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Assessing biodiversity of cave stygobiont fauna across Austria

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Abstract

As part of the overarching research initiative “Stygofauna Austriaca”, a citizen science project was coordinated with the support of the Austrian Speleological Association. Water bodies in 96 caves and anthropogenic subterranean structures were sampled by citizen scientists in search for groundwater fauna. In total, 12,085 individuals were sorted from 171 samples, resulting in 132 aquatic taxa, of which 67 species could be identified to date. Statistical analysis revealed no correlations of Shannon diversity and Species richness with the physico-chemical parameters tested. Arthropoda and subsequently Copepoda (Harpacticoida and Cyclopoida), dominated in relative abundances on community level. Analysis of Beta-Diversity (PCoA) merely yielded minor significant patterns. The category water body connection, classifying water bodies as either isolated or connected, has proven to be the most useful in analyzing stygobiont cave fauna. Three presumably new species for science were discovered: *Elaphoidella n.sp. 1, Elaphoidella n.sp. 2, Elaphoidella n.sp. 3*. First finding for Austria include the annelids *Aelosoma gertae* (Marcus, 1944), *Aelosoma travancorense* (Aijer, 1926) and *Parvidrilus spelaeus* (Martinez-Anselmil, Sambugar et Giani, 2002), the cyclopoids *Megacyclops brachypus* (Kiefer, 1954) and *Graeteriella boui* (Lescher-Moutoue, 1974), and the harpacticoids *Maraenobiotus brucei brucei* (Richard, 1898) and *Elaphoidella charon* (Chappuis, 1936). A comparison of the recent findings with historic records revealed that the majority of the invertebrate taxa detected represent new findings of aquatic fauna in individual caves, as 74 caves completely lack historic records. Species accumulation curves indicate that there is more to be discovered. While we appreciate the massive support of the citizen scientists, it also needs to be considered that sampling efficiency was very variable and our data analyses needs to be treated with caution.

Zusammenfassung

Im Rahmen der übergeordneten Forschungsinitiative „Stygofauna Austriaca" wurde mit Unterstützung des Österreichischen Verbands für Höhlenkunde, ein Citizen-Science-Projekt koordiniert. Dabei untersuchten freiwillige Helferinnen und Helfer Gewässer in 96 Höhlen sowie in künstlich geschaffenen unterirdischen Strukturen, auf das Vorkommen von Grundwasserfauna. Insgesamt wurden 12,085 Individuen aus 171 Proben aussortiert. Dabei konnten 132 aquatische Taxa festgestellt werden, wovon 67 bis auf Artniveau bestimmt wurden. Die Auswertung physikalisch-chemischer Parameter ergab keine Korrelation mit der Shannon-Diversität oder der Species richness. Auf Community-Ebene dominierten Arthropoda und in weiterer Folge Copepoda (Harpacticoida und Cyclopoida) die relativen Häufigkeiten. Die Analyse der Beta-Diversität (PCoA) ergab lediglich geringfügige signifikante Muster. Die Kategorie „water body connection", die Gewässer entweder als isoliert oder verbunden klassifiziert, erwies sich als am geeignetsten für die Analyse von stygobionter Höhlenfauna. Drei vermutlich neue Arten für die Wissenschaft wurden gefunden: *Elaphoidella n.sp.* 1, *Elaphoidella n.sp*. 2, *Elaphoidella n.sp*. 3. Erstnachweise für Österreich umfassen die Anneliden *Aelosoma gertae* (Marcus, 1944), *Aelosoma travancorense* (Aijer, 1926) und *Parvidrilus spelaeus* (Martinez-Anselmil, Sambugar und Giani, 2002), die Cyclopoiden *Megacyclops brachypus* (Kiefer, 1954) und *Graeteriella boui* (Lescher-Moutoue, 1974) sowie die Harpacticoiden *Maraenobiotus brucei brucei* (Richard, 1898) und *Elaphoidella charon* (Chappuis, 1936). Ein Vergleich von rezenten Daten aus dem Projekt mit historischen Funden zeigte, dass die Mehrheit der Proben neue Nachweise darstellt, da für 74 der insgesamt 96 beprobten Höhlen bisher keine historischen Aufzeichnungen von aquatischer Fauna vorhanden waren. Artenakkumulationskurven deuten darauf hin, dass es noch mehr zu finden gibt. Obwohl wir die immense Unterstützung der Citizen scientists schätzen, sollte beachtet werden, dass die Effizienz der Probennahme sehr variabel war und unsere Datenanalyse mit Vorsicht zu behandeln ist.

Content

1 Introduction

Groundwater research globally has shifted from a traditional perspective in the early 20th century, regarding subterranean habitats as extreme environments characterized by scarce biodiversity and often reduced abundance of specific taxa compared to the surface, to an ecosystem approach utilizing multi- and transdisciplinary expertise, uncovering complex microhabitats home to an unexpectedly high invertebrate diversity (Danielopol & Griebler, 2008). Groundwater and its communities (microbes and fauna) play a crucial role in supplying ecosystem services for the purpose of human well-being, such as water purification, nutrient cycling and provision of habitat for unique species, contributing to overall ecological health. However, despite its ecological significance, groundwater fauna remains understudied compared to surface-dwelling organisms (Griebler & Avramov, 2015).

A solid research foundation to understand and subsequently protect these ecosystem services is highly relevant for Austria, since 50% of its population depends on drinking water from karst areas, with approximately one fifth of the nation covered by karstic rocks (Kralik, 2001). On a global scale, about 20-25% of the world´s population depend on groundwater resources originating in karst (Ford & Williams, 2007). It is karst systems that harbor most caves. According to Ford & Williams (2007), the term karst can be defined as a type of landscape formed by chemical dissolution of highly soluble rocks, such as limestone, marble and gypsum. On top of rock solubility, secondary porosity (= porosity formed after deposition of the rock) needs to be sufficiently well developed in order to produce karst. Karst groundwater systems are mainly set apart from other groundwater types by the significant role that dissolution plays in regards to the characteristics of water flow in karst. The latter is much more dynamic in a sense that permeability is increased over time by the enlargement of void spaces, leading to a progressively more turbulent flow. Karst can be (simplified) subdivided in two main zones, the vadose and the phreatic zone. The vadose zone is the unsaturated part, which begins with the epikarst right beneath the soil. Precipitation that filters through the epikarst is called percolating or dripping water, which can form pools on rock/sediment surfaces inside of caves. The phreatic zone is the saturated part of karst, where cavities are completely filled by water. A universal definition for the term cave does not exist. It is often defined as a natural subterranean cavity bigger than a human, but aside from the vagueness of this definition, it is also tied to an anthropogenic point of view and has no biological background. Generally, for a cave to be registered in the Austrian cave cadaster it has to reach a length of at least 5m (Plan, 2007).

In general, caves, as a habitat for organisms adapted to subterranean environments, are mainly characterized by the absence of light and thus absence of primary production (photosynthesis), as well as a relatively constant temperature throughout the year. Animals adapted to subterranean environments usually exhibit a loss of pigmentation, reduced or absent eyes and elongated appendages. Stygobiont animals exhibit reduced size and worm-like body structures with often reduced appendages in addition to loss of eyes and pigment (Culver & Pipan, 2019). Culver & Pipan mention 6 key sources of energy which can support life in cave environments: Chemoautotrophy (Microorganisms), percolating water carrying organic material, flowing water such as streams carrying organic material, wind and gravity dislocating organic material into the cave, active movement of animals (fecal matter of bats) and roots penetrating into shallow caves. Comprehensive, quantitative declarations of subterranean biodiversity are difficult to achieve, owning to the limited accessibility of subterranean environments to humans, high degree of endemism and cryptic species complexes. Approximately 2000 stygobiont species are estimated to occur in Europe, with a significant proportion (396 species) attributed to the Dinaric karst (Culver & Pipan, 2019). The Postojna-Planina cave system, located in the Dinaric karst of Slovenia, harbors the worldwide highest cave dwelling species richness, with 116 species (as of 2021) of which 71 are aquatic (Zagmajster et al., 2021).

With its diverse geology and rich karst landscapes, which are predominantly composed of limestone, locally dolomite, marble formations and crystalline rocks, Austria presents a unique perspective on groundwater ecology and, with, as of December 2016, 16.300 documented caves in the Austrian cave cadaster (Spötl et al., 2018), holds a long tradition in speleological activities. Headquartered in Vienna, the Austrian Speleological Association (VÖH, Verband Österreichischer Höhlenforschung) was founded in 1949 and serves as an umbrella organization for several speleological societies and show caves, and since coordinates speleological activities and karst and cave research in Austria. Among several others, key areas of activity are the publication of media (e.g. journal "Die Höhle"), organization of training courses, maintenance of the national cave cadaster and raising public awareness for the importance of the conservation of caves. Since the 1960s research in subterranean biology has mainly explored hyporheic habitats, saturated porous aquifers and springs in karst and non-karst regions (Christian & Spötl, 2010). The most comprehensive literature about Austrian cave fauna up until today is the catalogue of the extant cave animals of Austria (Strouhal & Vornatscher, 1975), compiling records and associated literature collected by Hans Strouhal and supplemented with data collected by Josef Vornatscher. It provides an impressive directory of about 418 caves; however, the vast majority of these records are terrestrial organisms such as Arthropoda and Chiroptera. Quarternary glaciations have long been assumed to have caused extensive destruction of subterranean habitats in alpine areas. The scarcity of stygobiont species in caves of Vorarlberg was attributed by Breuss (2004) to this underlying concept. This interpretation is rooted in the hypothesis that formerly glaciated areas were unable to preserve cave fauna, which was underscored by the seemingly absent "true cave fauna" north of the biogeographical boundary "Draulinie" (Holdhaus, 1954). According to this assumption, Holdhaus attributed "poorly mobile, wingless and blind" cave animals very limited potential for postglacial recolonization. This paradigm has since been weakened, given the circumstance of the discovery of obligate subterranean arthropods in the Northern Alps. Janetschek (1955) states that survival in glaciated areas was indeed possible, on condition that parts of fissured mountain ridges protruded above the ice cover. Breuss (2004) mentions the possibility of a more efficient and quicker dispersal of stygofauna in comparison with terrestrial cave fauna, due to interconnected groundwater systems, ultimately leading to a facilitated postglacial recolonization. A more recent study by McInerney et al. (2014), covering the phylogenetic history of two Niphargus species endemic to Britain and Ireland, suggests that the long-term persistence of groundwater fauna in subterranean refugia may have played a more important role than previously thought. Overall, while research on groundwater fauna in Austria is advancing, there are still gaps in knowledge, particularly regarding extensive, nationwide and electronically accessible

Information about species distribution and ecosystem interactions as well as updating of old data. Addressing these gaps is crucial for effectively managing and conserving underground ecosystems in Austria and beyond.

This thesis covers the outcome from a citizen science project, which was part of the overarching research initiative “Stygofauna Austriaca”, led by Univ.-Prof. Mag. Dr. Christian Griebler (University of Vienna, Department for Functional and Evolutionary Ecology) and funded by the biodiversity fund. Together with a consortium of participants from the University of Vienna (Dr. Carina Zittra, MSc. Constanze Englisch, Dr. Ursula Eisendle, Dr. Andreas Fuchs, Matthäus Greilhuber, Tobias Gall-Andreici, Max Hämmerle, Raphael Veits), project partners (Dr. Tobias Pfingstl, Karl-Franzens University of Graz, Dr. Michael Duda, Natural History Museum of Vienna, Dr. Luise Kruckenhauser, MSc. Oliver Macek, Dr. Martin Schwendtner, Mag. Katharina Bürger, Austrian Speleological Association), a subcontractor (Dr. Santiago Gaviria, Technisches Büro für Biologie) and consultants (Erhard Christian, Otto Moog), the groundwater fauna (= stygofauna) was extensively evaluated and summarized and digitally documented on a nationwide scale for the first time. The project Stygofauna Austriaca is comprised of different work packages, tackling the systematic exploration of Austrians groundwater biodiversity. Individual work packages dealt with the reviewing, verifying and digitalizing of historic, recent and grey literature as well as expert knowledge, leading to the development of a database and the nationwide classifying of groundwater habitat quality. Other work packages addressed the documentation of voucher specimens of new and revised species and archiving in close collaboration with the Natural History Museum of Vienna. Further work packages contained the development of a potential future concept for monitoring groundwater and public transfer of gained knowledge. One work package, supported by the Austrian Speleological Association, was a citizen science project organized to efficiently investigate aquatic cave habitats across Austria, making use of caving expert´s knowledge and establishing valuable connections between groundwater research and interested citizens.

This master’s thesis can be seen as a contribution to this growing field of research, underscoring the importance to advancing research of often overlooked cave inhabiting stygobiont fauna. The goal is to give an overview of recent and historic records and to explore the collected dataset for any patterns that potentially aid in understanding the distribution of Stygofauna in cave environments. This is addressed by the following research questions:

- Does cave stygobiont biodiversity significantly differ between different habitat categories?
- Is there a significant correlation between Alpha diversity and selected environmental variables?

2 Material and Mehtods

2.1. Study site and Sampling

In collaboration with the Austrian Speleological Association sampling of cave waters was conducted by its members and other volunteers (citizen scientists) within the period of February 2024 and September 2025 in 81 natural caves and 15 anthropogenic underground structures, comprised of 14 tunnels and 1 well inside a vaulted subterranean structure, distributed throughout all provinces of Austria except Vienna (Table 3). As depicted on the map (Figure 1), sampled caves are mainly located in limestone, marble and carbonate sedimentary rock, making the northern calcareous alps and alpine foothills the most represented ecoregion with only a few caves located in the southern alps, central alps, the pannonian basin and the granite and gneiss plateau. Overall, the sampling sites range in altitude from 246 to 2523 meters above sea level.

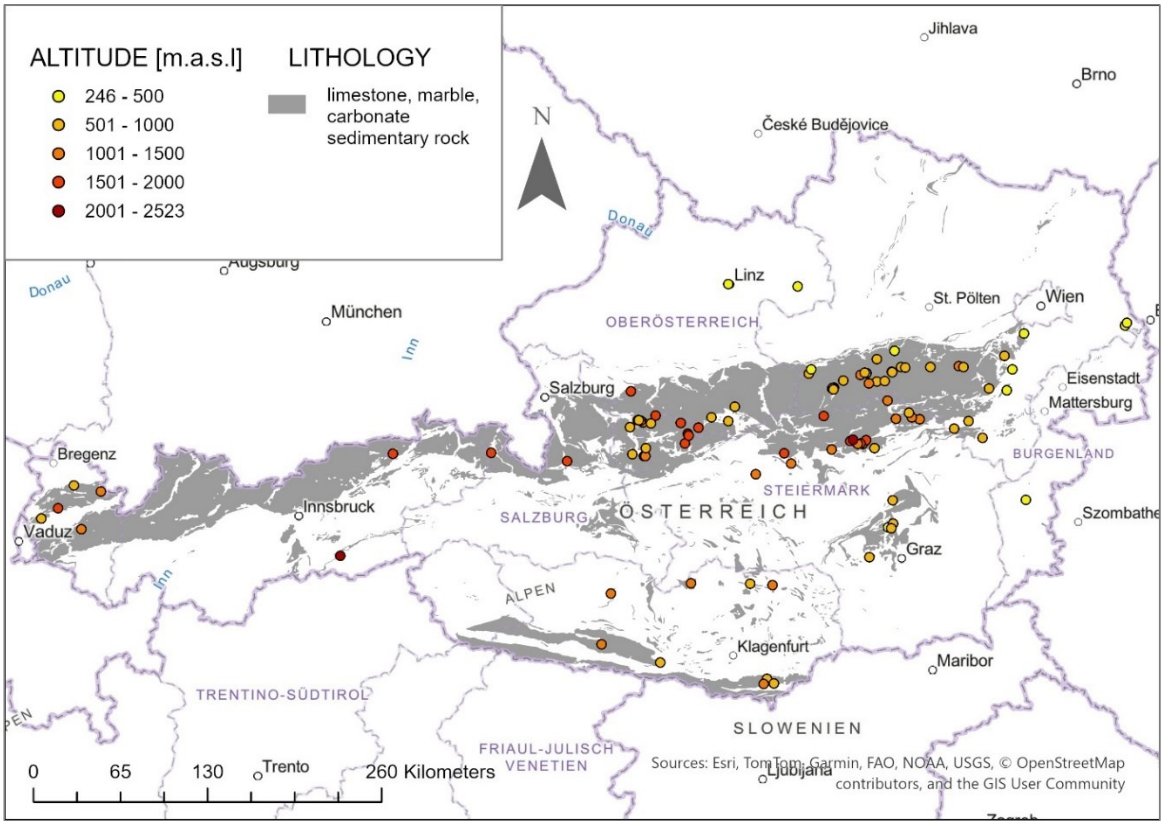

Figure 1: Distribution of sampling sites. Sources: Esri, USGS, NOAA, Basemap: World Terrain Reference, INSPIRE Geologische Einheiten 1:500 000 Österreich (Oberflächengeologie).

Sampling kits including a detailed step by step guide and identification chart for bigger animals were assembled and distributed to the citizen scientists (Figure 2). Fauna samples were collected in a non-standardized manner using customized, hand-sewn nets combining a 102 µm mesh size net and a handle of aquaristic supplies nets with a 12cm x 15cm opening, guiding the net closely along rock surfaces within water bodies and stirring up sediment which was followed by washing the contents through a sieve. After repeating this cycle a couple of times, the gathered material was transferred from the sieve into Greiner plastic tubes using high grade Ethanol. In addition, water samples were collected for analysis of physico-chemical parameters using 2x 50ml Greiner tubes. Air and Water temperature was measured on-site using a carry-on thermometer. Complementary to the written sampling guide a training video was filmed and provided on the homepage of the Austrian Speleological Association. Back in the lab, water samples were analyzed for pH and electrical conductivity (EC) using field sensors (WTW, Weilheim, Germany). Major ion concentrations (Na^+, K^+, Ca^{2+}, Mg^{2+}, Cl^-, SO_4^{2-}) were determined via ion chromatography (Dionex ICS-1100 RFIC; Thermo Scientific, Idstein, Germany). Nutrient concentrations (NO_3^-, NO_2^-, NH_4^+, PO_4^{3-}) were determined by standard photometric assays. Measurements of oxygen were deliberately omitted, because almost all sampling sites are located in oxygenated environments subjected to air flow and oxygen concentration in the water column was therefore assumed to be in equilibrium with the surrounding atmosphere. Additional information about the sampling sites (elevation, pictures, description of the location, type of water body, coordinates of the caves entrance) was gathered on site as well. The categorization of the cave water bodies in regards to different characteristics (Table 1 & Table 2) was carried out post sampling with the aid of pictures taken at the sampling sites and thorough consultation by members of the Austrian Speleological Association that have extensive knowledge of the sampled cave systems. Special permits for sampling have been obtained prior to the start of the project.

