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# Adequate indicators for environmental change in alpine river systems (Hohe Tauern NP, Austria)

## Preliminary results

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## Abstract

Alpine rivers are among the most threatened ecosystems due to increasing human pressures and environmental/climate change. As a consequence, various effects on their function and structure have been suggested, cause-effect relationships have hardly been studied. Within the research project PROSECCO.ALPS we recorded abiotic parameters and collected water chemistry and macrozoobenthos samples at 18 sites in two high alpine catchments (Großglockner and Sonnblick region) three times in 2011. After sample analyses we tested more than 30 biological indicators on their applicability to assess ecological conditions in high alpine streams. Preliminary results showed distinct differences in the species communities, individual densities and diversity with decreasing environmental harshness. Although most tested indices were developed for lower altitudes, they have the potential to provide a comprehensive set on ecological information important for indicating environmental/climate change effects.

## Keywords

biological assessment, Chironomidae, macrozoobenthos, monitoring

## Introduction

Alpine rivers are among the most threatened ecosystems due to increasing human pressures and effects from climate/environmental change (HANNAH et al. 2007). These impacts strongly alter ecosystem structure and function (BROWN et al. 2009),nevertheless, cause-effect relationships have hardly been demonstrated in high alpine catchments (BROWN et al. 2006; FÜREDER 2007). Within the framework of the project *PROSECCO.ALPS* (*PRO*glacial*S*tream *E*cology and *C*limate *C*hange over the *ALPS*), this study wants to i) assess faunal patterns along a gradient of environmental conditions, and ii) apply a comprehensive set of biological indices, in order to iii) find the most adequate ones for alpine lotic ecosystem condition and change.

## Study sites and methods

We selected 18 study sites along a gradient of environmental harshness, 14 with (GAG1-4, KRP1, PAZ1-3, GBK1-2, GBK5-6, GBK9-10; Figure 1 & 2) and four without glacial influence (GAG5, GBK3, GBK4 and GBK8; Figure 1 & 2), in two alpine catchments (Sonnblick and Großglockner Group, Table 1).

Table 1: General information about the two investigated areas in the Hohe Tauern National Park, Austria within the framework of PROSECCO.ALPS

| Facts about | Großglockner Group | Sonnblick Group |
|---|---|---|
| Coordinates | 47°04`49"N | 47°02`52"N |
| | 12°44`49"E | 12°59`06"E |
| Area [km²] | 484.5 | 18.6 |
| Altitude range [m a.s.l.] | 2074-2627 | 2186-2359 |
| Exposition | East & North | South & West |
| Sampling sites | 1 without & | 3 without & |
| | 8 with glacial influence | 6 with glacial influence |

Semi-quantitative macrozoobenthos samples were collected in three replicates at each sampling site, using a Euro-kick-net (100µm mesh size). Simultaneously water chemistry was measured with a multi-parameter probe and water was filtered for gaining the organic and inorganic content. In the laboratory all captured invertebrate larvaeand pupae were sorted and, where possible, identified to the lowest taxonomic (species) level, using suitable identification keys: Chironomids (JANECEK 1998), Ephemeroptera (BAUERNFEIND & HUMPESCH 2001), Plecoptera (LUBINI et al. 2000) and Trichoptera (WARINGER & GRAF 1997). With these datamorethan 35indicators were tested (Table 2) in order to find the most adequate for environmental change in alpine rivers.

In our presentation we present the results of one sampling occasion in July 2011.

Table 2: Tested indicators

| Indicator Type | Index |
|---|---|
| **Abiotic Index** | Chemical Index to Bach |
| **Biotic Index** | Extended Trend Biotic Index |
| | Longitudinal Zonation Index |
| | Trent Biotic Index |
| | Saprobic Index |
| **Diversity Index** | Brillouin Diversity |
| | Fisher's Alpha |
| | Margalef Diversity |
| | McIntiosh Diversity |
| | Menhinick Diversity |
| | Shannon Wiener |
| | Simpson Diversity |
| | Strong's Diversity |
| | Whittaker Bw |
| | Cody Bc |
| | Harrison 1 |
| | Harrison 2 |
| | Routledge Be |
| | Routledge Bi |
| | Routledge Br |
| | Wilson & Shmida Bt |
| | Brillouin Evenness |
| | Camargo |
| | McIntosh Evenness |
| | NHC |
| | Pielou J |
| | Shannon Maximum/Minimum |
| | Simpson Evenness |
| | Gini |
| **Functional Approach** | Functional Feeding Groups |
| | RETI |
| **Multimetric Approach** | Index of Biotic Integrity |
| | "Standorttypieindex" |
| **Multivariate Approach** | RIVPACS |
| | SERCON |

## Results

Preliminary results showed that besides KRP1, the Großglockner Group (Figure 1) was characterized by a quite uniform benthic community which was dominated by Diamesinae and other Chironomids.

