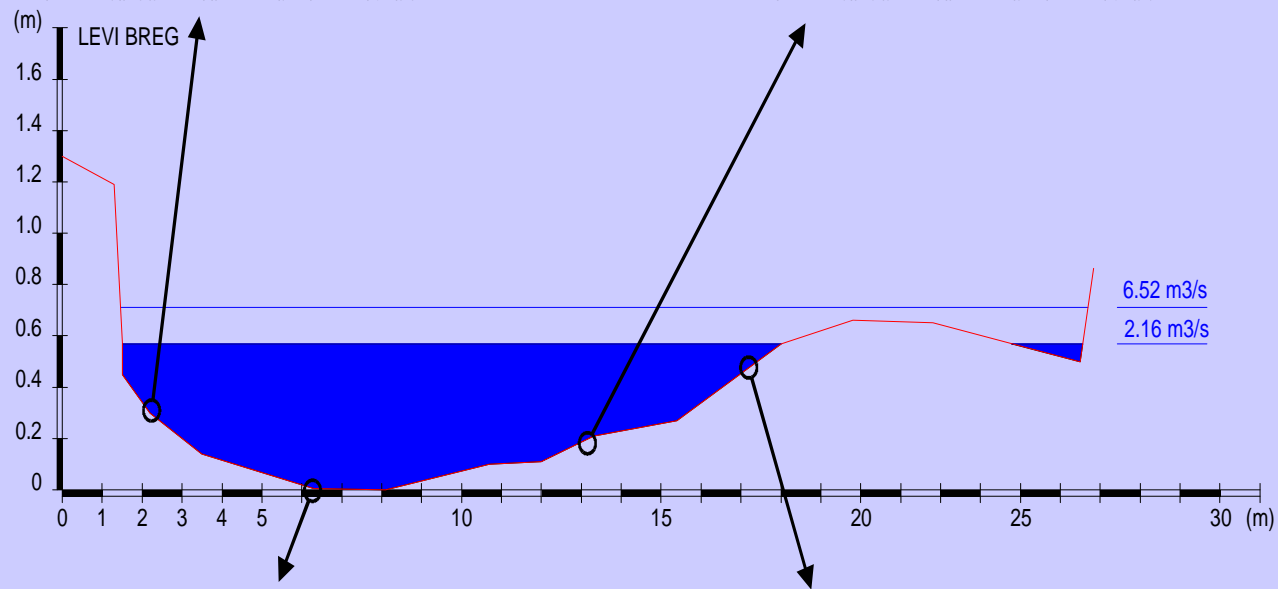
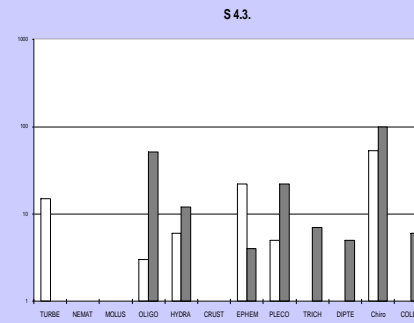
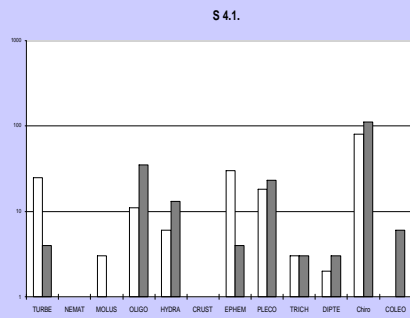
**Hydrological, morphological, ecological criteria;
duration and quantity of water abstraction**

HYDROLOGICAL METHOD

- **Basic hydrological parameters**
- **Ecological estimation, inventory of habitats**
- **Morphological estimation (substrata)**

ECOLOGICAL METHOD

- **Inventory of water organisms: zoobentos, phytobentos, macrophytes, fish (seasonal dynamics)**
- **diversity, biomass, rare and endangered species**



- estimation of changes at different flows
- physicochemical parameters
- water quality
- landscape evaluation
- other uses of water

The EF is determined according to biotic and abiotic parameters

Decision ® results of experts

4. APPLICATION OF DETERMINATION OF EF

From 1992 the EF was determined on more than 180 parts of running waters in Slovenia and mostly for existing water users – the tolerance limit of the user economy was considered,

→ The most water users abstract too large quantities of water in low flow periods;



IMPACT: changes in physical, chemical, hydrological and morphological parameters of water ® natural balance was disturbed



$Q = 1600 \text{ l/s}$

$Q = 0 \text{ l/s}$



5. CASE STUDY: THE SOCA RIVER

- The first hydropower plants were built 1930-1932
- The Doblar and Plave power plants were constructed in 1939 and 1940
- As a consequence of power utilisation, there is no natural flow regime downstream of the Podsela Dam to the Italian border.