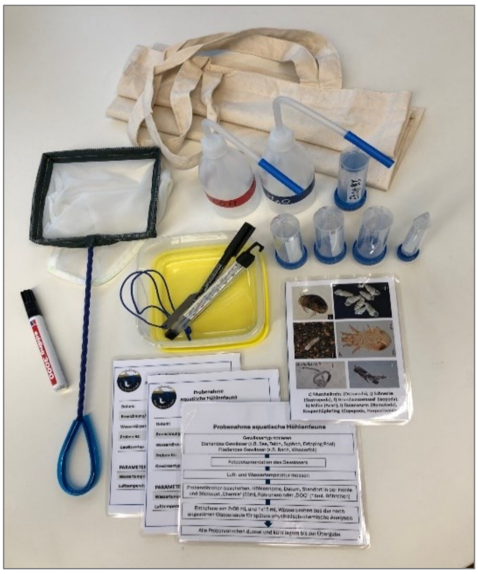

Figure 2: Sampling kit, Photo: Christian Griebler.

After staining of the fauna samples with eosin, animals were sorted into major taxonomic groups using a stereomicroscope and their abundance was recorded. In cases of fragmented individuals only heads of individuals and for the taxonomic group Ostracoda only intact individuals were counted. The sorted animals were stored in Eppendorf tubes with screw caps filled with undenaturated Ethanol (96%) in order to preserve DNA integrity and kept in the freezer until they were sent to experts for morphological species identification and/or molecular analysis. In cases of mismatch between initial abundance records and the specimens' numbers recorded by experts after species identification, numbers were corrected in favor of the experts counts to improve reliability of the data.

Table 1: Classification of habitat categories.

Habitat category	Water body type	Water body size	Sediment type	Water body stability	Infiltration	Water body connection	Water body movement
Source of determination	on site or post sampling with aid of pictures	post sampling with aid of pictures	post sampling with aid of pictures	expert knowledge (VÖH)	expert knowledge (VÖH)	expert knowledge (VÖH)	on site or post sampling with aid of pictures
	driplet pool: formation driven by accumulations of dripping water from above	**tiny:** volume < 1 litre	**none:** bare rock	**episodic:** water body dries out from time to time, dependent on flooding events	**diffuse:** water enters the cave by slowly seeping through fissures in the rock (dripping water)	**isolated:** water body is constantly separated from other water bodies	**flowing**
	pool: smaller than a lake, not primarily formed by dripping water	**small:** volume ≤ $1m^3$	**fine:** dominated by silt, clay or sand, water turbid when stirred	**perennial:** water body remains persistent, independent from flooding events	**point recharge:** water enters the cave via a stream originating from the surface	**connected:** water body is connected to other water bodies during events of flooding, streams	**stagnant**
	siphon: part of the cave which is completely filled with water	**medium:** volume = $1\text{-}10m^3$	**coarse:** dominated by gravel and stones, water clear				
	lake: big, isolated and stagnant	**big:** volume > $10m^3$					
	stream: flowing movement						

Table 2: Classification of habitat categories.

Habitat category	Length of the cave	Depth of the cave	Lithology	Elevation category	Glaciation
Source of determination	Length codes provided by Katharina Bürger (VÖH)	Depth codes provided by Katharina Bürger (VÖH)	expert knowledge (VÖH)	based on (simplified) "Die forstlichen Wuchsgebiete Österreichs" (W.Kilian, F.Müller, F.Starlinger, 1994) & shapefile "Forstliche Wuchsgebiete" (BFW 2024, available on data.gv.at)	shapefile provided by VanHusen, 1987
	very short: length code 1 (1-50m)	**very shallow:** depth code 1 (1-50m)	**limestone**	**colline:** südliche Randgebirge <700m, Pannonisches Tief- und Hügelland 100-350m, Niederösterreichischer Alpenostrand 200-350m, Nördliches Alpenvorland Ostteil 200-300m	**glaciated:** sampling site within borders of last glacial maximum
	short: length code 2 (50-500m)	**shallow:** depth code 2 (50-100m)	**marble limestone**	**montane:** südl. Randgebirge 700-1550m, südliche Zwischenalpen Südteil 460-1500m, Ost- und Mittelsteirisches Bergland 300-1400m, Nördliche Randalpen Ostteil 300-1450m, Nördliche Randalpen Westteil 400-1450m, Niederösterreichischer Alpenostrand 350-1400m, Bucklige Welt 300-1400m, Mühlviertel 200-1200m, Subkontinentale Innenalpen Ostteil 750-1650m, östliche Zwischenalpen Nordteil 500-1400, subillyrisches Hügel- und Terrassenland 300-700m	**not glaciated:** sampling site outside borders of last glacial maximum
	moderately short: length code 3 (500-5000m)	**moderately shallow:** depth code 3 (100-200m)	**dolomitic limestone**	**subalpine:** Nördliche Randalpen Westteil 1450-1950m, Nördliche Randalpen Ostteil 1400-1900m	
	intermediate: length code 4+5 (5000-25000m)	**intermediate:** depth code 4 (200-500m)	**sandstone**	**alpine:** Nördliche Randalpen Westteil >1950m, Nördliche Randalpen Ostteil >1900m, Subkontinentale Innenalpen Westteil >2200m	
	moderately long: length code 6 (25000-50000m)	**moderately deep:** depth code 5 (500-750m)	**clastic sedimentary rock**		
	long: length code 7 (50000-100000m)	**deep:** depth code 6 (750-1000m)	**crystalline rock**		
	very long: length code 8 (100000-500000m)	**very deep:** depth code 7 (1000-1250m)	**gypsum**		

Table 3: Overview of the sampling sites. Sampling sites where no fauna was found are marked in bold.

Cave name / sampling site	Cave registry number	Type	Province	Region	Altitude [m.a.s.l.]	Cave length [m]	Cave depth [m]	Length code	Depth code
Altenbergschacht	3925/6	cave	K	Bad Eisenkappl	1000	-	-	-	-
Amanda Unterbau	K3925	tunnel	K	Friesach	760	-	-	-	-
Barbarastollen	-	tunnel	K	Hüttenberg	1070	-	-	-	-
Bärenloch	2839/2	cave	STMK	Mixnitz	578	1337	59	3	2
Bärenlucke	1836/180	cave	NÖ	Sankt Anton an der Jessnitz	665	835	64	3	2
Baschghöhle	1112/1	cave	VBG	Übersaxen	780	308	17	2	1
Brühlhöhle	**1125/1**	**cave**	**VBG**	**Andelsbuch**	**620**	**272**	**33**	**2**	**1**
Bullenhöhle	1622/57	cave	STMK	Tauplitz	1570	1502	259	3	4
Burianhöhle	1824/1	cave	NÖ	Lackenhof	1015	833	142	3	3
Dachstein-Mammuthöhle	1547/9	cave	OÖ	Obertraun	1321	67725	1207	7	7
Dachstein-Rieseneishöhle	1547/17	cave	OÖ	Obertraun	1421	2700	90	3	2
Da-Vinci-Höhle	1615/37	cave	OÖ	Bad Ischl	1065	3785	113	3	3
Eggerloch	3742/2	cave	K	Villach	573	709	123	3	3
Eisensteinhöhle	1864/1	cave	NÖ	Bad Fischau-Brunn	380	2341	87	3	2
Eisgrabenschacht	1745/50	cave	STMK	Thörl	1384	440	300	2	4
Eislüg	1625/28	cave	OÖ	Hinterstoder	1515	2125	173	3	3
Eisriesenwelt	1511/24	cave	SBG	Werfen	1640	-	407	6	4
Elmhöhlensystem	1624/38	cave	STMK	Totes Gebirge, Pühringerhütte	1658	5472	354	4	4
Falkensteinhöhle	2861/3	cave	NÖ	Breitenstein	919	102	22	2	1
Feistringgrabenhöhle	1745/7	cave	STMK	Aflenz	956	747	108	3	3
Fischeralmstollen	-	tunnel	K	Weißensee	1052	-	-	-	-
Fladung-Hochobir	-	tunnel	K	Bad Eisenkappl	1237	-	-	-	-
Frauenmauer-Langsteinhöhle	1742/1	cave	STMK	Tragöss	1467	46242	692	6	5
Freschenhöhle	1111/7	cave	VBG	Laterns	1855	725	48	3	1
Griesgrabenhöhle	**1851/203**	**cave**	**STMK**	**Neuberg an der Mürz**	**1445**	**1314**	**46**	**3**	**1**
Grillenbergwerk	K1854/1	tunnel	NÖ	Payerbach	622	-	-	-	-
Güntherhöhle	2921/2	cave	NÖ	Hainburg an der Donau	265	252	25	2	1
Hammerbach-Ursprung	2836/34	cave	STMK	Tanneben	410	40	3	1	1
Herdengelhöhle	1823/4	cave	NÖ	Lunz am See	881	129	11	2	1
Hermannshöhle	2871/7	cave	NÖ	Kirchberg am Wechsel	629	4430	73	3	2
Hinterbergerbach-Schwinde	6844/14	cave	OÖ	St.Thomas am Blasenstein	460	-	-	2	1
Hirlatzhöhle	1546/7	cave	OÖ	Hallstatt	870	105498	1077	8	7
Hirschfallhöhle	1823/5	cave	NÖ	Lunz am See	937	331	50	2	2
Hirschgrubenhöhle	1744/450	cave	STMK	Hochschwab	1896	5596	201	4	4
Hochkarschacht	1814/5	cave	NÖ	Hochkar	1640	751	117	3	3
Hochlecken-Grosshöhle	1567/29	cave	OÖ	Höllengebirge	1522	6531	886	4	6
Hofertalschacht	1745/85	cave	STMK	Hochschwab	1809	181	115	2	3
Hohlensteinhöhle	1831/1	cave	STMK	Mariazell	1031	375	17	2	1
Höllenloch	1612/1	cave	OÖ	Bad Goisern	547	407	54	2	2
Höllwandquelle	**1851/164**	**cave**	**STMK**	**Mürzsteg, Hinteralm**	**1257**	**7**	**3**	**1**	**1**
Hundalm Eishöhle	**1266/1**	**cave**	**T**	**Angerberg**	**1520**	**264**	**51**	**2**	**2**
Kaiser-Josephi-Fundgrube	**K1837/2**	**tunnel**	**NÖ**	**Türnitz**	**971**	-	-	-	-
Kammschacht	1867/5	cave	NÖ	Muggendorf	1285	880	94	3	2
Klafflingbrunnen	1837/18	cave	NÖ	Loich, Pielachtal	460	128	7	2	1
Klausengrube	-	tunnel	K	Radlgraben	1110	-	-	-	-
Kohlerhöhle	1833/1	cave	NÖ	Annaberg	690	650	42	3	1
Komfort-Schluchthöhle	1745/95	cave	STMK	Karlalpe	1601	1417	114	3	3
Konradhöhle	2644/1	cave	STMK	Hohentauern	1215	772	16	3	1
Koppenbrüllerhöhle	1549/1	cave	OÖ	Obertraun	565	4654	146	3	-
Kreidelucke	1628/2	cave	OÖ	Hinterstoder	580	1042	88	3	2
Kühlloch	**1616/5**	**cave**	**OÖ**	**Bad Ischl**	**554**	**1405**	**373**	**3**	**4**
Leitenhöhle	2783/1	cave	STMK	Stallhofen	541	150	20	2	1
Luftschutzstollen Enzesfeld	K1869/1	tunnel	NÖ	Enzesfeld-Lindabrunn	285	-	-	-	-
Lurgrotte	2836/1	cave	STMK	Semriach	634	12070	277	5	4
Mailoch	1722/5	cave	STMK	Radmer	1130	254	62	2	2
Mausrodlhöhle	1824/9	cave	NÖ	Lunz am See	670	102	17	2	1
Miralucke	1867/8	cave	NÖ	Muggendorf	698	453	24	2	1
Naglsteghöhle	1626/5	cave	OÖ	Rettenbachtal	862	816	216	3	4
Nasses Loch	1836/19	cave	NÖ	Schwarzenbach a.d. Pielach	730	186	26	2	1
Nestelberghöhle	1816/11	cave	NÖ	Ötscher	498	200	91	2	2
Nordwandschacht	**1625/141**	**cave**	**STMK**	**Totes Gebirge**	**2092**	**1808**	**284**	**3**	**4**
Obere Schiesserbachhöhle	1616/7	cave	OÖ	Bad Ischl	640	868	55	3	2
Ötschertropfsteinhöhle	1824/10	cave	NÖ	Gaming	710	575	54	3	2
Paulinenhöhle	1837/11	cave	NÖ	Türnitz	639	242	15	2	1
Piessling-Ursprung	**1636/3**	**cave**	**OÖ**	**Rossleiten**	**755**	**1461**	**184**	**3**	**3**
Portal am Pfaffenkappel	**1323/22**	**cave**	**SBG**	**Loferer Steinberge**	**1775**	-	-	-	-
Reichenwaldhöhle	1826/2	cave	NÖ	Waidhofen an der Ypps	760	510	44	3	1
Rettenbachhöhle	1651/1	cave	OÖ	Windischgarsten	680	1348	130	3	3
Rinnender Stein	1836/36	cave	NÖ	Annaberg	840	115	14	2	1
Rudolfstollen	K401/1	tunnel	OÖ	Linz-Urfahr	270	-	-	-	-
Schachernhöhle	1866/9	cave	NÖ	Innerfahrafeld	651	1810	-	-	-
Schneckenloch	1126/1	cave	VBG	Egg	1285	3558	148	3	3
Schönberg-Höhlensystem	1626/300	cave	OÖ	Ebensee	1718	2E+06	1061	8	7
Schwabenreithhöhle	1823/32	cave	NÖ	Lunz am See	957	134	10	2	1
Seegrotte	K1915/1	tunnel	NÖ	Hinterbrühl	246	-	-	-	-
Siebenschläferschacht	1745/109	tunnel	STMK	Hochschwab	1423	414	135	2	3
Spannagelhöhle	2515/1	cave	T	Hintertux, Zillertal	2523	11500	329	5	4
Stadelalm-Eiskluft	1713/22	cave	STMK	Johnsbach	1650	4495	623	3	5
Steinbockschacht	1744/599	cave	STMK	Hochschwab	2022	2851	1127	3	7
Stiller-Graben-Stollen	K2822/2	tunnel	BGL	Stadtschlaining	380	-	-	-	-
Stollen Flattnitz	2717/	tunnel	K	Flattnitz	1360	-	-	-	-
Taubenloch	1816/6	cave	NÖ	Ötscher	1446	28602	662	6	5
Tonionhöhlensystem	1762/1	cave	NÖ	Niederalpl	1487	15053	580	5	5
T-Höhle	1616/8	cave	OÖ	Bad Ischl	567	124	17	2	1
Totes Weib	1851/10	cave	STMK	Mürzsteg	880	541	35	3	1
Trockenes Loch	1836/34	cave	NÖ	Schwarzenbach an der Pielach	764	4510	116	3	3
Trübbachhöhle	1211/4	cave	VBG	Raggal	1457	423	20	2	1
Tuffsteinhöhle	1827/19	cave	NÖ	Waidhofen an der Ypps	414	13	3	1	1
Türkenbrunnen	K1911/10	well	NÖ	Gainfarn	522	-	-	-	-
Türkenschanzstollen	-	**tunnel**	**K**	**Eisenkappel-Vellach**	**664**	-	-	-	-
Turnerbundhöhle	1863/22	cave	NÖ	Hohe Wand	910	40	30	1	1
Untere Schiesserbachhöhle	**1616/6**	**cave**	**OÖ**	**Bad Ischl**	**605**	**422**	**103**	**2**	**3**
Wasserleitungsstollen	K2921/9	tunnel	NÖ	Hainburg an der Donau	257	300	8	-	-
Wildbaderhöhle	1625/150	cave	STMK	Bad Mitterndorf	1993	12717	1101	5	7
Wildemannloch	2836/27	cave	STMK	Peggau	680	794	102	3	3
Wilhelminenhöhle	1823/7	cave	NÖ	Lunz am See	695	403	30	2	1

2.2 Data Analysis and Visualization

All statistical analyses were carried out with R version 4.4.3 and RStudio 2024.12.1+563 utilizing a modified pipeline written and provided by Clemes Krawautz and Angela Cukusic. The following packages were used: phyloseq, dplyr, ggplot2, rstatix, corrplot, EnvStats. Maps were created with ArcGis pro version 3.5.3. Due to the considerable deviation from normality, analysis was executed with mostly non-parametric tests. It has to be noted that, considering the non-standardized sampling, the resulting data can realistically only be interpreted in a qualitative manner and all statistical analysis is to be viewed with caution.

In order to utilize the dataset with as little loss of information as possible, data was prepared differently for several steps in analysis. Taxa of stygoxen animals (= taxa that do not belong to the cave water fauna, e.g. terrestrial species) were excluded from the abundance table for all of the analysis, which still leaves taxa included that were not further identified to species level (for example Phylum Nematoda). Only for steps where species data is required (Species richness, Shannon diversity) data was further restricted. For these steps only species and groups which were not identified on species level but remained unique in the data set were included, for example a Phylum which was not further processed yet or a Family/Genus which did otherwise not occur in the species data. Abundances from multiple sampling occasions at different times but taken from the same water body were summed up and for the respective physico-chemical parameters the average was used, except for species accumulation curves where every sample was kept individually. Values of hydrochemical parameters below detection limit were substituted by zeros.

For visualization of environmental gradients, a PCA was calculated using z-standardized and log-transformed environmental variables. In order to check if environmental variables have an impact on biodiversity indices a correlation matrix (Spearman) including Shannon diversity and Species richness was conducted. For visualization of the sampling effort, species accumulation curves were calculated. To explore differences in dominance of taxa on community level, all samples within a grouping variable were aggregated to one sample and illustrated in a compositional barplot. Beta-diversity was explored using a Hellinger based PCoA with Euclidean distances, followed by an ANOVA to test for homogeneity of variances (betadispersion) and a PERMANOVA to test for significance. Alpha diversity was analyzed by calculating the Shannon diversity and testing differences between the grouping factors using a Kruskal Wallis test and subsequent KW-Dunn post-hoc test for comparison between more than two groups and a Mann-Whitney test in cases of comparison between two groups. For the analysis of differences of incidence within samples between the grouping factors, abundances were transformed to incidences and based on contingency tables Fisher´s exact test with subsequent pairwise Fisher tests (multiple groups, Holm corrected) in cases of expected cell frequency < 5 and Chi squared test in cases of expected cell frequency > 5 was used.

With the help of C. Englisch, M. Hämmerle and T. Gall-Andreici historic literature data were collected, provided in a reference management tool (Zotero) and examined for Austrian records of cave water fauna. The results concerning sampled caves were summarized in tables for each major taxonomic group.