The nine sampling sites of the Sonnblick Group (Figure 2) offer a more diverse species community. Both investigation areas show a similar trend. With decreasing environmental harshness (GAG1 to GAG4 and PAZ1 to PAZ3; GBK10 to GBK1), the benthic invertebrate abundance and Simpson diversity (SD) are increasing. Sampling sites without glacial influence (GAG5; GBK8, GBK4, GBK3) follow this trend but are characterized by comparatively higher individual density and diversity. Overall we evaluated 35 relevant indices of six indicator types (single parameter – multivariate/multimetric; Table 2) and grouped them according to their suitability and sensitivity. The most adequate indicators were applicable for: assessment of the overall situation (SERCON), assemblage changes along a stream (LZI), biodiversity (S&W, S, M), ecosystem health (SI, IBI, EBI, BMWP) and environmental harshness (Bach's CI).

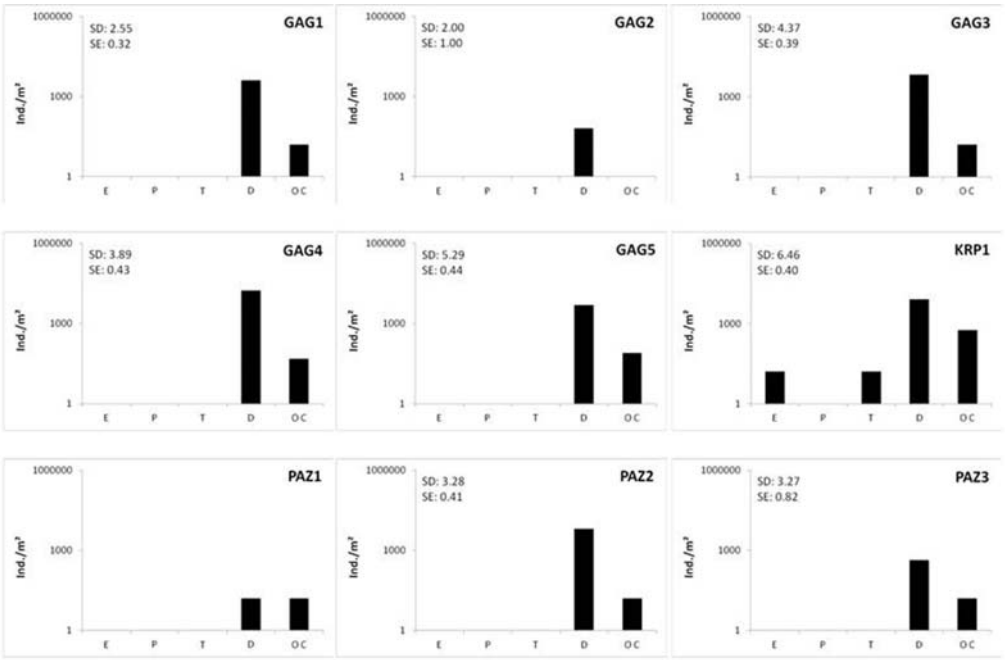


Figure 1: Abundance (individuals/m²) of the nine sampling sites in the Großglockner Group, Hohe Tauern National Park. SD – Simpson Diversity, SE – Simpson Evenness, E – Ephemeroptera, P – Plecoptera, T – Trichoptera, D – Diamesinae, OC – other Chironomids

## Discussion

Our study showed that the paucity of information on the conditions and functions of alpine ecosystems can be compensated by applying sophisticated methodologies. Although most indices were developed for the implementation in river systems at lower altitudes, they still have the potential to provide a comprehensive set on ecological information. With the inclusion of recently elaborated knowledge (e.g. adaptations of biota, tolerances to harshness), we currently work on models for indicator modification and fine-tuning to unerringly evaluate and predict effects from environmental/climate change.