THE PURPOSE:

Determination of EF

The Soca River

power plant Doblar and Plave, (90) 180 m³/s

4320 m, 7950 m,

1996 - 2002

SO1 – SO4

Qmin Doblar = 0.2 m³/s, Qmin Plave = 0.5 m³/s



MATERIAL AND METHODS

- **Periphyton and periphyton biomass, zoobentos in different aquatic habitats**
- **Hydrological parameters: flow, current velocity**
- **Flow duration curve with and without abstraction**
- **Temperature, oxygen, saturation, conductivity**
- **The Wolman Count of sediment samples was performed**
- **Flora and fauna in the riparian zone**
- **Landscape evaluation – increasing flow downstream the dam (test)**

RESULTS

Hydrology

Table 1: Flows in the River Soca in 1998.

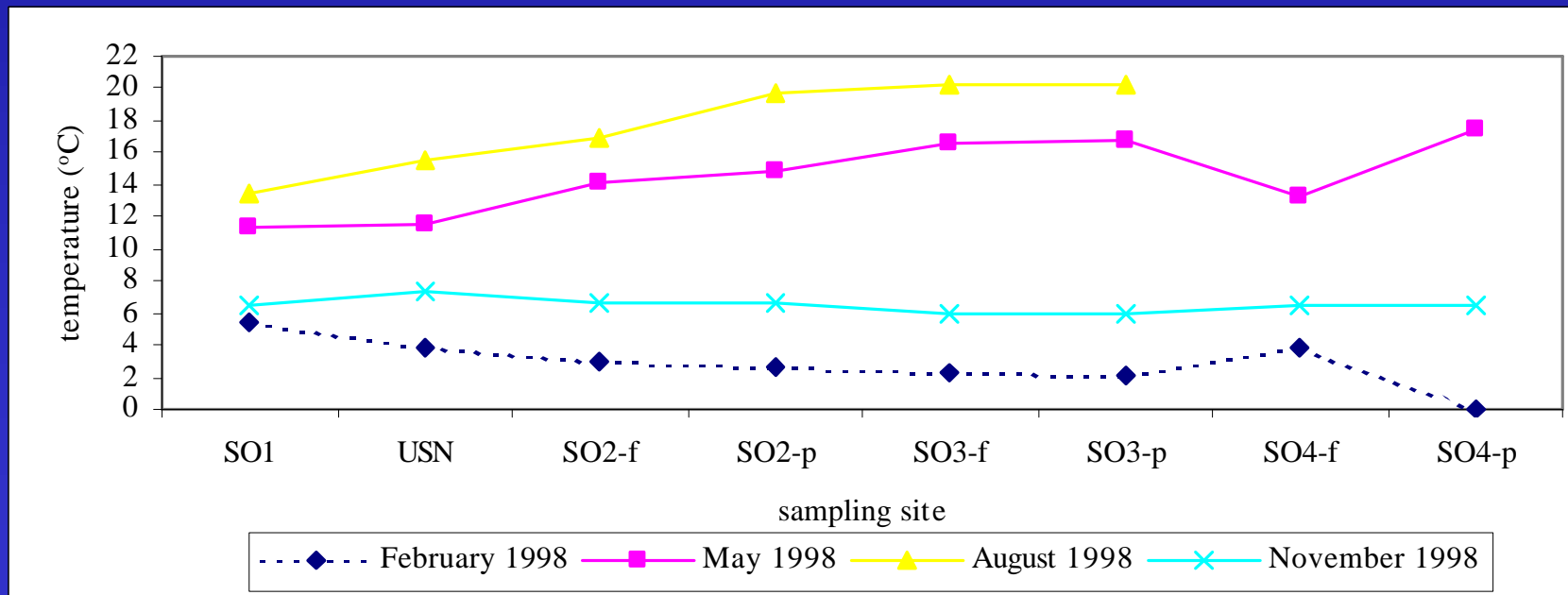
Cross section	Q W98 (m³/s)	Q S98 (m³/s)	Q S98 (m³/s)	Q W98 (m³/s)
SO1	11.3	11.3	16.9	16.3
SO2	0.26	0.27	0.26	0.23
SO3	0.26	0.27	0.26	0.23
SO4	2.23	0.86	/	1.25