3 Results & Discussion

In total, 12,085 Individuals were sorted from 171 samples of 96 sampling sites, resulting in the identification of 132(22) aquatic taxa of which 67(11) species were recorded, numbers in brackets represent taxa classified as stygoxen. 24 out of all samples did not contain invertebrates, leading to a total of 12 caves where no fauna was found (Table 3, marked in bold). The groups Amphipoda and Turbellaria still remain to be processed for species identification and Nematoda, while meanwhile processed, are not further touched upon within the scope of this thesis. Examples of taxa that were found are shown in Figure 4 & Figure 5.

3.1 Statistical Data Analysis

Illustrated in Figure 3, the calculated PCA shows none of the ellipses are clearly separated in terms of physical-chemical conditions and selected environmental characteristics (e.g. elevation), especially limestone, dolomitic limestone and marble limestone cannot be distinguished from each other. Crystalline rock and gypsum cluster apart, but overlap with dolomitic limestone, marble limestone and each other. The correlation matrix shown in Figure 3 revealed no significant correlation of the Shannon diversity (H´) and species richness (= “Observed”) with any of the environmental variables tested.

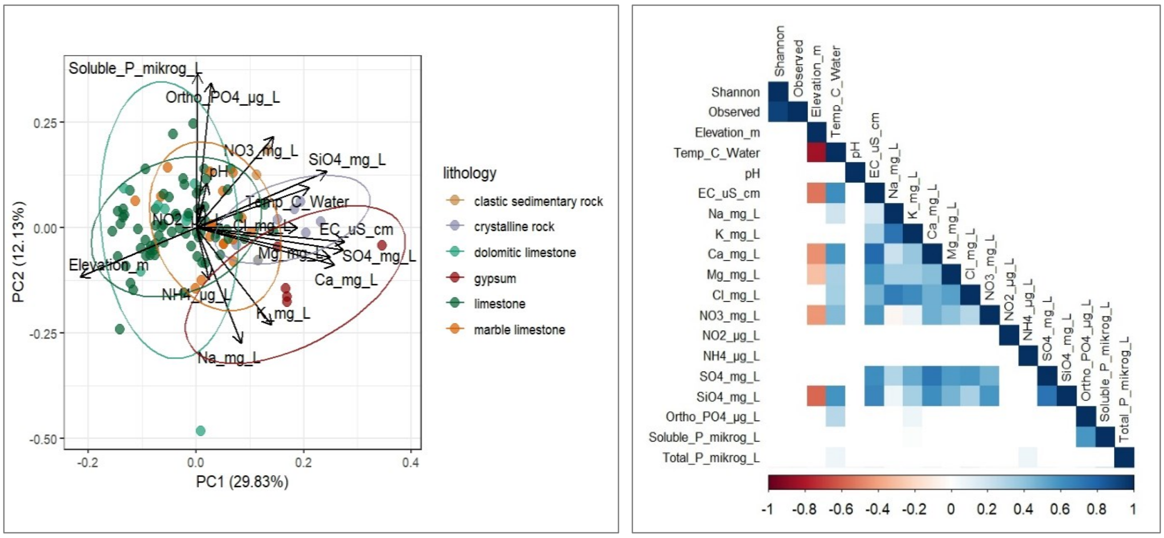

Figure 3: PCA of z-standardized and log-transformed environmental variables on the left and correlation matrix using spearman correlation with environmental variables, Shannon diversity (H´) and Species richness = "Observed", on the right.

In the following a few variables are briefly mentioned and discussed. Chloride concentrations in most cases ranged from close to 0 up to 25 mg/l, only very few values reached concentrations above 100 mg/l, with the highest being 178 mg/l (Rinnender Stein). For reference, chloride concentration in cities with intense road de-icing salt applications reach averages between 415 mg/l and 1100 mg/l (Aghazadeh et al., 2010; Williams et al., 2000, as cited in Becher et al., 2022). Concentrations of nitrate, for most caves, ranged around and below 10 mg/l, with only the caves Rinnender Stein (119 mg/l) and Seegrotte (72 mg/l) exceeding the drinking water threshold of 50 mg/l. Rinnender Stein is also among the caves with the highest electrical conductivity (1012 µS/cm), only exceeded by Kohlerhöhle (1102 µS/cm), Rudolfstollen (1057 µS/cm), Trübbachhöhle (2210 µS/cm) and Seegrotte (3280 µS/cm). The majority of electrical conductivity values span around and below 500 µS/cm, which is well below the drinking water threshold of 2500 µS/cm at 20°C. However, it is important to mention that the EC is not exclusively a sign of deteriorated water quality, but also an indication for the mineralogy. Ammonium concentrations in most cases ranged between 2 µg/l and 50 µg/l, with the highest value measured in the tunnel Barbarastollen (278 µg/l), which is well below the drinking water threshold of 500 µg/l. Becher et al. (2022) reviewed numerous studies regarding the impact of physico-chemical parameters, stating that nutrients overall seem to be of minor importance for groundwater fauna. A full overview of the environmental values can be found in the Tab. AX 1- 4. As expected, there is a number of positive and negative correlations found with the physical-chemical parameters. Prominent ions, such as calcium, magnesium and sulfate correlate positively with the electrical conductivity (Figure 3). Some relationships result from the mineralogy, e.g. calcium and sulfate (gypsum). Negative correlations are found for water temperature and elevation, which is expected. The trend of decreasing nitrate values with increasing elevation points at a less intensive land use and application of fertilizers in high altitude areas (Figure 3).

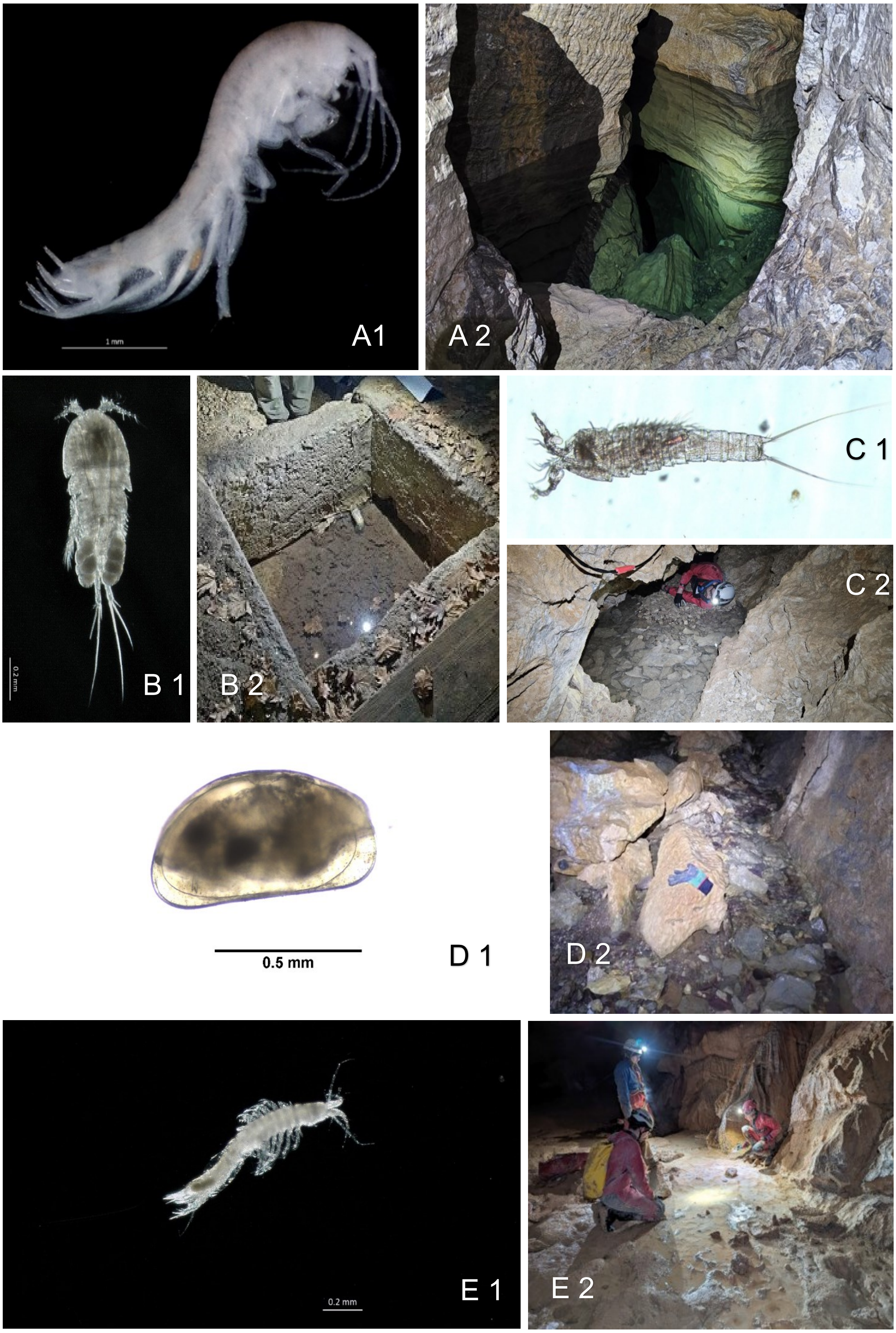

Figure 4: Examples of Taxa found as part of the citizen science project. Same letters indicate which taxon was found at which sampling site. A1 = Niphargus sp., Photo: G. Paveza; A2 = Siphon at Miralucke, Photo: G. Paveza; B1 = Paracyclops imminutus, Photo: G. Paveza; B2 = Pool at Türkenbrunnen, Photo: T. Gramanitsch, S. Wendelin, R. Sattra; C1 = Elaphoidella proserpina, Photo: S. Gaviria; C2 = dripwater pool at Hirschgrubenhöhle, Photo: E. Kaminsky; D1 = Schellencandona belgica, Photo: S. Gaviria; D2 = stream at Frauenmauer-Langsteinhöhle, Photo: D. Wundsam, K. Bürger; E1 = Bathynellidae gen.sp., Photo = G. Paveza; E2 = dripwater pool at Dachstein-Mammuthöhle, Photo: L. Plan, L. Altenberger.

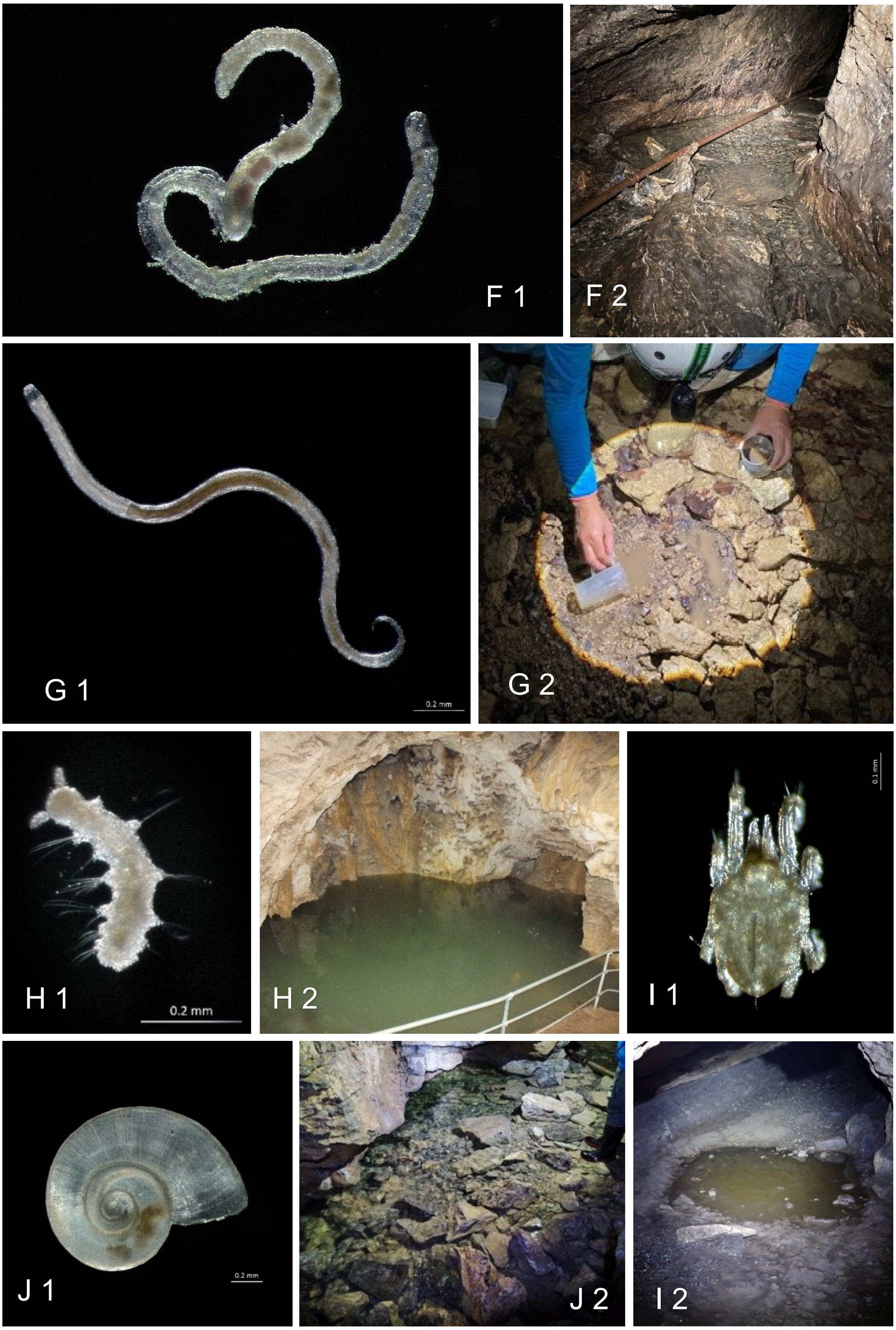

Figure 5: Examples of Taxa found as part of the citizen science project. Same letters indicate which taxon was found at which sampling site. F1 = Oligochaeta fam.gen.sp., Photo: G. Paveza; F2 = stream at Klafflingbrunnen, Photo: K. Bürger, C. Griebler; G1 = Nematoda fam.gen.sp, Photo: G. Paveza; G2 = dripwater pool at Herdengelhöhle, Photo: K. Bürger, C. Griebler; H1 = Troglochaetus beranecki, Photo: G. Paveza; H2 = lake at Ötschertropfsteinhöhle, Photo: K. Bürger, M.l Hiptmair, H. Wahl; I1 = Soldanellonyx chappuisi, Photo: G. Paveza; I2 = dripwater pool at Schneckenloch, Photo: K. Ritter.

Species accumulation curves can be used to estimate if the sampling effort was sufficient. Only the species accumulation curve depicting the federal state Vorarlberg reaches a kind of plateau at around 30 samples (Figure 6), indicating a satisfactory sampling effort. Oberösterreich, Steiermark and Niederösterreich show a slight increase, indicating species richness could potentially yield higher results with additional sampling. For Kärnten, Tirol, Salzburg and Burgenland sampling effort was not enough to conclude anything based on the species accumulation curves.

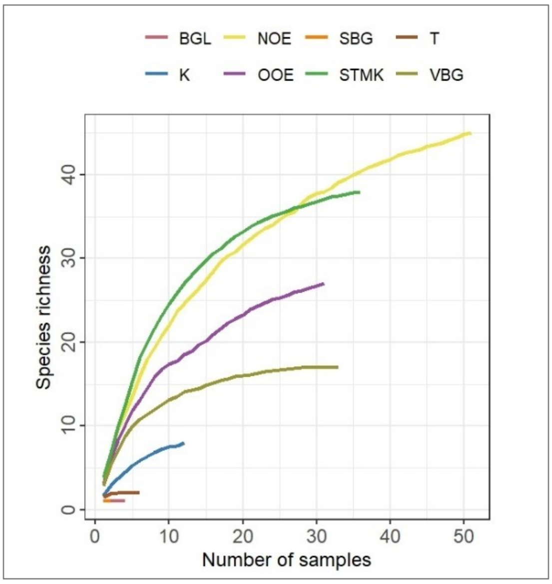

Figure 6: Species accumulation curves using the federal states of Austria as grouping factor. BGL = Burgenland, NOE = Niederösterreich, SBG = Salzburg, T = Tirol, K = Kärnten, OOE = Oberösterreich, STMK = Steiermark, VBG = Vorarlberg.

The compositional barplots (Figure 7) showing relative abundances of all Phyla in each category, indicate that there are slight differences on community level between the different categories of cave water habitats we distinguished, however a general pattern is not evident. Arthropoda are almost exclusively the most dominant Phylum, followed by Nematoda, Annelida and Mollusca. This is not surprising, as Arthropoda are usually the most dominant group among groundwater communities (Becher et al., 2022). Relative to other Phyla, Nematoda seem inclined towards the types of water bodies “pool” and “driplet pool” and “tiny to medium sized water bodies”. They also show higher dominance in samples with fine sediment, in isolated water bodies and formerly glaciated sampling sites. Annelida are more dominant in flowing and connected water bodies, while Mollusca are equally abundant in flowing and stagnant water bodies, however, almost completely absent in formerly glaciated areas and isolated water bodies.

The compositional barplot of the Phylum Arthropoda (Figure 8), shows that Harpacticoida and Cyclopoida were generally the most dominant Orders, together they consistently constituted about 75% of the faunal communities in the different categories. This is congruent with research done by Galassi et al. (2009), who state that copepods usually dominate over other crustacean and non-crustacean groups in groundwater. They also suggest that copepods prefer low water velocity habitats in karstic environments, where retention of organic matter is higher. Harpacticoida in this case are more dominant in flowing and perennial water bodies, whereas Cyclopoida seem to be inclined towards stagnant and episodic water bodies. Amphipoda and Podocopida are both seemingly inclined towards coarse sediment, while Amphipoda are relatively more abundant in isolated and Podocopida more abundant in connected water bodies.