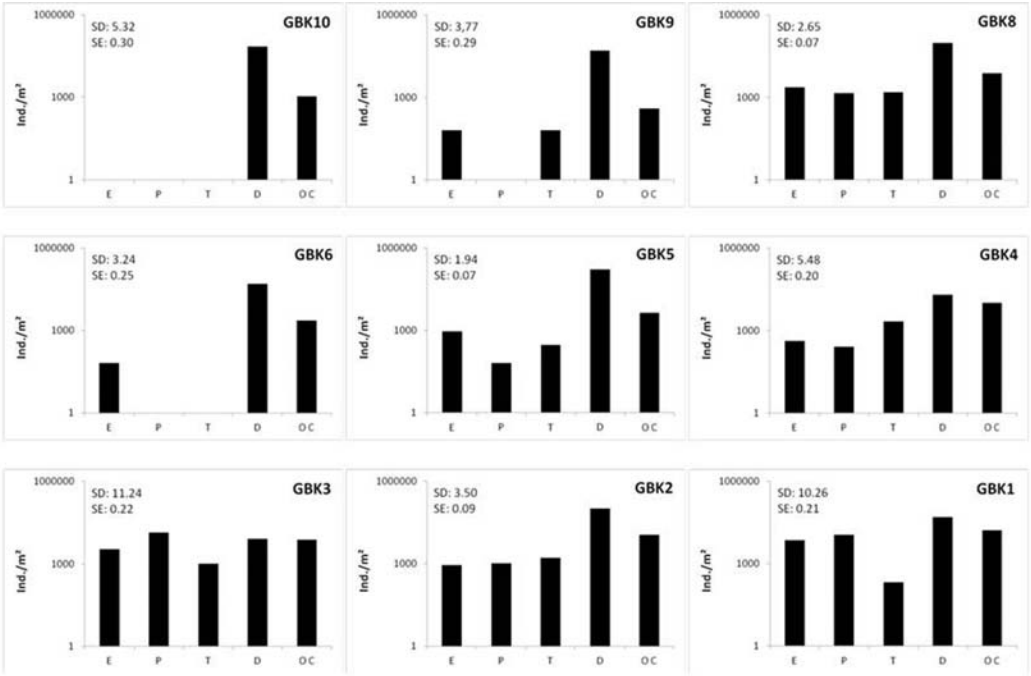


Figure 2: Abundance (individuals/m²) of the nine sampling sites in the Goldberg Group, Hohe Tauern National Park.
SD – Simpson Diversity, SE – Simpson Evenness, E – Ephemeroptera, P – Plecoptera,
T – Trichoptera, D – Diamesinae, OC – other Chironomids

## References


BAUERNFEIND, E. & U.H. HUMPESCH 2001. Die Eintagsfliegen Zentraleuropas (Insecta: Ephemeroptera): Bestimmung und Ökologie. Verlag des Naturhistorischen Museums Wien: 239 pp.

BROWN, L.E., MILNER, A.M. & D.M. HANNAH 2006. Stability and persistence of alpine stream macroinvertebrate communities and the role of physicochemical habitat variables.Hydrobiologia 560: 159-173.

BROWN, L.E., HANNAH, D.M. & A.M. MILNER 2009. ARISE: a classification tool of Alpine RIver and Stream Ecosystems. Freshwater Biology 54: 1357-1369.

FÜREDER, L. 2007. Life at the Edge: Habitat Condition and Bottom Fauna of Alpine Running Waters. International Review of Hydrobiology 92: 491-513.

HANNAH, D.M., BROWN, L.E., MILNER, A.M., GURNELL, A.M., MCGREGOR, G.R., PETTS, G.E., SMITH, B.P.G. & D.L. SNOOK 2007. Integrating climate-hydrology-ecology for alpine river systems. Aquatic Conservation: Marine and Freshwater Ecosystems 17: 636-656.

JANECEK, B.F.R. 1998. Fauna AquaticaAustriaca – Taxonomie und Ökologie aquatischer wirbelloser Organismen. Diptera: Chironomidae (Zuckmücken). Bestimmung von 4. Larvenstadien mitteleuropäischer Gattungen und österreichischer Arten. Universität für Bodenkultur, Abt. Hydrobiologie Wien, 117 pp.

LUBINI, V., KNIPSEL, S. & G. VINCON 2000. Plecoptera – Bestimmungsschlüssel Schweiz. Neuauflage von Aubert J. (1959): Plecoptera. InsectaHelvetica 1: 79 pp.

WARINGER, J. & W. GRAF 1997. Atlas der Österreichischen Köcherfliegenlarven unter Einschluß der angrenzenden Gebiete. FacultasUniversitätsverlag Wien: 286 pp.


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