Downstream of the dam Podselca:

Physicochemical parameters

High seasonal oscillation in water temperature and concentration of oxygen

Differences among aquatic habitats



Species composition

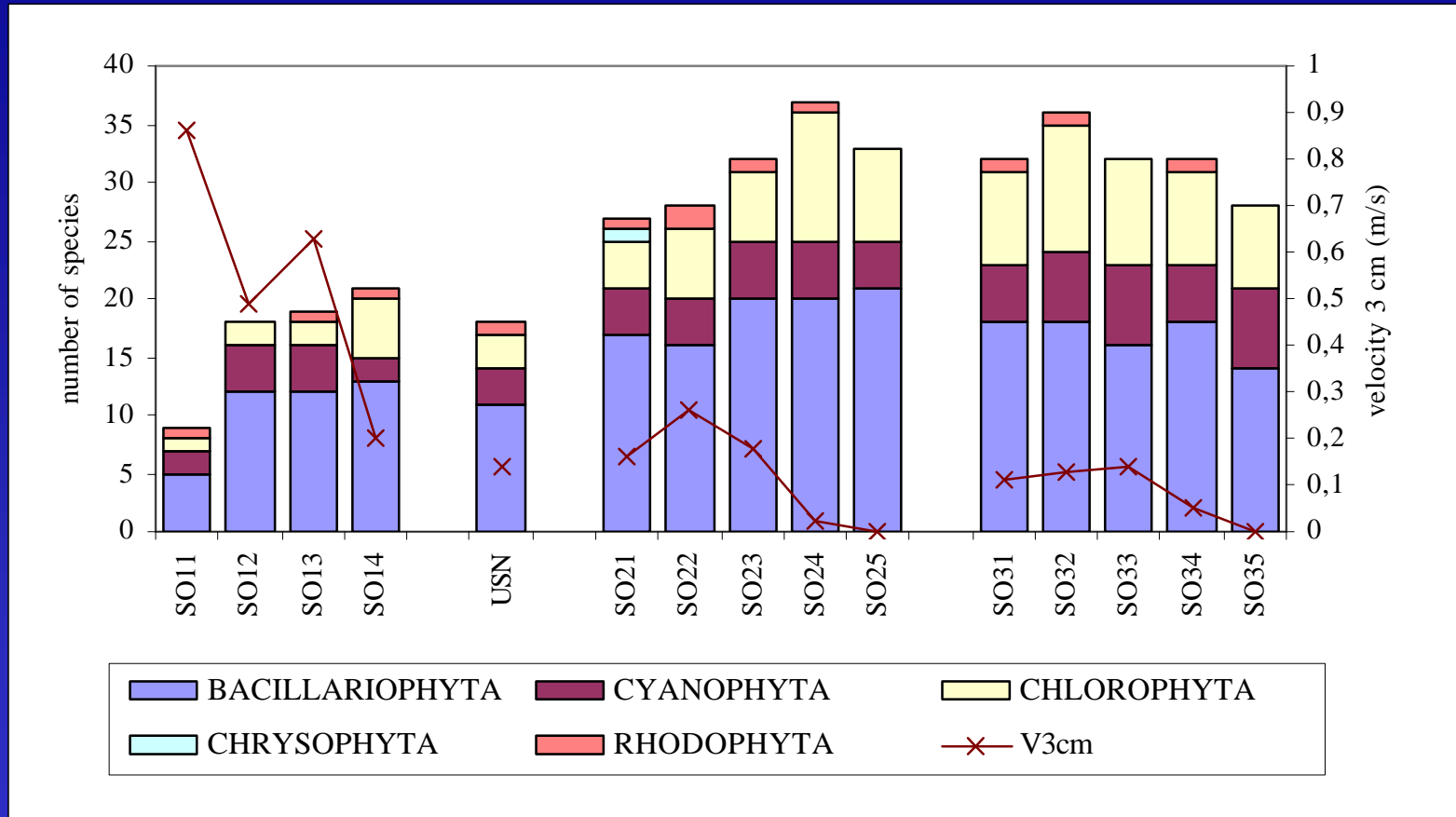


Figure 1. The periphyton composition at sampling sites in the river Soca and stream Usnica, August 1998.