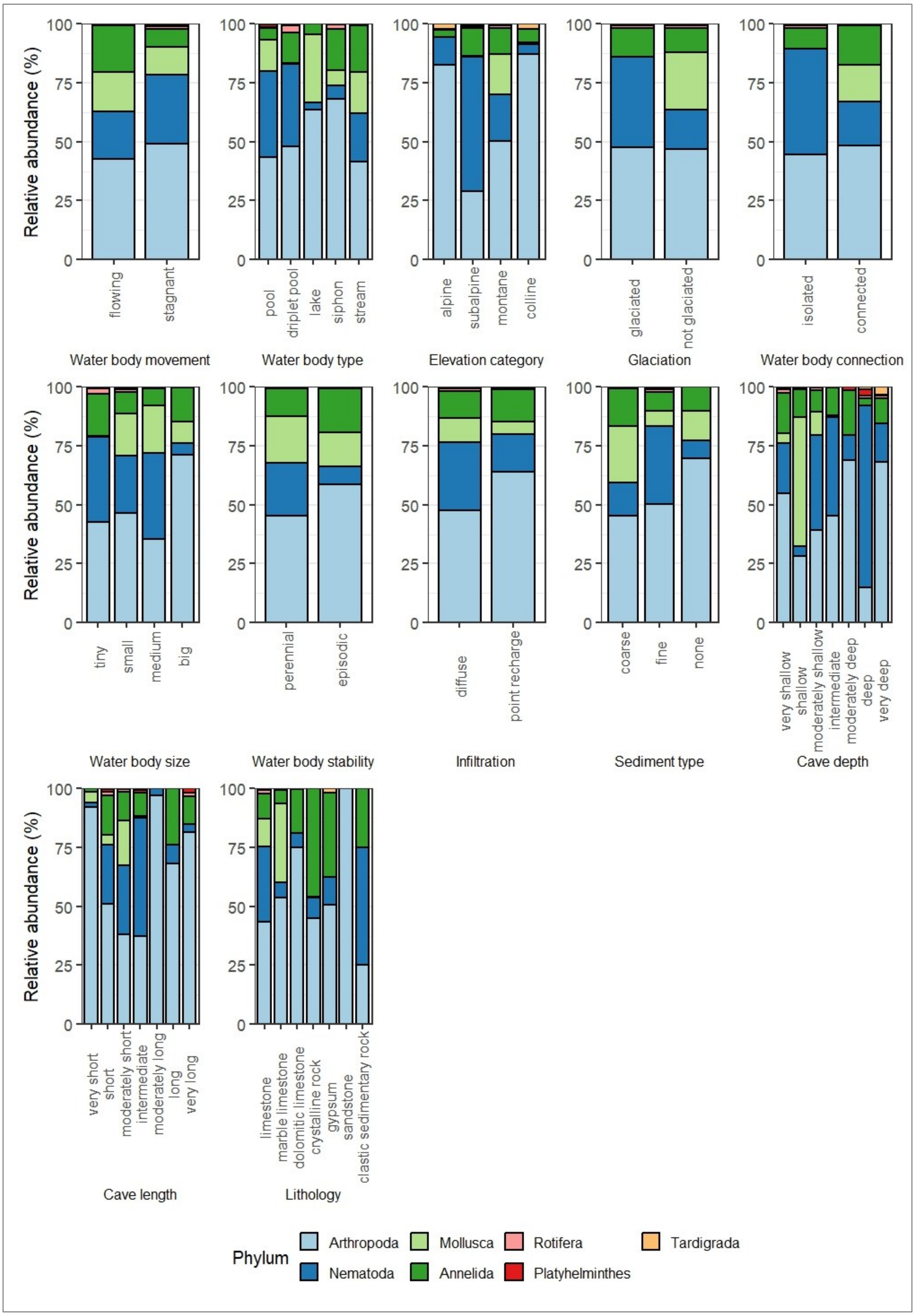

Figure 7: Compositional barplot of relative abundances showing the taxonomic level Phylum.

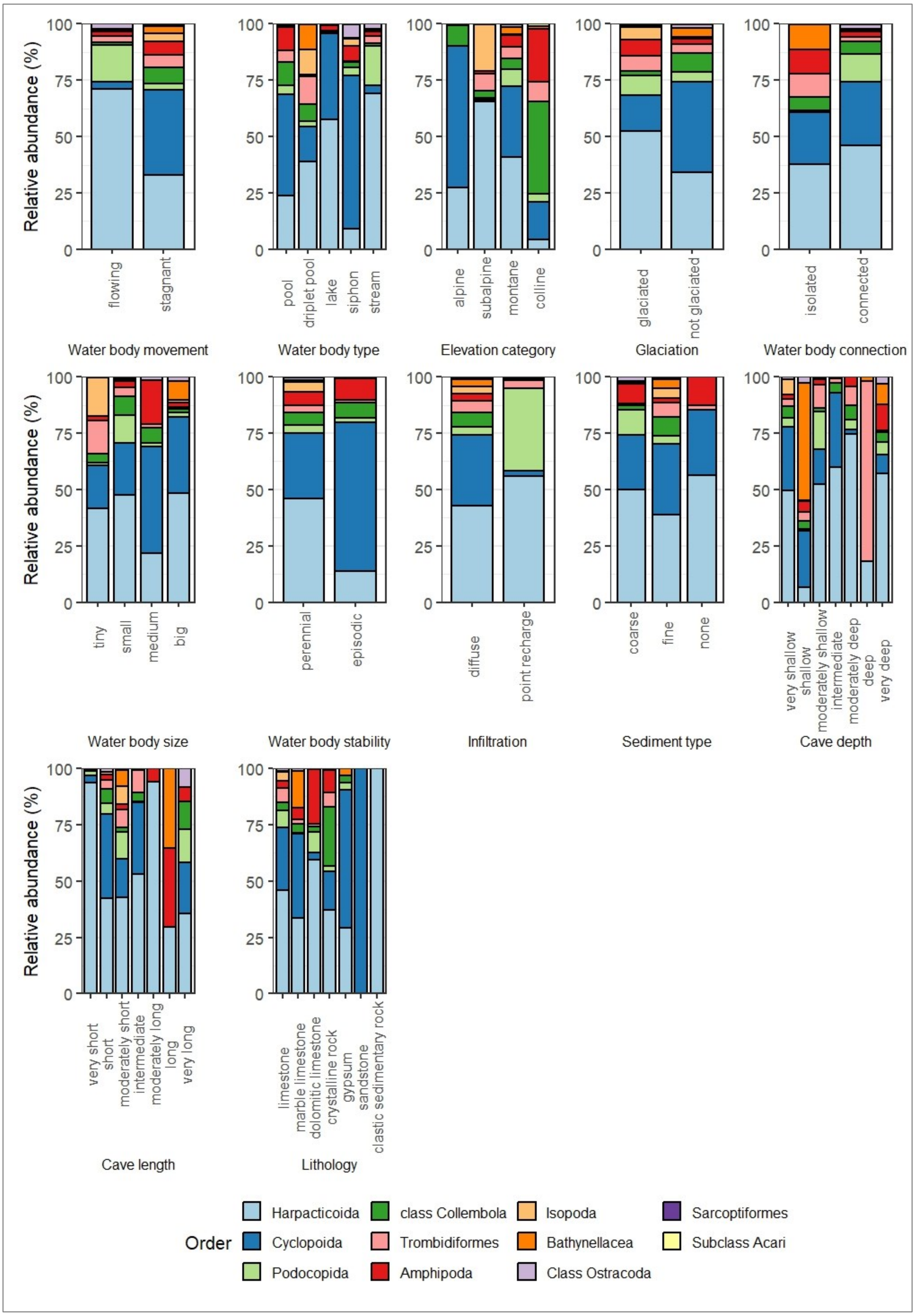

Figure 8: Compostional barplot of relative abundances showing the taxonomic level Order or higher (e.g. class, subclass).

At Phylum level, only the categories water body movement, water body type and water body connection resulted in significant differences on community composition using a PERMANOVA (water body movement: $p = 0.005$, water body connection: $p = 0.002$, water body type: $p = 0.001$) while also meeting the prerequisite of homogeneity of variances tested by ANOVA (betadispersion). However, community composition does not seem to primarily differ due to these underlying grouping factors. This is already evident by the vastly overlapping ellipses (Figure 9) and confirmed by the small R^2 values, showing that only a very small portion of variance is explained by water body movement ($R^2 = 0.01904$), water body type ($R^2 = 0.05023$) and water body connection ($R^2 = 0.03065$). Repeating the same analysis only with species of the Phylum Arthropoda, the result does not change considerably, except glaciation now meeting the requirement of homogeneity of variances instead of water body type (PERMANOVA: water body movement: $p = 0.001$, $R^2 = 0.02965$; water body connection: $p = 0.002$, $R^2 = 0.03582$; glaciation: $p = 0.027$, $R^2 = 0.01459$).

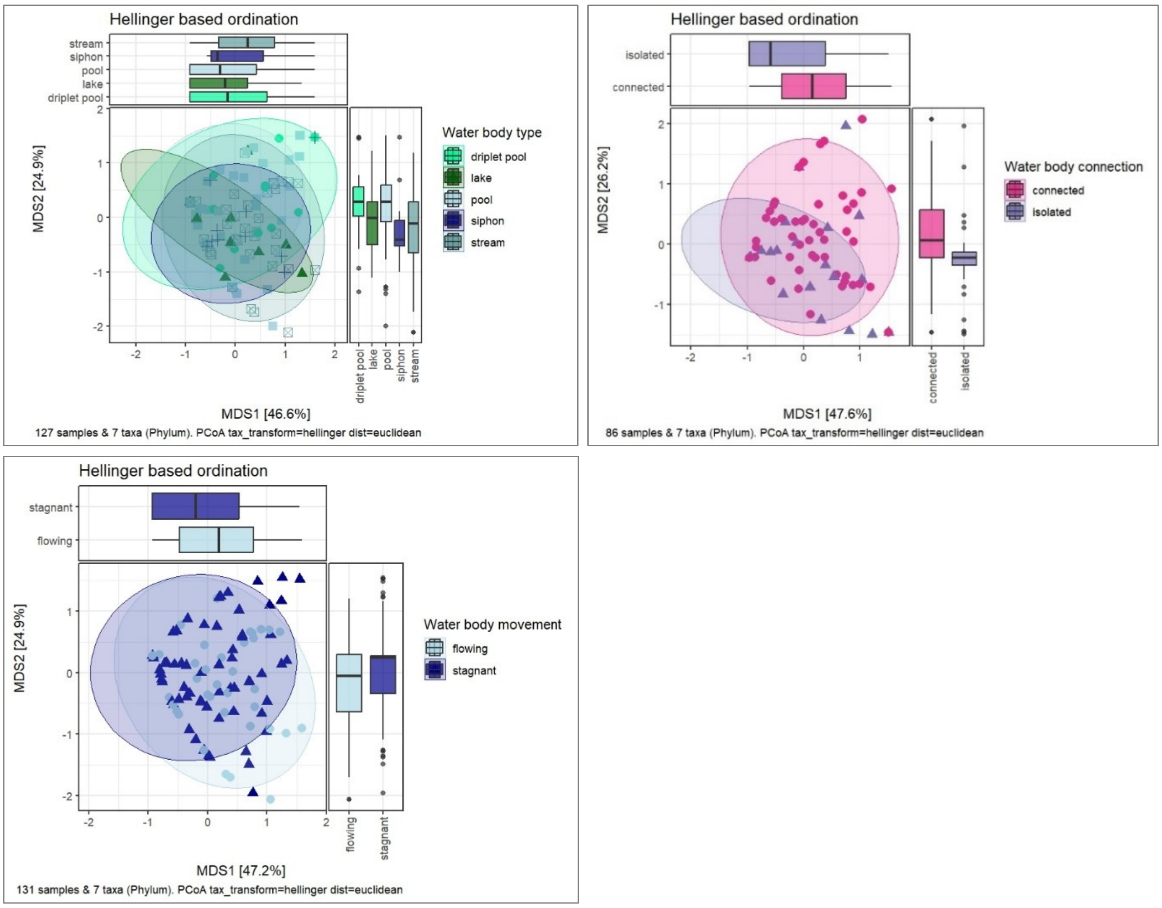

Figure 9: PCoA using Hellinger transformation on abundances and Euclidean distance measure.

As already mentioned in section 1, survival of stygobiont fauna with regard to quarternary glaciations and the extent and potential of postglacial recolonization has been discussed for decades and is still topic of recent research initiatives. Challenging these historic beliefs once more, species richness of aquatic fauna sampled in caves is not visibly lower at sampling sites within the borders of the last Würm glacial maximum compared to sampling sites outside of these borders (Figure 10). The caves Schneckenloch and Freschenhöhle, which are among the caves with the highest species richness in this project (Schneckenloch: 22, Freschenhöhle: 19), are even located at the very west end side of Austria. Further, Figure 14 shows that the Shannon diversity of samples from glaciated and not glaciated sites does not significantly differ. It should be noted, however, that sampling coverage of especially Tirol and Salzburg, containing large former glaciated areas, was relatively low.

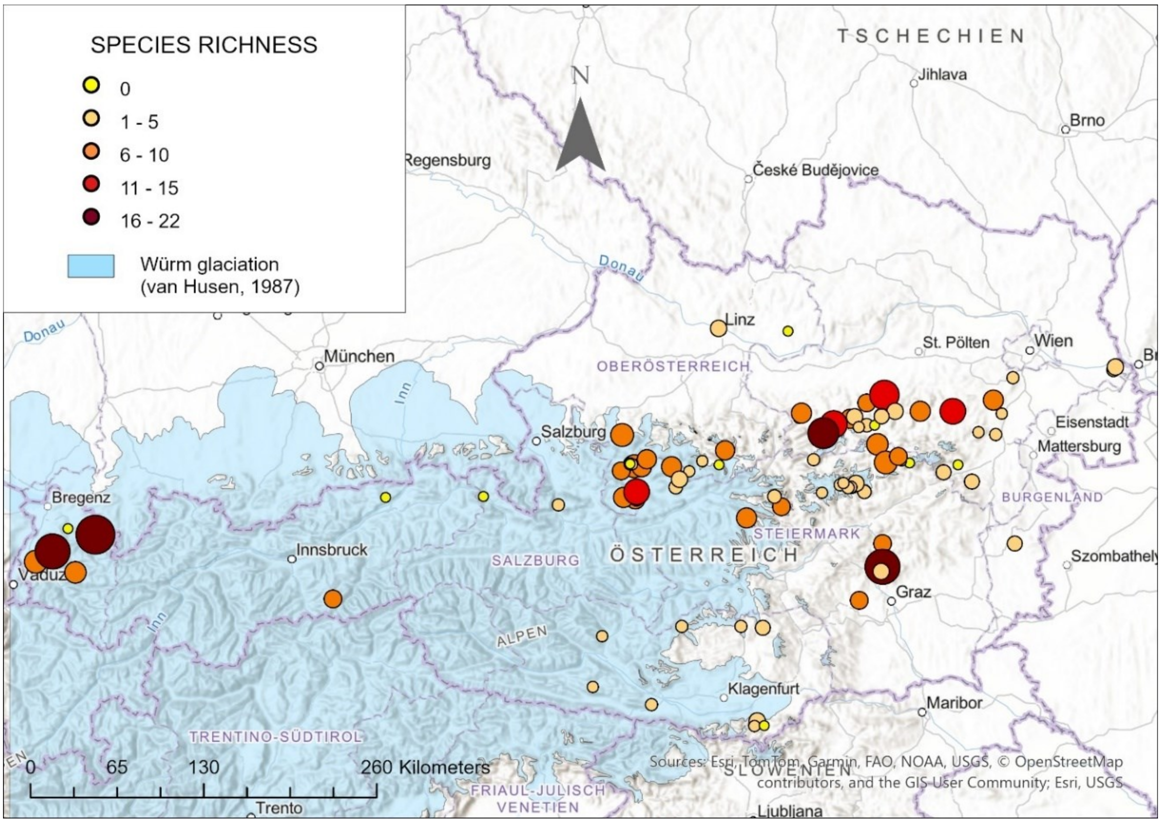

Figure 10: Map depicting Species richness at each sampling site. Species richness includes taxa which were not further processed yet (for example Amphipoda, Turbellaria, Nematoda) and taxa which could not be identified on species level, but remained unique in the dataset (for example Bythiospeum sp.). Area in blue shows extent of the last glacial maximum of the Würm glaciation, shapefile provided by van Husen.

Even though the density of caves is over all considerably lower, mainly due to the dominance of silicate, non-karstic rocks in the central alps, there still exist numerous smaller caves (= category “Kleinhöhle”) that could potentially contribute to a firmer conclusion (Figure 11). Additionally, by only taking the maximum extent as source for classifying sampling sites as glaciated/not glaciated, interpretation could be distorted, since it remains unclear if and how long sampling sites close to the border were in fact glaciated. Finally, it needs to be underlined that sampling was performed by many citizen scientists with various experience and data can be interpreted only qualitatively and with some caution.

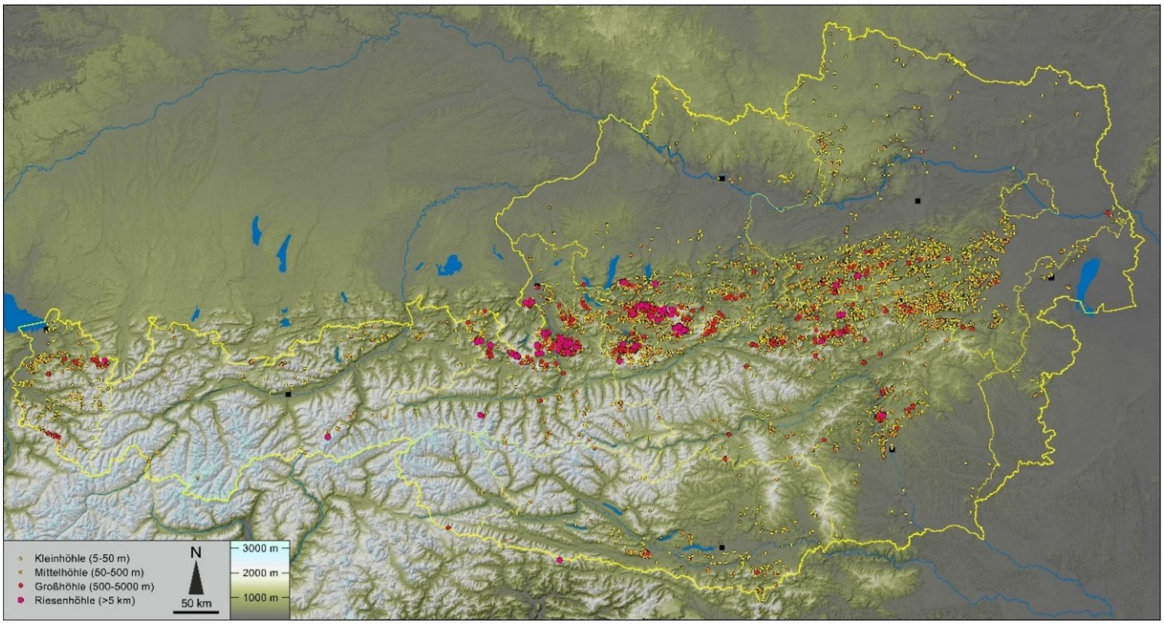

Figure 11: Map of Austria showing all caves registered by the Austrian Speleological Association as of 2016, provided by Lukas Plan.