Periphyton biomass

- The highest values in summer in the sections with low water level and low current velocity,
- Low flow, favourable light conditions and sediment structure were factors which made proliferation of algae possible



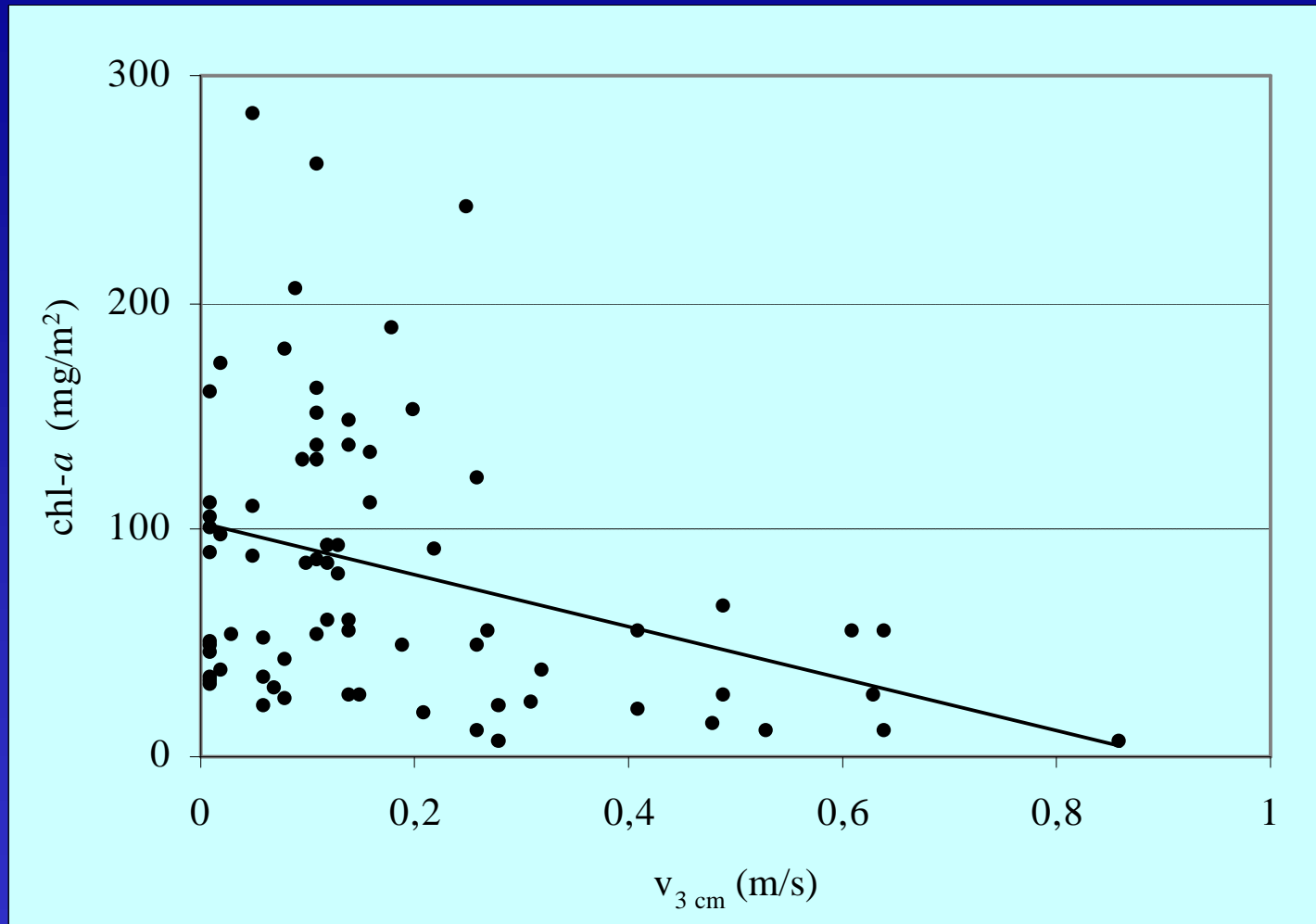


Figure 3. Correlation between $v_{3\text{cm}}$ (m/s) and chl-a (mg/m²) for the river Soca.