Alpha diversity only significantly differs between the categories water body connection and water body size. Shannon diversity was found to be higher in connected compared to isolated water bodies, while in medium sized water bodies it was significantly lower compared to small and big sized water bodies. Higher Shannon diversity in connected water bodies could possibly be explained by more abundant or more regular food availability caused by flooding events distributing organic material through the cave system. However, since TOC (total organic carbon) and DOC (dissolved organic carbon) as measures of food availability are not available for this project, this interpretation is speculative. As for water body size the difference could likely be attributed to the highly subjective classification, exclusively based on pictures and not actual measurements of volume, as there is no pattern evident which is consistent with biological reasoning.

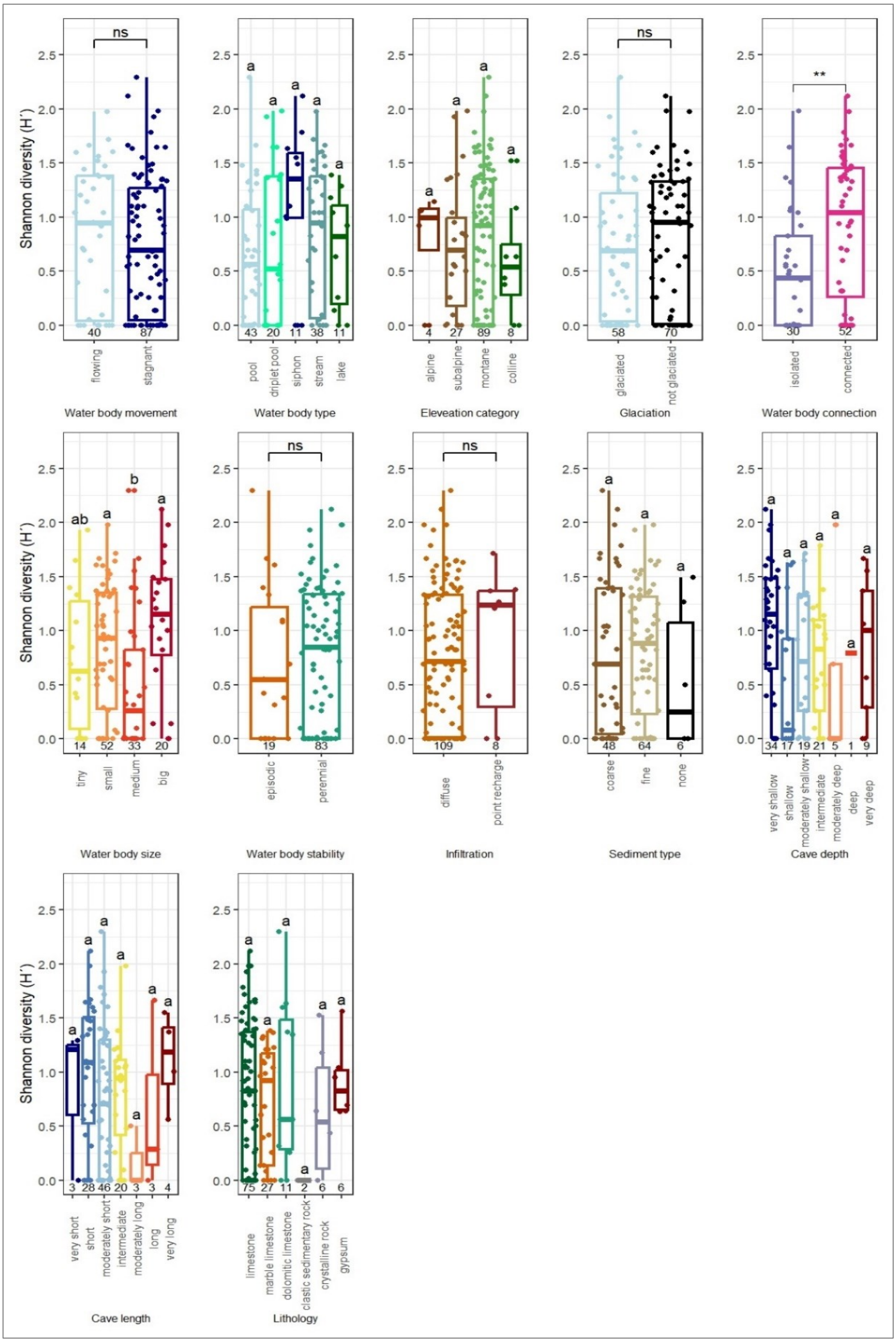

*Figure 12: Shannon diversity (H´) for each habitat category. Differences of H´ among more than two groups were tested using a Kruskal Wallis test and subsequent KW-Dunn post-hoc test. Groups sharing the same letters are not significantly different. Differences between two groups were tested using a Mann-Whitney U test. Significance levels are indicated as ns (not significant), * (p ≤ 0.05), ** (p ≤ 0.01), and *** (p ≤ 0.001). Numbers below the boxplots indicate the sampling sizes (n).*

For the incidence of the Phyla Arthropoda and Nematoda no significant differences between any of the categories of habitat types tested were found. Incidence of Annelida (Figure 14) was significantly higher in samples from water bodies classified as flowing and connected. For water body type and water body size there is an overall significance, however, post hoc KW-Dunn test revealed no significant differences between the individual groups tested. Incidence of the Phylum Mollusca was significantly higher in samples classified as not being glaciated during the last ice age. Out of 58 samples originating from locations categorized as “glaciated”, only two contained Mollusca, i.e. the caves Elmhöhlensystem and Hochlecken-Großhöhle, both located towards the eastern edge of the last glacial maximum. Incidence of Mollusca was also significantly higher in connected water bodies and the category Infiltration type “point recharge”. “Point recharge” and “diffuse recharge” are, however, considerably uneven in sampling sizes (point recharge: n = 8 vs. diffuse: n = 110), which could lead to the significance being biased. The post hoc KW-Dunn test on water body sizes revealed a significant difference between “big” and “small”. Incidence of Cyclopoida (Figure 13) was significantly higher in formerly not glaciated areas and connected water bodies. Post hoc KW-Dunn tests show significantly higher incidences in the water body types “lake” and “siphon” compared to “driplet pool”, “pool” and “stream”, as well as significantly higher incidences in big sized water bodies and montane sampling sites compared to subalpine. However, the category elevation has the same issue of highly uneven sampling sizes and should therefore not be considered further. For the group of Harpacticoida, there is a significantly higher incidence in samples classified as “flowing”. Again, it should be noted that the category “stagnant water body” has more than double the amount of samples than the category “flowing water body”. In conclusion, the category water body connection consistently re-appears with significant results (PCoA, Shannon diversity, Incidence) while also having somewhat comparable sampling sizes. It can be suggested that this category has the highest potential for being biologically relevant for stygofauna. The categories water body type, water body size, water body movement, elevation and glaciation also seem promising, but should be investigated with more evenly distributed sampling sizes in order to be meaningfully interpreted.

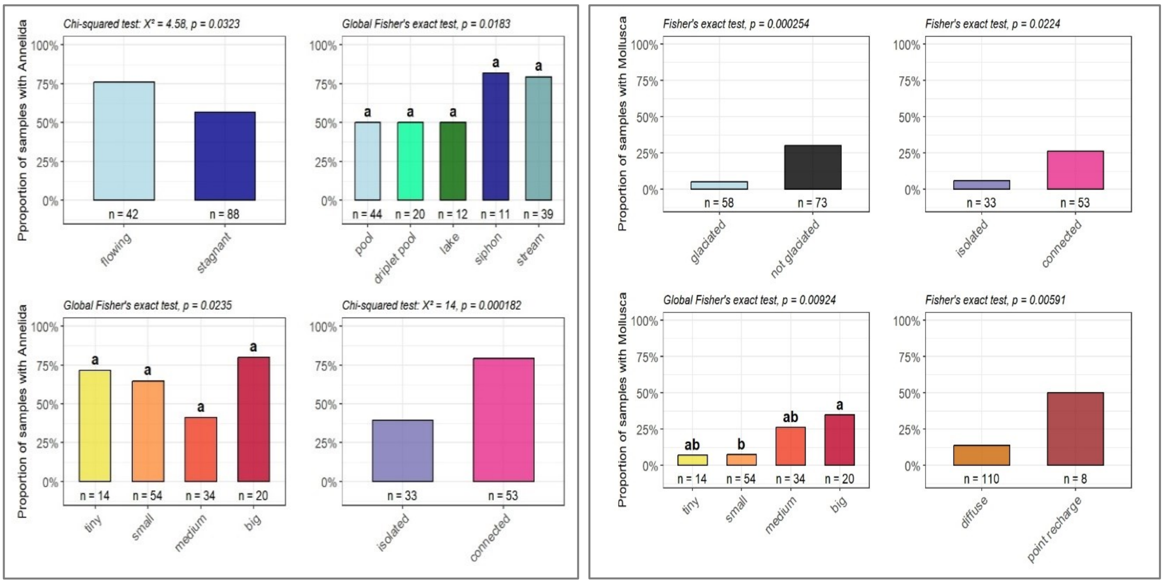

Figure 14: Barplots showing the proportion of samples in percent (%) with the taxonomic groups Annelida and Mollusca and grouping factors on the x-axis. Differences in incidence between the grouping factors were tested based on contingency tables with Fisher´s exact test and subsequent pairwise Fisher tests (Holm corrected p) in cases of expected cell frequencies <5, letters indicating significance. For testing in cases of cell frequencies >5 Chi-squared test was used.

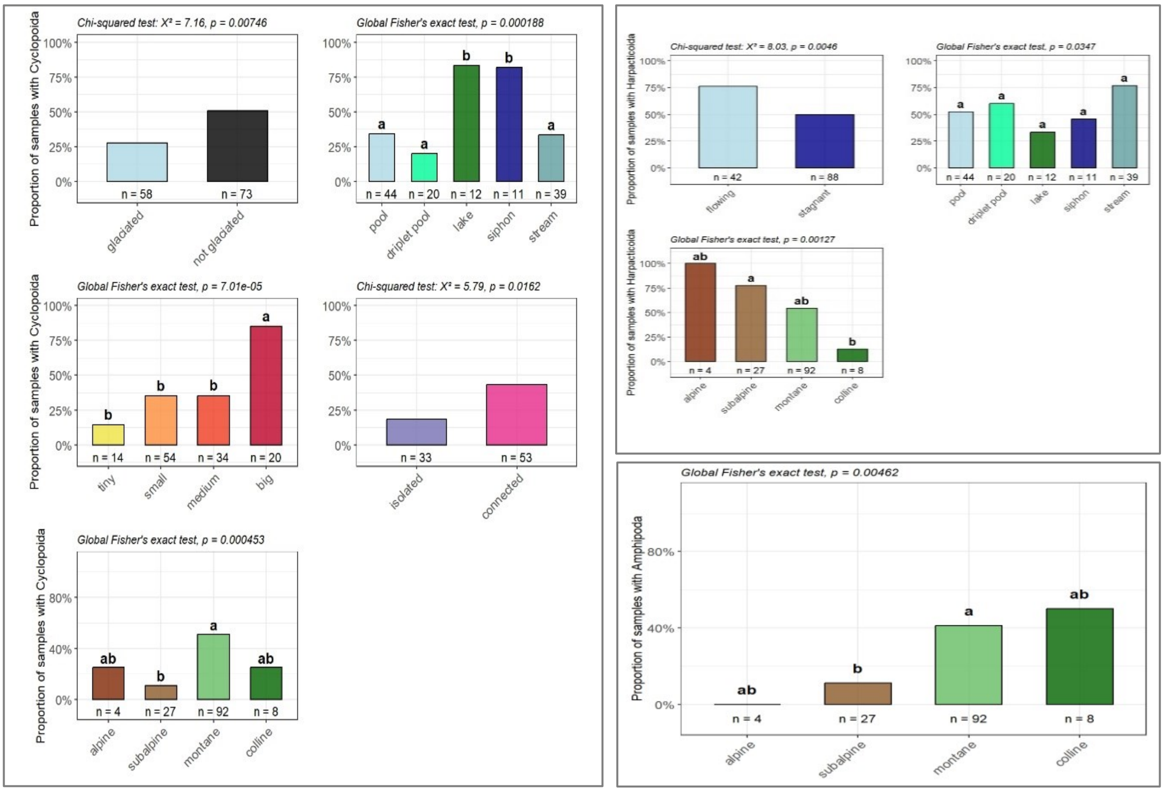

Figure 13: Barplots showing the proportion of samples in percent (%) with the taxonomic groups Cyclopoida, Harpacticoida and Amphipoda and grouping factors on the x-axis. Differences in incidence between the grouping factors were tested based on contingency tables with Fisher´s exact test and subsequent pairwise Fisher tests (Holm corrected p) in cases of expected cell frequencies <5, letters indicating significance. For testing in cases of cell frequencies >5 Chi-squared test was used.

3.2 Comparison of Historical and Recent Data

As a result of this project 7 species (2 Harpacticoida, 2 Cyclopoida, 1 Oligochaet, 2 Aelosomatidae) were recorded in Austria for the first time.

The Harpacticoid (Copepoda) *Maraenobiotus brucei brucei* (Table 4) is a species with holarctic distribution (Janetzky et al., 1996) with records from groundwater in northern Germany (Noodt, 1952). First findings in Austria are from Schneckenlochhöhle (Vbg) and Spannagelhöhle (T). *Elaphoidella charon* was considered an endemic species of the Slovenian Dinaric Karst (Mori & Brancelj, 2008). First findings in Austria are the caves DaVinci-Höhle and Koppenbrüllerhöhle, both located in the Northern Calcereous Alps of upper Austria, but in different alpine Karst massifs: Dachstein (Koppenbrüllerhöhle) and Höllengebirge (DaVinci-Höhle). Out of 12 historic records only one species, *Bryocamptus echinatus,* was re-discovered in the cave Falkensteinhöhle. The historically recorded *Elaphoidella plesai* is the only species which was neither re-discovered in its historic location nor in any of the recent samples. The endemic species *Elaphoidella proserpina* was last recorded by Löffler in 1965, in samples from Karlsgraben, Schneealpe (Stmk) (Löffler & Neuhuber, 1970). It has previously also been recorded in the caves Mausrodlhöhle, Brunnenstube (Chappuis, 1934) and Wilhelminenhöhle (Löffler & Neuhuber, 1970). Although it was not found again in the two former caves during the citizen science project, there are several new records in 6 other caves. Specimens of 13 caves from the genus *Elaphoidella* presumably represent a new species for science (*Elaphoidella n.sp. 1*). Two other presumably new species were found in the caves Lurgrotte (Elaphoidella n.sp. 2) and Hofertalschacht (Elaphoidella n.sp. 3). Overall, 7 stygobiont and 8 stygophile species were found within the group of Harpacticoida.

Two Cyclopoid species (Copepoda), *Megacyclops brachypus* and *Graeteriella boui* (Table 5) were exclusively known from southern (Dussart, 1969; Einsle, 1993) and southeastern (Einsle, 1993) caves of France. *M. brachypus* was recorded in 5 Austrian caves and *G. boui* in the cave Ötschertropfsteinhöhle. None of the 13 historic records were re-discovered in the respective caves, but otherwise in several new locations. Only *Diacyclops bisetosus*, historically recorded in the cave Lurgrotte was not found at all during the recent sampling survey. Christian and

Spötl (2010) mention *Diacyclops clandestinus* and *Diacyclops languidus maisi* in the cave Lurgrotte referring to records from Plesa & Buzilă (1998), however, this seems to be unpublished data, as a full citation is missing in the literature references. Hence, it was not included in Table 5. Overall, 9 stygobiont and 2 stygophile species were found within the group of Cyclopoida.

The Oligochaet species (Table 11, Table 12) *Parvidrilus spelaeus* was described from caves in Italy and Slovenia (Martinez-Ansemil, 2002). The new record is from the drainage tunnel Wasserleitungsstollen in lower Austria (NÖ, Table 12). *Pristina sima* is known from the mediterranean, as well as Japan, the Nearctic and Neotropis (Timm, 2009; Timm & Martin, 2019), was first recorded in Austria from the Lobau and the Danube Floodplain National Park (Griebler et al. 2023) and was now recorded for the first time in an Austrian cave, Klafflingbrunnen in lower Austria (NÖ, Table 12). None of the 23 historic records of Oligochaeta were found again in the historic locations and only 4 of those records were found in recent samples. Overall, 2 stygobiont and 8 stygophile species were found within the group of Oligochaeta.

In the group of Aphanoneura (Table 13), two new findings for Austria were accomplished. *Aelosoma gertae*, in Europe previously known from the Netherlands (Timm, 2009) was found in three caves with far distances in between – Baschghöhle (Vbg), Lurgrotte (Stmk) and Koppenbrüllerhöhle (OÖ). *Aelosoma travancorense* is a species with cosmopolitan distribution (Timm, 2009), now found for the first time in a cave in lower Austria (NÖ, Burianhöhle). The only historic record of the group Aphanoneura, *Aelosoma hemprichii*, was neither found in the historic location Lurgrotte (Neuherz, 1974), nor in any of the other caves. The only polychaet species *Troglochaetus beranecki* was found in 5 caves.

The group Ostracoda (Table 6) yielded 2 historic records out of 5, which were found again in the historic locations, i.e. *Pseudocandona albicans* in the cave Falkensteinhöhle and another record in Rettenbachhöhle was an undetermined Ostracoda. *Schellencandona belgica*, was first recorded in groundwaters of Vienna, likewise in a sub-project of Stygofauna austriaca (Heat below the City, Englisch et al., 2026) and the second time recorded within the citizen science project in the cave Wilhelminenhöhle. In total, 4 stygobiont and 4 stygophile species were found within the group of Ostracoda.

Historic records for the group Eumalacostraca (Table 7), in particular in the group of Amphipoda and the species *Niphargus tatrensis,* are highly unreliable because they refer to a species complex which underwent numerous taxonomic revisions. Fišer et al. (2010) re-evaluated old museum samples based on morphological characters and ecological data, hypothesizing that three species (*N. tatrensis*, *N. aggtelekiensis* and *N. scopicauda*) exist in this cryptic species aggregate. Among others, samples from the caves Koppenbrüllerhöhle, Herdengelhöhle, Wilhelminenhöhle, Lurgrotte and Ötscher Höhle (most likely referring to Ötschertropfsteinhöhle, 1824/10) were presumably assigned to *N. aggtelekiensis*.

In a more recent attempt to shed light on this issue, Stoch et al. (2020) sampled type localities of all described species in the *N. tatrensis* species complex and conducted molecular analyses to re-evluate its phylogenetic relationships, concluding that three species (*N. lurensis*, *N. salzburgensis* and *N. moogi*) occur in Austria. Most historic Austrian records attributed to *N. tatrensis* are likely referable to *N. salzburgensis*, although individual historical museum specimens were not genetically re-examined. Further historical records include *N. thienemanni*, *N. strouhali* and *N. aquliex*. Samples from the citizen science project containing Amphipoda were sent to Cene Fišer at the University of Ljubljana, Slovenia, and currently await DNA sequencing.