TEST: Increasing flow downstream the dam

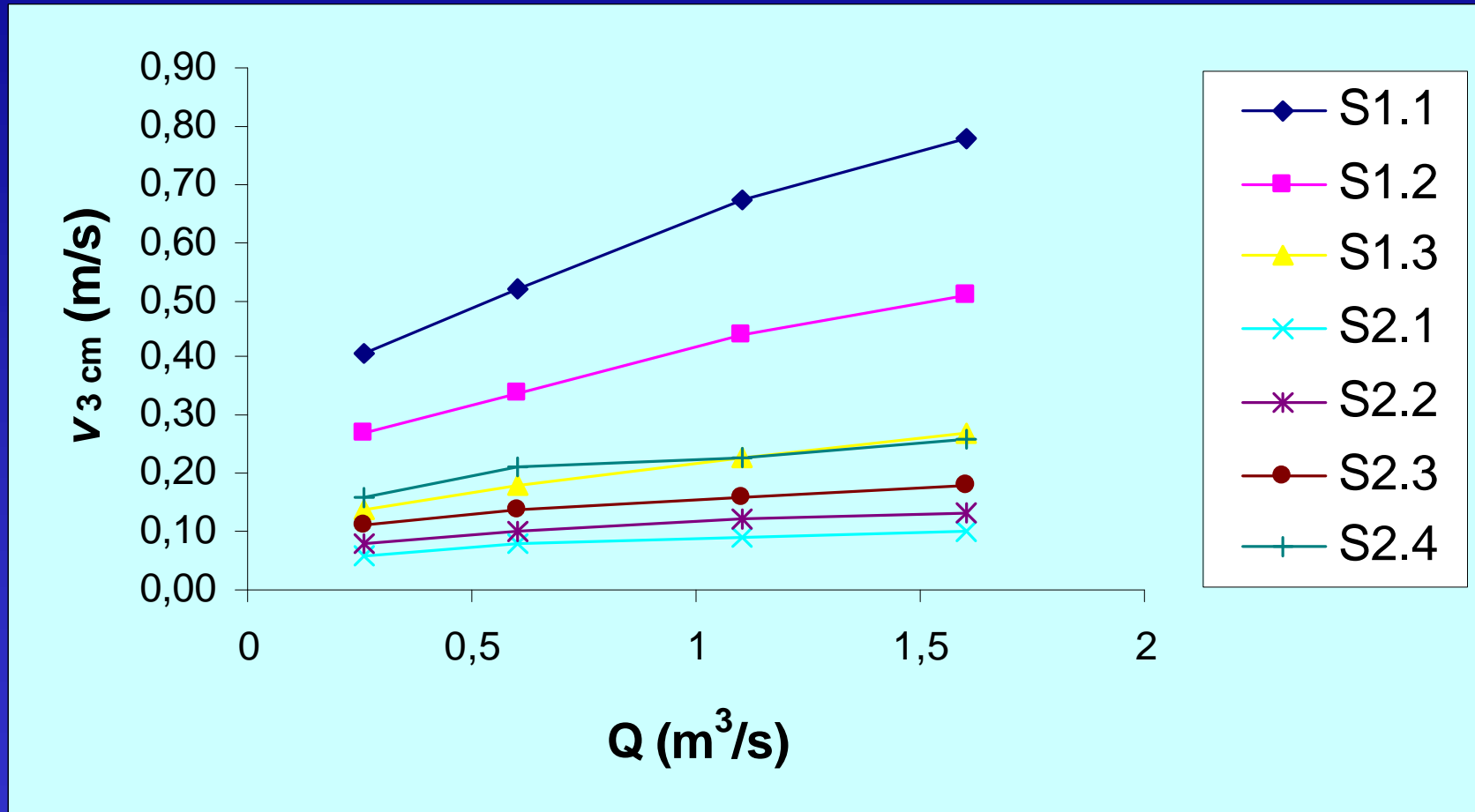


Figure 4. Increasing flow in comparison with velocity 3 cm above the bottom

EF DETERMINATION FOR THE SOCA RIVER

The impact of abstractions, especially in the time of low flows shows big changes in hydrological, physicochemical and biological parameters downstream of the dams

- Improve the habitats: the number and diversity
- Take into account: existing water abstraction for (60 years)
- According to analyses of abiotic and biotic parameters



The EF below the Podsela dam = 1.0 m³/s (before 0.2 m³/s)

The EF below the Ajba dam = 2.5 m³/s (before 0.5 m³/s)

6. CONCLUSIONS

- In last 10 years there has been strong efforts to improve ecological characteristics of the Slovenian running waters with determination and assurance of EF
- Scaling:
 - Predictions algae biomass and species diversity at different velocities, sediment size, nutrients ... for different types of rivers
 - Use habitat models
 - More measurements