The only historic record of Bathynellacea is from the cave Hermannshöhle (Vornatscher, 1948). The catalogue of the extant cave animals of Austria (Strouhal & Vornatscher, 1975) lists this record as *Bathynella natans*, however, Christian (1997) refers to this classification to be questionable. Two samples contained Bathynellacea, 7 samples contained Bathynellidae and 1 sample contained Parabathynellidae (Table 7). Those specimens are not further processed yet and still await species identification.

In the group of Isopoda two species, i.e. *Proasellus strouhali* and *Proasellus cavaticus,* were identified. 1 historic record of *Proasellus strouhali* was found again in the cave Mausrodlhöhle and two historic records of *Proasellus cavaticus* were found again in the caves Baschghöhle and Schneckenloch (Table 7).

Historic cave records of the group Acari (Table 8) document almost exclusively terrestrial species. The only record of an aquatic, stygobiont mite is from Hermannshöhle; i.e. *Soldanellonyx chappuisi* (Christian, 1997), which was not found again in this location, but in several other caves. Besides *S. chappuisi,* the stygophile *Halacarellus fontinalis* and the stygobiont *Schwiebea cavernicola* were found.

None of the 20 historic records of Mollusca (Table 9, Table 10) were found again in the historic locations, 13 of those records were not found in any of the recent samples. This result might be attributed to the difficult, sometimes impossible species identification of juvenile or damaged individuals, since traits of shell morphology are oftentimes crucial if no live material is available for DNA barcoding. Many of the historic as well as recent records are uncertain species identifications or only determined to genus level. For example, *Belgrandiella styriaca* was historically recorded in the cave Bärenloch (Stojaspal, 1978), whereas recent findings of a high number of individuals in the same location could only be identified as *Belgrandiella cf. styriaca*. 3 out of 13 recently found Mollusc taxa (Gastropoda and Bivalvia) were certain species identifications, *Alzoniella hartwigschuetti* (Gastropoda, stygobiont), *Hauffenia wienerwaldensis* (Gastropoda, stygobiont) and *Euglesa casertana* (Bivalvia, stygoxen). *Alzoniella hartwigschuetti* is an endemic species to Austria (Reischütz & Reischütz, 2009). For the first time live material of this species was found, which enabled colleagues from the Natural History Museum of Vienna (M. Duda, L. Kruckenhauser, O. Macek, I. Fischer) to successfully generate the first DNA Barcodes from 4 individuals collected in the caves Schachernhöhle, Trockenes Loch and Klafflingbrunnen.

Other taxonomic groups which were recorded in this project are Nematoda and Rotifera (Table 14) and Tardigrada and Platyhelmintes (Table 15). Historic records of these groups did not yield any matches with recent data, however Platyhelminthes still await species identification and species of the group Nematoda, while already determined, results arrived too late to still be considered in this thesis.

In conlusion, the majority of the recent samples represent new findings of aquatic fauna in caves, as 74 caves completely lack historic records. Very few historic records were found again in the same locations, but this is potentially rather an issue related to the sampling effort. Most locations were only sampled once. As already illustrated with the species accumulation curves (Figure 6), sampling especially in lower Austria, was far from exhaustive, which gives reason to suspect that species in those historic locations may not have disappeared but are only rare. In fact, there is far more stygobiont fauna to uncover in future research initiatives.

Table 4: Recent (R) abundance and Historic (H) occurence of Harpacticoida found in each cave. StyB = stygobiont, StyP = stygophile, StyX = stygoxen. X´s mark findings in historic literature, the number represents literature citations. Species names represent the current state of research, deviations in original publications are noted next to the citations. 1 = Neuherz, 1974; 3 = Löffler & Neuhuber, 1970: Echinocamptus pilosus; 6 = Vornatscher, 1943; 8 = Strouhal, 1954: Echinocamptus luenensis; 9 = Christian, 1997; 10 = Franz, 1954; 12 = Chappuis, 1934: Echinocamptus hoferi; 13 = Pesce & Galassi, 1994; 27 = Haseke & Weigand, 2000.

Cave name	Cave registry number	Province	*Ameiridae gen. sp.*	***Attheyella crassa* (Sars G.O., 1863) StyP**	***Attheyella crassa* (Sars G.O., 1863) StyP**	***Attheyella wierzejskii* (Mrazek, 1893) StyP**	***Bryocamptus echinatus* (Mrazek, 1893) StyP**	***Bryocamptus echinatus* (Mrazek, 1893) StyP**	***Bryocamptus hoferi* (Van Douwe, 1908) StyP**	***Bryocamptus hoferi* (Van Douwe, 1908) StyP**	***Bryocamptus pygmaeus* (Sars G.O., 1863) StyP**	***Bryocamptus zschokkei* (Schmeil, 1893) StyP**	***Bryocamptus zschokkei* (Schmeil, 1893) StyP**	*Bryocamptus weberi* (Kessler, 1914) StyX	*Bryocamptus sp.*	*Canthocamptidae gen. sp.*	***Elaphoidella n. sp. 1* StyB**	***Elaphoidella n. sp. 2* StyB**	***Elaphoidella n. sp. 3* StyB**	***Elaphoidella charon* Chappuis, 1936 StyB**	***Elaphoidella cf. charon* Chappuis, 1936 StyB**	***Elaphoidella phreatica* (Chappuis, 1925) StyB**	***Elaphoidella cf. phreatica* (Chappuis, 1925) StyB**	***Elaphoidella plesai* Pesce & Galassi, 1994 StyB**	***Elaphoidella plesai* Pesce & Galassi, 1994 StyB**	***Elaphoidella proserpina* Chappuis, 1934 StyB**	***Elaphoidella proserpina* Chappuis, 1934 StyB**	***Epactophanes richardi* Mrázek, 1893 StyP**	***Maraenobiotus brucei brucei* (Richard, 1898) StyP**	***Pilocamptus pilosus* (Douwe, 1910) StyB**	***Pilocamptus pilosus* (Douwe, 1910) StyB**	*Pesceus schmeili* (Mrázek, 1893) StyX	*Harpacticoida fam. gen. sp.*	*Harpacticoida fam. gen. sp.*	Copepoditen	**sum**
Phylum			ARTHROPODA																																	
Class			Copepoda																																	
Order			Harpacticoida																																	
Family			Ameiridae	Canthocamptidae																																
			R	H	R	R	H	R	H	R	R	H	R	R	R	R	R	R	R	R	R	R	R	H	R	H	R	R	R	H	R	R	H	R	R	
Altenbergschacht	3925/6	K																																	1	1
Barbarastollen	-	K								1																										1
Baschghöhle	1112/1	Vbg						134																											6	140
Bärenlucke	1836/180	NÖ								4																										4
Bullenhöhle	1622/57	Stmk															3																		2	5
Burianhöhle	1824/1	NÖ						5					2																						1	8
Dachstein-Mammuthöhle	1547/9	OÖ																					7												3	10
Dachstein-Rieseneishöhle	1547/17	OÖ																																1		1
DaVinci-Höhle	1615/37	OÖ						103												7		5												4	6	125
Eisensteinhöhle	1864/1	NÖ																																	1	1
Eisgrabenschacht	1745/50	Stmk																																84		84
Eisriesenwelt	1511/24	Sbg															4																		1	5
Elmhöhlensystem	1624/38	Stmk						52		48					3		8																	52	39	202
Falkensteinhöhle	2861/3	NÖ		X[6]			X[8]	24																											1	25
Feistringgrabenhöhle	1745/7	Stmk																																	2	2
Frauenmauer-Langsteinhöhle	1742/1	Stmk																									4								1	5
Freschenhöhle	1111/7	Vbg	2					1		54			1															1						1	16	76
Hammerbach-Ursprung	2836/34	Stmk			2											1																				3
Herdengelhöhle	1823/4	NÖ								4				55			1																			60
Hermannshöhle	2871/7	NÖ					X[9]					X[10]																						2		2
Hinterbergerbach-Schwinde	6844/14	OÖ																																31		31
Hirtlatzhöhle	1546/7	OÖ								2																										2
Hirschgrubenhöhle	1744/450	Stmk																									8								1	9
Hochkarschacht	1814/5	NÖ																																21		21
Hochlecken-Großhöhle	1567/29	OÖ												14																					9	23
Hofertalschacht	1745/85	Stmk																	8																15	23
Hohlensteinhöhle	1831/1	Stmk						69					8				8																		12	97
Kammschacht	1867/8	NÖ																														1			2	3
Klafflingbrunnen	1837/18	NÖ			1			35								1	2																			39
Komfort Schluchthöhle	1745/95	Stmk																									26									26
Konradhöhle	2644/1	Stmk						18																											33	51
Koppenbrüllerhöhle	1549/1	OÖ						3												1	1														2	7
Leitenhöhle	2783/1	Stmk											23	35																					12	70
Lurgrotte	2836/1	Stmk					X[1]	4				X[1]			2	1		1						X[13]			1			X[3]					4	13
Mailoch	1722/5	Stmk								4																									1	5
Mausrodlhöhle	1824/9	NÖ							X[12]								10									X[12]									2	12
Miralucke	1867/8	NÖ															1																			1
Paulinenhöhle	1837/11	NÖ			3																															3
Obere Schißerbachhöhle	1616/7	OÖ																									1									1
Rettenbachhöhle	1651/1	OÖ																															X[27]			0
Schachernhöhle	1866/9	NÖ						1																										1		2
Schneckenlochhöhle	1126/1	Vbg						265		123				36															4						20	448
Schönberghöhlensystem	1626/300	OÖ								3					3																				9	15
Spannagelhöhle	2515/1	T																											12						2	14
Steinbockschacht	1744/599	Stmk						1																											1	2
Stiller-Graben-Stollen	K2822/2	Bgl																									11								2	13
Stollen Flattnitz	2717/	K				95																													11	106
Taubenloch	1816/6	NÖ																																21		21
Tonion-Höhlensystem	1762/1	NÖ														3	5																		1	9
Totes Weib	1851/10	Stmk								3							1																	1		5
Trockenes Loch	1836/34	NÖ															2																			2
Trübbachhöhle	1211/4	Vbg								2	1					3					1														2	9
Tuffsteinhöhle	1827/19	NÖ				200		98																							100					398
Türkenbrunnen	K1911/10	NÖ														2																2				4
Turnerbundhöhle	1863/22	NÖ																																1		1
Wildbaderhöhle	1625/150	Stmk															40																		6	46
Wildemannloch	2836/27	Stmk												9																					1	10
Wilhelminenhöhle	1823/7	NÖ						33		13							86									X[3]									51	183
Wasserleitungsstollen	K2921/9	NÖ						3																											1	4
sum			2		6	295		849		261	1		34	149	8	11	171	1	8	8	2	5	7		0		51	1	16		100	3		220	280	2489

Table 5: Recent (R) abundance and Historic (H) occurence of Cyclopoida found in each cave. StyB = stygobiont, StyP = stygophile, StyX = stygoxen. X´s mark findings in historic literature, the number represents literature citations. Species names represent the current state of research, deviations in original publications are noted next to the citations. 1 = Neuherz, 1974: Cyclops viridis; 6 = Vornatscher, 1943: Cyclops fimbriatus; 9 = Christian, 1997; 11 = Vornatscher, 1954; 12 = Chappuis, 1934: Cyclops viridis, Diacyclops languidoides f. gotica; 14 = Weigand & Trockner 1996; 43 = Stoch & Pospisil, 2000.

Phylum			ARTHROPODA																																			
Class			Copepoda																																			
Order			Cyclopoida																																			
Family			Cyclopidae																																			
Cave name	Cave registry number	Province	*Acanthocyclops vernalis* (Fischer, 1853) StyX	***Acanthocyclops kieferi* (Chappuis, 1925) StyB**	*Acanthocyclops robustus* (Sars G.O., 1863) StyX	*Acanthocyclops sp.*	*Cyclopidae gen. sp.*	*Cyclopinae gen. sp.*	***Diacyclops bisetosus* (Rehberg, 1880) StyP**	***Diacyclops bisetosus* (Rehberg, 1880) StyP**	*Diacyclops cf. charon* (Kiefer, 1931)	***Diacyclops cohabitatus* Monchenko 1980 StyB**	***Diacyclops cohabitatus* Monchenko 1980 StyB**	***Diacyclops clandestinus* (Kiefer, 1926) StyB**	***Diacyclops clandestinus* (Kiefer, 1926) StyB**	***Diacyclops languidoides* (Lilljeborg, 1901) StyB**	*Diacyclops languidus* (Sars G.O., 1863) StyX	*Diacyclops languidus / languidoides*	*Diacyclops sp.*	*Eucyclopinae gen. sp.*	***Eucyclops graeteri* (Chappuis, 1927) StyB**	***Eucyclops serrulatus* (Fischer, 1851) StyP**	***Eucyclops serrulatus* (Fischer, 1851) StyP**	***Graeteriella sp.* StyB**	***Graeteriella boui* Lescher-Moutoué, 1974 StyB**	***Graeteriella boui* Lescher-Moutoué, 1974 StyB**	***Graeteriella unisetigera* (Graeter, 1908) StyB**	***Megacyclops brachypus* Kiefer, 1955 StyB**	*Megacyclops viridis* (Jurine, 1820) StyX	*Megacyclops viridis* (Jurine, 1820) StyX	*Paracyclops sp.*	***Paracyclops fimbriatus* (Fischer, 1853) StyP**	***Paracyclops fimbriatus* (Fischer, 1853) StyP**	***Paracyclops imminutus* Kiefer, 1929 StyB**	***Speocyclops cerberus* (Chappuis, 1934) StyB**	*Cyclopoida fam. gen. sp.*	Copepoditen	**sum**
			R	R	R	R	R	R	H	R	R	H	R	H	R	R	R	H	R	R	R	H	R	R	H	R	R	R	H	R	R	H	R	R	R	R	R	
Altenbergschacht	3925/6	K	1																																		2	3
Amanda Unterbau	K3925	K	1													32																						33
Bärenloch	2839/2	Stmk														12											1										6	19
Bärenlucke	1836/180	NÖ																																			1	1
Baschghöhle	1112/1	Vbg																					1										3				4	8
Burianhöhle	1824/1	NÖ																																	4			4
DaVinci Höhle	1615/37	OÖ	1													2			1															1		3	3	11
Falkensteinhöhle	2861/3	NÖ																														X[6]						0
Feistringgrabenhöhle	1745/7	Stmk																																			1	1
Fladung Hochobir	-	K	30																																		200	230
Grillenbergwerk	K1854/1	NÖ																																		2		2
Hammerbach-Ursprung	2836/34	Stmk																																			1	1
Herdengelhöhle	1823/4	NÖ																		1													7		8		19	35
Hermannshöhle	2871/7	NÖ																											X[9]			X[11]						0
Hinterbergerbach-Schwinde	6844/14	OÖ																																		4		4
Hirlatzhöhle	1546/7	OÖ														6																					5	11
Höllenloch	1612/1	OÖ														1																					1	2
Klafflingbrunnen	1837/18	NÖ																												1							6	7
Klausengrube	-	K																	1																			1
Koppenbrüllerhöhle	1549/1	OÖ														8					1																2	11
Leitenhöhle	2783/1	Stmk																																	5		10	15
Lurgrotte	2836/1	Stmk					1		X[1]					X[44]								X[1]						16	X[1]			X[1]			4	1	16	38
Mausrodlhöhle	1824/9	NÖ										X[12,43]																8	X[12]				1	5			97	111
Miralucke	1867/8	NÖ						2								187														2	2			2			43	238
Naglsteghöhle	1626/5	OÖ														1																					1	2
Ötschertropfsteinhöhle	1824/10	NÖ																						2		34												36
Paulinenhöhle	1837/11	NÖ																						2			63								7		2	74
Pießling Ursprung	1636/3	OÖ																				X[14]										X[14]						0
Rettenbachhöhle	1651/1	OÖ				1										34		X[27]																			5	40
Rudolfstollen	K6843/2	OÖ																									1											1
Schachernhöhle	1866/9	NÖ														1																			1		1	3
Schneckenloch	1126/1	Vbg	9	1	46						1																						4				150	211
Schwabenreithhöhle	1823/32	NÖ																																		11		11
Seegrotte	K1915/1	NÖ																										3						6			5	14
Spannagelhöhle	2515/1	T	2																																		142	144
Stiller-Graben-Stollen	K2822/2	Bgl																					6										5				5	16
Stollen Flattnitz	2717/	K	3																1				3														20	27
Tonion-Höhlensystem	1762/1	NÖ																																			1	1
Trockenes Loch	1836/34	NÖ																						1													1	2
Trübbachhöhle	1211/4	Vbg														1	1		1	1																	2	6
Tuffsteinhöhle	1827/19	NÖ																					2											10			1	13
Türkenbrunnen	K1911/10	NÖ																										2					59	1			100	162
Wildemannloch	2836/27	Stmk																									5										5	10
Wilhelminenhöhle	1823/7	NÖ																															3	42			62	107
sum			47	1	46	1	1	2		0	1		0		0	285	1		4	2	1		12	5		34	70	29		3	2		82	67	29	21	920	1666

Table 6: Recent (R) abundance and Historic (H) occurence of Ostracoda found in each cave. StyB = stygobiont, StyP = stygophile, StyX = stygoxen. X´s mark findings in historic literature, the number represents literature citations. Species names represent the current state of research, deviations in original publications are noted next to the citations. 1 = Neuherz, 1974: Cypridopsis subterranea; 4 = Vornatscher, 1955; 6 = Vornatscher, 1943: Candona parallela; 11 = Vornatscher, 1954; 27 = Haseke & Weigand, 2000.

Phylum			ARTHROPODA																		
Class			Ostracoda																		
Superfamily			Cypridoidea																		
Family			Cyprididae					Candonidae													
Cave name	Cave registry number	Province	*Cypris pubera* Müller 1776 StyX (R)	***Cavernocypris subterranea* (Wolf, 1920) StyP** (H)	***Cavernocypris subterranea* (Wolf, 1920) StyP** (R)	***Herpetocypris reptans* (Baird, 1835) StyP** (R)	***Psychrodromus fontinalis* (Wolf, 1919) StyP** (R)	*Candoninae gen. sp.* (R)	*Candona sp.* (H)	*Candona sp.* (R)	***Cryptocandona kieferi kieferi* (Klie, 1938) StyB** (R)	***Cryptocandona kieferi danubialis* Namiotko, Danielopol & Marmonier, 2005 StyB** (R)	*Fabaeformiscandona fabaeformis* (Fischer, 1851) StyX (R)	***Mixtacandona laisi* (Klie, 1938) StyB** (R)	***Pseudocandona albicans* (Brady, 1864) StyP** (H)	***Pseudocandona albicans* (Brady, 1864) StyP** (R)	***Schellencandona belgica* (Klie, 1937) StyB** (R)	*Schellencandona sp.* (R)	*Cypridoidea fam. gen. sp.* (R)	*Ostracoda fam. gen. sp.* (H)	*Ostracoda fam. gen. sp.* (R)	**sum**
Altenbergschacht	3925/6	K			10														9		7	26
Bärenloch	2839/2	Stmk																			5	5
Bärenlucke	1836/180	NÖ			2																	2
Baschghöhle	1112/1	Vbg																	1		11	12
DaVinci Höhle	1615/37	OÖ			25														2			27
Falkensteinhöhle	2861/3	NÖ													X[6]	1						1
Herdengelhöhle	1823/4	NÖ						1										2	10		2	15
Hermannshöhle	2871/7	NÖ							X[11]													0
Hirlatzhöhle	1546/7	OÖ			3														4		4	11
Hirschfallhöhle	1823/5	NÖ																			1	1
Hohlensteinhöhle	1831/1	Stmk			10														26		2	38
Klafflingbrunnen	1837/18	NÖ															1		1			2
Koppenbrüllerhöhle	1549/1	OÖ			3														1			4
Leitenhöhle	2783/1	Stmk																			1	1
Lurgrotte	2836/1	Stmk	1	X[1]		1			X[4]													2
Mausrodlhöhle	1824/9	NÖ																	1		2	3
Reichenwaldhöhle	1826/2	NÖ																			1	1
Rettenbachhöhle	1651/1	OÖ																		X[27]	1	1
Schachernhöhle	1866/9	NÖ																			8	8
Schneckenloch	1126/1	Vbg			130									3					40		1	174
Stadelalm-Eiskluft	1713/22	Stmk			1														1			2
Stiller-Graben-Stollen	K2822/2	Bgl											1									1
Stollen Flattnitz	2717/	K																			1	1
Trockenes Loch	1836/34	NÖ																			3	3
Trübbachhöhle	1211/4	Vbg									1											1
Tuffsteinhöhle	1827/19	NÖ					8														1	9
Türkenbrunnen	K1911/10	NÖ															13		3		2	18
Wilhelminenhöhle	1823/7	NÖ															4		23		6	33
Wasserleitungsstollen	K2921/9	NÖ										2							1			3
sum			1		184	1	8	1		0	1	2	1	3		1	18	2	123		59	405

Table 7: Recent (R) abundance and Historic (H) occurence of Eumalacostraca found in each cave. StyB = stygobiont, StyX = stygoxen. X´s mark findings in historic literature, the number represents literature citations. Species names represent the current state of research, deviations in original publications are noted next to the citations. Historic classifications of Niphargus tatrensis/aggtelekienses are outdated (Stoch et al. 2020). 2 = Cerny, 1928: Rivulogammarus fossarum; 5 = Janetschek, 1952: Asellus cavaticus, Niphargus foreli thienemanni; 7 = Strouhal & Vornatscher, 1975; 12 = Chappuis, 1934; 17 = Breuss, 2004; 19 = Seemann, 1971; 20 = Vornatscher, 1974; 21 = Strouhal, 1940; 22 = Brehm, 1956; 23 = Vornatscher, 1951; 24 = Waldner, 1937; 25 = Schellenberg, 1935; 26 = Trimmel, 1974; 27 = Haseke & Weigand, 2000; 29 = Trimmel, 1962; 30 = Strouhal, 1939; 31 = Neuherz, 1974; 32 = Waldner, 1932; 33 = Strouhal, 1958: Asellus (Proasellus) cavaticus strouhali; 38 = Fišer et al., 2010; 39 = Stoch & Christian & Flot, 2020; 40 = Kühnelt, 1962; 41 = Schellenberg, 1935.

Phylum			Arthropoda																							
Subclass			Eumalacostraca																							
Order			Amphipoda												Bathynellacea					Isopoda						
Family			Niphargidae									Gammaridae			Bathynellidae			Parabathynellidae		Asellidae						
Cave name	Cave registry number	Province	*Niphargus sp.* StyB	*Niphargus sp.* StyB	*Niphargus aquilex* Schiødte, 1855 StyB	*Niphargus aggtelekiensis* Dudich, 1932 StyB	*Niphargus lurensis* Schellenberg, 1935 StyB	*Niphargus tatrensis* Wrzesniowsky, 1890 StyB	*Niphargus salzburgensis* Schellenberg, 1935 StyB	*Niphargus strouhali* Schellenberg, 1933 StyB	*Niphargus thienemanni* Schellenberg, 1934 StyB	*Gammarus cf. pulex*	*Gammarus fossarum* Koch, 1836 StyX	*Gammarus sp.*	*Bathynella (natans)* Vejdovksy, 1882 StyB	*Bathynellidae gen. sp.* StyB	*Bathynellidae gen. sp.* StyB	*Parabathynellidae gen. sp.* StyB	*Bathynellacea fam. gen. sp.* StyB	*Proasellus sp.*	*Proasellus sp.*	*Proasellus cavaticus* (Leydig, 1871) StyB	*Proasellus cavaticus* (Leydig, 1871) StyB	*Proasellus strouhali* (Karaman, 1955) StyB	*Proasellus strouhali* (Karaman, 1955) StyB	sum
			H	R	H	H		H		H	H	H	H	H	H	H	R	R	R	H	R	H	R	H	R	
Amanda Unterbau	K3925	K		24																						24
Barbarastollen	-	K		7																						7
Bärenloch	2839/2	Stmk		1																						1
Baschghöhle	1112/1	Vbg	X[17]	2										X[17]								X[17]	8			10
Dachstein-Mammuthöhle	1547/9	OÖ	X[19]	12				X[20]									6		6							24
DaVinci Höhle	1615/37	OÖ		4															2							6
Eggerloch	3742/2	K		14						X[21]																14
Elmhöhlensystem	1624/38	Stmk		1																						1
Fischeralmstollen	-	K		97																						97
Fladung Hochobir	-	K		2																						2
Frauenmauer-Langsteinhöhle	1742/1	Stmk					X[39]		X[41]																	0
Hammerbach-Ursprung	2836/34	Stmk		1																						1
Herdengelhöhle	1823/4	NÖ		3		X[38]		X[22]	X[39]																	3
Hermannshöhle	2871/7	NÖ		1											X[34]		123									124
Hirschfallhöhle	1823/5	NÖ						X[7]																		0
Hochkarschacht	1814/5	NÖ																					1			1
Hochlecken-Großhöhle	1567/29	OÖ															1									1
Hohlensteinhöhle	1831/1	Stmk		1				X[7]																		1
Kammschacht	1867/5	NÖ		1																						1
Klafflingbrunnen	1837/18	NÖ		8																						8
Klausengrube	-	K		10																						10
Koppenbrüllerhöhle	1549/1	OÖ		1		X[38]		X[23]																		1
Kreidelucke	1628/2	OÖ		6				X[23]																		6
Luftschutzstollen Enzesfeld	K1869/1	NÖ		4																						4
Lurgrotte	2836/1	Stmk	X[2]	3	X[40]	X[38]	X[39]	X[2]					X[2]													3
Mausrodlhöhle	1824/9	NÖ	X[12]	6				X[24]									1							X[33]	8	15
Miralucke	1867/8	NÖ		10																						10
Nasses Loch	1836/19	NÖ		1																						1
Ötschertropfsteinhöhle	1824/10	NÖ		2		X[38]		X[25]	X[39]																	2
Reichenwaldhöhle	1826/2	NÖ		1					X[39]																	1
Rettenbachhöhle	1651/1	OÖ	X[26]	5				X[27]												X[27]			2			7
Rudolfstollen	K6843/2	OÖ		2								X[28]														2
Seegrotte	K1915/1	NÖ			X[30]								X[30]													0
Schachernhöhle	1866/9	NÖ		12				X[29]																		12
Schneckenloch	1126/1	Vbg	X[17]	4							X[5]						1					X[5]	2			7
Schönberghöhlensystem	1626/300	OÖ		3																						3
Schwabenreithhöhle	1823/32	NÖ		1																			1			2
Siebenschläferschacht	1745/109	STMK		1																						1
Taubenloch	1816/6	NÖ		2																						2
Trübbachhöhle	1211/4	Vbg															1									1
Wasserleitungsstollen	K2921/9	NÖ		1														1								2
Wildemannloch	2836/27	Stmk		3				X[31]																		3
Wilhelminenhöhle	1823/7	NÖ		4		X[38]		X[32]	X[39]																	4
sum				261													133	1	8		0		14		8	425

Table 8: Recent (R) abundance and Historic (H) occurence of Acari found in each cave. StyB = stygobiont, StyP = stygophile, StyX = stygoxen. X´s mark findings in historic literature, the number represents literature citations. 9 = Christian, 1997; 27 = Haseke & Weigand, 2000.

Phylum			Arthropoda									
Subclass			Acari									
Order			Trombidiformes						Sarcoptiformes			
Family			Halacaridae				Arrenuridae		Acaridae			
Cave name	Cave registry number	Province	***Halacarellus fontinalis* Bartsch & Gerecke, 2011 StyP**	***Soldanellonyx chappuisi* Walter, 1917 StyB**	***Soldanellonyx chappuisi* Walter, 1917 StyB**	*Troglohalacarus dentipes* Viets 1937 StyX	*Arrenurus sp.*	*Trombidiformes fam. gen. sp.*	***Schwiebea cavernicola* Vitzthum, 1932 StyB**	*Acari fam. gen. sp.*	*Acari fam. gen. sp.*	**sum**
			R	H	R	R	R	R	R	H	R	
Altenbergschacht	3925/6	K			5							5
Bärenlucke	1836/180	NÖ	4		1							5
Dachstein-Rieseneishöhle	1547/17	OÖ			1			2				3
DaVinci Höhle	1615/37	OÖ									1	1
Feistringgrabenhöhle	1745/7	Stmk	1									1
Freschenhöhle	1111/7	Vbg			3		2	1				6
Güntherhöhle	2921/2	NÖ									1	1
Herdengelhöhle	1823/4	NÖ			21		1	2				24
Hermannshöhle	2871/7	NÖ		X[9]								0
Hochlecken-Großhöhle	1567/29	OÖ			40							40
Hohlensteinhöhle	1831/1	Stmk	4									4
Klaffingbrunnen	1837/18	NÖ	6			16						22
Lurgrotte	2836/1	Stmk	11		1							12
Nasses Loch	1836/19	NÖ	1									1
Obere Schießerbachhöhle	1616/7	OÖ						1				1
Rettenbachhöhle	1651/1	OÖ								X[27]		0
Rudolfstollen	K6843/2	OÖ			1			7				8
Schneckenloch	1126/1	Vbg			115		2					117
Tonion-Höhlensystem	1762/1	NÖ			4							4
Türkenbrunnen	K1911/10	NÖ							6			6
Wildbaderhöhle	1625/150	Stmk						1				1
Wildemannloch	2836/27	Stmk	5									5
Wilhelminenhöhle	1823/7	NÖ	7		29			1				37
sum			39		221	16	5	15	6		2	304

Table 9: Recent (R) abundance and Historic (H) occurence of Mollusca found in each cave. StyB = stygobiont, StyP = stygophile. X´s mark findings in historic literature, the number represents literature citations. Species names represent the current state of research, deviations in original publications are noted next to the citations. 1 = Neuherz, 1974; 14 = Weigand & Trockner, 1996; 15 = Reischütz et al., 2024; 16 = Stojaspal, 1978: Paladilhiopsis tschapecki bormanni n. ssp., Belgrandiella n. sp.; 23 = Vornatscher, 1951; 27 = Haseke & Weigand, 2000; 35 = Weißmair & Hauser, 1992; 36 = Aescht & Bisenberger, 2011. Table continued on next page.

Phylum			MOLLUSCA																						
Class			Gastropoda																						
Superfamily			Hydrobioidea																						
Family			Hydrobiidae																						
Cave name	Cave registry number	Province	*Alzoniella hartwigschuetti* (Reischütz 1983) StyB	*Belgrandiella cf. styriaca* Stojaspal 1978 StyP	*Belgrandiella styriaca* Stojaspal 1978 StyP	*Belgrandiella styriaca* Stojaspal 1978 StyP	*Belgrandiella sp.* StyP	*Belgrandiella sp.* StyP	*Bythinella austriaca / conica* StyP	*Bythinella austriaca* (Frauenfeld, 1857) StyP	*Bythinella austriaca* (Frauenfeld, 1857) StyP	*Bythinella cf. conica* Clessin, 1910 StyP	*Bythinella cf. conica* Clessin, 1910 StyP	*Bythinella sp.* StyP/B	*Bythinella cf. sp.* StyP/B	*Graziana lacheineri* Küster, 1853 StyP	*Graziana lacheineri* Küster, 1853 StyP	*Hauffenia wienerwaldensis* Haase, 1992 StyB	*Hauffenia kerschneri* (Zimmermann 1930) StyB	*Hauffenia kerschneri* (Zimmermann 1930) StyB	*Hauffenia sp.* StyB	*Hauffenia sp.* StyB	*Hydrobiidae gen. sp.*	*Hydrobiidae gen. sp.*	*Hydrobioidea gen. sp.*	sum
			R	R	H	R	H	R	R	H	R	H	R	H	R	H	R	R	H	R	H	R	H	R	R	
Bärenloch	2839/2	Stmk		221	X[16]																					221
Elmhöhlensystem	1624/38	Stmk																							1	1
Hammerbach-Ursprung	2836/34	Stmk		2																						2
Hochlecken-Großhöhle	1567/29	OÖ																							1	1
Klafflingbrunnen	1837/18	NÖ	42																							42
Kreidelucke	1628/2	OÖ								X[23]																0
Lurgrotte	2836/1	Stmk								X[1]						X[1]										0
Mausrodlhöhle	1824/9	NÖ										X[15]														0
Miralucke	1867/8	NÖ							20									77							1	98
Pießling Ursprung	1636/3	OÖ												X[14]												0
Rettenbachhöhle	1651/1	OÖ					X[27]			X[35]				X[27]				388	X[36]		X[27]		X[35]			388
Rudolfstollen	K6843/2	OÖ																							1	1
Schachernhöhle	1866/9	NÖ	235																							235
Totes Weib	1851/10	Stmk							2						1										2	5
Trockenes Loch	1836/34	NÖ	3																							3
Tuffsteinhöhle	1827/19	NÖ											19													19
sum			280	223		0		0	22		0		19		1		0	465		0		0		0	6	1016

Table 10: Recent (R) abundance and Historic (H) occurence of Mollusca found in each cave. StyB = stygobiont, StyX = stygoxen. X´s mark findings in historic literature, the number represents literature citations. 1 = Neuherz, 1974; 15 = Reischütz et al., 2024; 16 = Stojaspal, 1978; 17 = Breuss, 2004; 27 = Haseke & Weigand, 2000.

Phylum			MOLLUSCA																							
Class			Gastropoda														Bivalvia									
Superfamily			Lymnaeoidea				Truncatelloidea						Valvatoidea						Sphaerioidea								
Family			Planorbidae		Lymnaeidae		Moitessieriidae						Valvatidae						Sphaeriidae								
Cave name	Cave registry number	Province	*Ancylus fluviatilis* O. F. Müller, 1774 StyP/X	*Ancylus fluviatilis* O. F. Müller, 1774 StyP/X	*Galba truncatula* (O. F. Müller, 1774)	*Galba truncatula* (O. F. Müller, 1774)	***Bythiospeum* sp. StyB**	***Bythiospeum* sp. StyB**	***Bythiospeum cf. bormanni* (Stojaspal, 1978) StyB**	***Bythiospeum bormanni* (Stojaspal, 1978) StyB**	***Bythiospeum bormanni* (Stojaspal, 1978) StyB**	***Bythiospeum cf. reisalpense* (P. L. Reischütz, 1983) StyB**	*Valvata* sp.	*Valvata* sp.	*Valvata piscinalis* (O. F. Müller, 1774)	*Valvata piscinalis* (O. F. Müller, 1774)	*Gastropoda fam. gen. sp.*	*Euglesa cf. casertana* (Poli, 1791)	*Euglesa cf. casertana* (Poli, 1791)	*Euglesa casertana* (Poli, 1791) StyX	*Euglesa casertana* (Poli, 1791) StyX	*Pisidium* sp.	*Pisidium* sp.	*Bivalvia fam. gen. sp.*	*Bivalvia fam. gen. sp.*	**sum**
			H	R	H	R	H	R	R	H	R	R	H	R	H	R	R	H	R	H	R	H	R	H	R	
Altenbergschacht	3925/6	K															16								1	17
Bärenloch	2839/2	Stmk							222	X[16]							14									236
Baschghöhle	1112/1	Vbg																			11	X[17]				11
Klafflingbrunnen	1837/18	NÖ																	1							1
Lurgrotte	2836/1	Stmk	X[1]		X[1]			2					X[1]		X[1]		5									7
Mausrodlhöhle	1824/9	NÖ																		X[15]						0
Paulinenhöhle	1837/11	NÖ						1																		1
Rettenbachhöhle	1651/1	OÖ					X[27]																			0
Schachernhöhle	1866/9	NÖ										247									2					249
Tuffsteinhöhle	1827/19	NÖ																			14					14
sum				0		0		3	222		0	247		0		0	35		1		27		0		1	536

Table 11: Recent (R) abundance and Historic (H) occurence of Oligochaeta found in each cave. StyB = stygobiont, StyP = stygophile. X´s mark findings in historic literature, the number represents literature citations. 1 = Neuherz, 1974; 5 = Janetschek, 1952; 9 = Christian, 1927; 14 = Weigand & Trockner, 1996; 21 = Strouhal, 1940; 27 = Haseke & Weigand, 2000; 28 = Fritsch et al., 2016. Table continued on next page.

Phylum			ANNELIDA																											
Class			Clitellata																											
Subclass			Oligochaeta																											
Order			Enchytraeida																Crassiclitellata				Lumbriculida					
Family			Enchytraeidae															Propappidae		Lumbricidae				Dorydrilidae/ Lumbriculidae					
Cave name	Cave registry number	Province	*Fridericia alata* Nielsen & Christensen, 1959	*Fridericia aurita* Issel, 1905	*Fridericia aurita* Issel, 1905	*Achaeta sp.*	***Globulidrilus riparius* (Bretscher, 1899) StyP**	*Globulidrilus/ Marionina sp.*	*Henlea nasuta* (Eisen, 1878)	*Henlea nasuta* (Eisen, 1878)	*Henlea perpusilla* Friend, 1911	*Henlea perpusilla* Friend, 1911	*Enchytraeus christenseni* Dózsa-Farkas, 1992	*Enchytraeus christenseni* Dózsa-Farkas, 1992	*Enchytraeidae gen. sp.*	*Enchytraeidae gen. sp.*	*Cernosvitoviella sp.*	***Lumbricillus lineatus* (Müller, 1774) StyP**	*Propappus volki* (Michaelsen, 1916)	*Propappus volki* (Michaelsen, 1916)	*Lumbricidae gen. sp.*	*Lumbricidae gen. sp.*	*Eiseniella tetraedra* (Savigny in Cuvier, 1826)	*Eiseniella tetraedra* (Savigny in Cuvier, 1826)	***Dorydrilus michaelseni* Piguet, 1913 StyB**	***Dorydrilus michaelseni* Piguet, 1913 StyB**	*Dorydrilus/Trichodrilus sp.*	***Stylodrilus heringianus* Claparède, 1862 StyP**	***Stylodrilus heringianus* Claparède, 1862 StyP**	**sum**
			R	H	R	R	R	R	H	R	H	R	H	R	H	R	R	R	H	R	H	R	H	R	H	R	R	H	R	
Altenbergschacht	3925/6	K					2																							2
Baschghöhle	1112/1	Vbg																									5		15	20
Bullenhöhle	1622/57	Stmk															3													3
Burianhöhle	1824/1	NÖ					1																				1			2
Dachstein-Mammuthöhle	1547/9	OÖ																								3	3			6
Eggerloch	3742/2	K					2																X[21]							2
Eisensteinhöhle	1864/1	NÖ					1																							1
Elmhöhlensystem	1624/38	Stmk					4										37													41
Feistringgrabenhöhle	1745/7	Stmk					1	1																						2
Freschenhöhle	1111/7	Vbg					9	12																			9			30
Güntherhöhle	2921/2	NÖ						1																						1
Herdengelhöhle	1823/4	NÖ						5																						5
Hermannshöhle	2871/7	NÖ		X[9]					X[9]		X[9]		X[9]																	0
Hochlecken-Großhöhle	1567/29	OÖ					2										5													7
Hofertalschacht	1745/85	Stmk					7	1									2													10
Hohlensteinhöhle	1831/1	Stmk				2																					24			26
Klafflingbrunnen	1837/18	NÖ	1				9	4									22										98			134
Kohlerhöhle	1833/1	NÖ					1	1																						2
Konradhöhle	2644/1	Stmk					1										7	1											1	10
Koppenbrüllerhöhle	1549/1	OÖ					5	2									6										30			43
Leitenhöhle	2783/1	Stmk					2										2													4
Lurgrotte	2836/1	Stmk					3								X[1]		5				X[1]						7			15
Mailoch	1722/5	Stmk															1													1
Mausrodlhöhle	1824/9	NÖ					5																				23			28
Miralucke	1867/8	NÖ	2				4																				5			11
Naglsteghöhle	1626/5	OÖ	1														2										4			7
Nasses Loch	1836/19	NÖ	2																											2
Pießling Ursprung	1636/3	OÖ																	X[14]						X[14]			X[14]		0
Rettenbachhöhle	1651/1	OÖ					9	3																	X[27]		2			14
Rudolfstollen	K6843/2	OÖ																			X[28]									0
Schachernhöhle	1866/9	NÖ																									1			1
Schneckenloch	1126/1	Vbg					3	1							X[5]		31				X[5]						39			74
Schönberghöhlensytem	1626/300	OÖ					1																				1			2
Spannagelhöhle	2515/1	T				1	3																							4
Stadelalm-Eiskluft	1713/22	Stmk	3																											3
Tonion-Höhlensystem	1762/1	NÖ	2				4																				1			7
Totes Weib	1851/10	Stmk															12										6			18
Trockenes Loch	1836/34	NÖ					2																							2
Trübbachhöhle	1211/4	Vbg					1																							1
Tuffsteinhöhle	1827/19	NÖ					1																						5	6
Wildbaderhöhle	1625/150	Stmk															2													2
Wilhelminenhöhle	1823/7	NÖ					3										14													17
sum			11		0	3	86	31		0		0		0		0	151	1		0		0		0		3	259		21	566

Table 12: Recent (R) abundance and Historic (H) occurence of Oligochaeta found in each cave. StyB = stygobiont, StyP = stygophile, StyX = stygoxen. X´s mark findings in historic literature, the number represents literature citations. 1 = Neuherz, 1974; 2; 9 = Christian, 1997; 27 = Haseke & Weigand, 2000.

Phylum			ANNELIDA																													
Class			Clitellata																													
Subclass			Oligochaeta																													
Order			Parvidrilida	Tubificida																												
Family			Parvidrilidae	Naididae																												
Cave name	Cave registry number	Province	***Parvidrilus spelaeus*** **Martinez-Anselmil, Sambugar et Giani, 2002 StyB**	*Chaetogaster sp.*	*Chaetogaster sp.*	*Embelocephalus velutinus* (Grube, 1879) StyX	***Haplotaxis gordioides*** **(Hartmann in Oken, 1819) StyP**	***Haplotaxis gordioides*** **(Hartmann in Oken, 1819) StyP**	*Limnodrilus udekemianus* Claparède, 1862	*Limnodrilus udekemianus* Claparède, 1862	***Marionina argentea*** **(Michaelsen, 1889) StyP**	***Marionina argentea*** **(Michaelsen, 1889) StyP**	*Marionina sp.*	*Marionina sp.*	***Nais elinguis*** **Müller, 1774 StyP**	***Nais elinguis*** **Müller, 1774 StyP**	*Pristina sp.*	*Pristina foreli* (Piguet, 1906)	*Pristina foreli* (Piguet, 1906)	*Pristina sima* (Markus, 1944)	*Pristininae*	*Potamothrix/Tubifex sp.*	*Potamothrix moldaviensis* Vejdovský & Mrázek, 1903	*Potamothrix moldaviensis* Vejdovský & Mrázek, 1903	***Rhyacodrilus falciformis*** **Bretscher, 1901 StyP**	***Spirosperma ferox*** **Eisen, 1879 StyP**	*Tubifex tubifex* (Müller, 1774) StyP/X	*Tubifex tubifex* (Müller, 1774) StyP/X	*Tubificinae fam. gen. sp.*	Oligochaeta fam. gen. sp.	Oligochaeta fam. gen. sp.	**sum**
			R	H	R	R	H	R	H	R	H	R	H	R	H	R	R	H	R	R	R	R	H	R	R	R	H	R	R	H	R	
Barbarastollen	-	K						1																		1						2
Bärenloch	2839/2	Stmk										1																				1
Baschghöhle	1112/1	Vbg																								30						30
Bullenhöhle	1622/57	Stmk										1																				1
Dachstein-Mammuthöhle	1547/9	OÖ										6																				6
DaVinci Höhle	1615/37	OÖ										12																			2	14
Elmhöhlensystem	1624/38	Stmk																													33	33
Freschenhöhle	1111/7	Vbg										38																				38
Hammerbach-Ursprung	2836/34	Stmk																				1							3			4
Herdengelhöhle	1823/4	NÖ										15																	26			41
Hermannshöhle	2871/7	NÖ									X[9]																				2	2
Hinterbergerbach-Schwinde	6844/14	OÖ																													129	129
Hirlatzhöhle	1546/7	OÖ										1																				1
Hochlecken-Großhöhle	1567/29	OÖ										2																				2
Hofertalschacht	1745/85	Stmk										1																				1
Höllenloch	1612/1	OÖ										4																				4
Klafflingbrunnen	1837/18	NÖ				2														11	2								1			16
Kohlerhöhle	1833/1	NÖ																													1	1
Konradhöhle	2644/1	Stmk										3										1										4
Koppenbrüllerhöhle	1549/1	OÖ										5																				5
Kreidelucke	1628/2	OÖ																													2	2
Lurgrotte	2836/1	Stmk		X[2]			X[1]					6			X[1]							7			18		X[1]		18		1	50
Mailoch	1722/5	Stmk										10																				10
Mausrodlhöhle	1824/9	NÖ										1																				1
Miralucke	1867/8	NÖ										1					1															2
Naglsteghöhle	1626/5	OÖ				2						2																				4
Nasses Loch	1836/19	NÖ																													3	3
Obere Schießerbachhöhle	1616/7	OÖ														1																1
Rettenbachhöhle	1651/1	OÖ							X[27]			3	X[27]					X[27]					X[27]						2			5
Schachernhöhle	1866/9	NÖ										1																	1			2
Schneckenloch	1126/1	Vbg										26																				26
Schönberghöhlensytem	1626/300	OÖ																													3	3
Schwabenreithhöhle	1823/32	NÖ																													1	1
Spannagelhöhle	2515/1	T										2																				2
Stiller-Graben-Stollen	K2822/2	Bgl																				8							6			14
Totes Weib	1851/10	Stmk										13																				13
Tuffsteinhöhle	1827/19	NÖ																				1										1
Türkenbrunnen	K1911/10	NÖ										5										3							2			10
Wildemannloch	2836/27	Stmk																											5			5
Wasserleitungsstollen	K2921/9	NÖ	2																													2
sum			2		0	4		1		0		159		0		1	1		0	11	2	21		0	18	31		0	64		177	492

Table 13: Recent (R) abundance and Historic (H) occurence[28] of Aphanoneura and Polychaeta found in each cave. StyB = stygobiont, StyP = stygophile. X´s mark findings in historic literature, the number represents literature citations. 1 = Neuherz, 1974.

Phylum			ANNELIDA												
Class			Aphanoneura										Polychaeta		
Family			Aelosomatidae										Nerillidae		
Cave name	Cave registry number	Province	***Aelosoma cf. evelinae*** **Er. Marcus, 1944 StyP**	***Aelosoma marcusi*** **van der Land, 1971 StyP**	***Aelosoma quaternarium*** **Ehrenberg, 1831 StyP**	***Aelosoma gertae*** **Er. Marcus, 1944 StyP**	***Aelosoma hemprichii*** **Ehrenberg, 1828 StyP**	***Aelosoma hemprichii*** **Ehrenberg, 1828 StyP**	***Aelosoma hyalinum*** **Bunke, 1967 StyP**	***Aelosoma travancorense*** **Aiyer, 1926 StyP**	***Aelosoma vride*** **Stephenson, 1911 StyP**	*Aelosoma sp.*	***Troglochaetus beranecki*** **Delachaux, 1921 StyB**	*Annelida fam. gen. sp.*	**sum**
			R	R	R	R	H	R	R	R	R	R	R	R	
Baschghöhle	1112/1	Vbg				15									15
Burianhöhle	1824/1	NÖ								2					2
DaVinci Höhle	1615/37	OÖ			1										1
Elmhöhlensystem	1624/38	Stmk										1			1
Freschenhöhle	1111/7	Vbg			41							12			53
Hammerbach-Ursprung	2836/34	Stmk			1										1
Herdengelhöhle	1823/4	NÖ			15										15
Hirlatzhöhle	1546/7	OÖ											1		1
Hochlecken-Großhöhle	1567/29	OÖ			1										1
Höllenloch	1612/1	OÖ			3							4	1		8
Kammschacht	1867/8	NÖ							6		31	24			61
Koppenbrüllerhöhle	1549/1	OÖ				2									2
Leitenhöhle	2783/1	Stmk			7										7
Lurgrotte	2836/1	Stmk			8	1	X[1]								9
Mausrodlhöhle	1824/9	NÖ											1		1
Miralucke	1867/8	NÖ											3		3
Ötschertropfsteinhöhle	1824/10	NÖ	3										4		7
Rudolfstollen	K6843/2	OÖ												1	1
Schneckenloch	1126/1	Vbg			11				26		12	52			101
Tonion-Höhlensystem	1762/1	NÖ		1	2										3
Trübbachhöhle	1211/4	Vbg			18										18
Wilhelminenhöhle	1823/7	NÖ			2										2
sum			3	1	110	18		0	32	2	43	93	10	1	313

Table 14: Recent (R) abundance and Historic (H) occurence of Nematoda and Rotifera found in each cave. StyP = stygophile, StyX = stygoxen. X´s mark findings in historic literature, the number represents literature citations. Species names represent the current state of research, deviations in original publications are noted next to the citations. 9 = Christian, 1997; 27 = Haseke & Weigand, 2000; 42 = Eder, 1979: Monhystera vulgaris.

Phylum			NEMATODA									ROTIFERA		
Class			Chromadorea			Enoplea						Bdelloidea		
Order			Rhabditida	Monhysterida	Plectida	Mononchida		Dorylaimina	Triplonchida					
Family			Cephalobidae	Monhysteridae	Plectidae	Mononchidae		Tylencholaimidae	Tobrilidae			Bdelloidea fam. gen. sp.		
Cave name	Cave registry number	Province	*Cephalobus troglophilus* Andrassy, 1967 StyX	*Eumonhystera vulgaris* (de Man, 1880) Andrássy, 1981	***Plectus cirratus* Bastian, 1865 StyP**	***Mononchus truncatus* Bastian, 1865 StyP**	*Prionchulus sp.*	*Meylonema buchneri* (MEYL, 1953) Andrássy, 1960	***Tobrilus gracilis* (BASTIAN, 1865) StyP**	*Nematoda fam. gen. sp.*	*Nematoda fam. gen. sp.*	*Bdelloidea fam. gen. sp.*	*Bdelloidea fam. gen. sp.*	sum
			H	H	H	H	H	H	H	H	R	H	R	
Altenbergschacht	3925/6	K									5			5
Bärenloch	2839/2	Stmk											4	4
Bärenlucke	1836/180	NÖ											1	1
Baschghöhle	1112/1	Vbg									22			22
Bullenhöhle	1622/57	STMK									20			20
Burianhöhle	1824/1	NÖ									22			22
Dachstein-Mammuthöhle	1547/9	OÖ									4			4
Dachstein-Rieseneishöhle	1547/17	OÖ									8			8
Eisensteinhöhle	1864/1	NÖ									2			2
Eisgrabenschacht	1745/50	STMK									11			11
Eislüg	1625/28	OÖ									9			9
Eisriesenwelt	1511/24	SBG									1			1
Elmhöhlensystem	1624/38	STMK									384			384
Falkensteinhöhle	2861/3	NÖ									3			3
Feistringgrabenhöhle	1745/7	Stmk									1			1
Freschenhöhle	1111/7	Vbg									193		15	208
Güntherhöhle	2921/2	NÖ									3			3
Hammerbach-Ursprung	2836/34	STMK									9			9
Herdengelhöhle	1823/4	NÖ									174		32	206
Hermannshöhle	2871/7	NÖ	X[42]	X[42]	X[42]	X[42]	X[42]	X[42]	X[42]		1	X[9]		1
Hirlatzhöhle	1546/7	OÖ									1		1	2
Hirschgrubenhöhle	1744/450	STMK									36			36
Hochkarschacht	1814/5	NÖ									500			500
Hochlecken-Großhöhle	1567/29	OÖ									262		3	265
Hofertalschacht	1745/85	STMK									2			2
Hohlensteinhöhle	1831/1	Stmk									15			15
Höllenloch	1612/1	OÖ									3			3
Klafflingbrunnen	1837/18	NÖ									39		2	41
Kohlerhöhle	1833/1	NÖ									2			2
Konradhöhle	2644/1	STMK									5			5
Koppenbrüllerhöhle	1549/1	OÖ									3			3
Leitenhöhle	2783/1	STMK									2			2
Lurgrotte	2836/1	Stmk									44			44
Mailoch	1722/5	STMK									15			15
Mausrodlhöhle	1824/9	NÖ									3		1	4
Miralucke	1867/8	NÖ									1			1
Naglsteghöhle	1626/5	OÖ									4			4
Nasses Loch	1836/19	NÖ									1			1
Ötschertropfsteinhöhle	1824/10	NÖ									6			6
Rettenbachhöhle	1651/1	OÖ								X[27]				0
Rudolfstollen	K6843/2	OÖ									1			1
Schachernhöhle	1866/9	NÖ									2			2
Schneckenloch	1126/1	Vbg									666		40	706
Schönberghöhlensystem	1626/300	OÖ									1			1
Schwabenreithhöhle	1823/32	NÖ									1			1
Spannagelhöhle	2515/1	T									8			8
Stiller-Graben-Stollen	K2822/2	BGL									25			25
Tonion-Höhlensystem	1762/1	NÖ									8		1	9
Totes Weib	1851/10	STMK									14			14
Trockenes Loch	1836/34	NÖ									8			8
Trübbachhöhle	1211/4	VBG									5			5
Türkenbrunnen	K1911/10	NÖ									98			98
Wildbaderhöhle	1625/150	Stmk									25		1	26
Wildemannloch	2836/27	Stmk									17			17
Wilhelminenhöhle	1823/7	NÖ									511		19	530
sum											3206		120	3326

Table 15: Recent (R) abundance and Historic (H) occurence of Tardigrada and Platyhelminthes found in each cave. StyB = stygobiont, StyP = stygophile. X´s mark findings in historic literature, the number represents literature citations. Species names represent the current state of research, deviations in original publications are noted next to the citations. 1 = Neuherz, 1974; 18 = Mais, 1964; 37 = Abrahamczik, 1935.

Phylum			TARDIGRADA	PLATYHELMINTHES																
Class				Turbellaria																
Order				Bothrioplanida	Tricladida								Rhabdocoela				Prorhynchida			
Family			Tardigrada fam. gen. sp.	Bothrioplanidae	Dendrocoelidae		Planariidae					Dugesiidae	Typhloplanidae		Dalyelliidae		Prorhynchidae	Stenostomidae		
Cave name	Cave registry number	Province		***Bothrioplana semperi*** **(Braun, 1881) StyP**	***Dendrocoelum nausicaae*** **(Schmidt, 1861) StyB**	*Amyadenium sp.*	***Atrioplanaria racovitzai*** **(Beauchamp, 1928) StyB**	***Phagocata paravitta*** **(Reisinger, 1923) StyB**	*Planaria sp.*	***Polycelis felina*** **(Dalyell, 1814) StyP**	***Crenobia alpina*** **(Dana, 1766) StyP**	***Dugesia gonocephala*** **(Dugès, 1830) StyP**	*Castrada perspicua* (Fuhrmann, 1894)	***Ascophora paradoxa*** **(Findenegg, 1924) StyP**	*Microdalyellia schmidti* (Graff, 1882)	***Microdalyellia armigera*** **(Schmidt, 1862) Gieysztor, 1938 StyP**	***Prorhynchus stagnalis*** **(Schultze, 1851) StyP**	***Stenostomum sphagnetorum*** **(Papi, 1960) StyP**	*Turbellaria fam. gen. sp.*	sum
			R	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	R	
Bärenlucke	1836/180	NÖ																	1	1
Dachstein-Rieseneishöhle	1547/17	OÖ									X[18]									0
Elmhöhlensystem	1624/38	STMK																	4	4
Freschenhöhle	1111/7	Vbg	3																1	4
Güntherhöhle	2921/2	NÖ	2																	2
Herdengelhöhle	1823/4	NÖ	4																	4
Hermannshöhle	2871/7	NÖ											X[11]		X[11]					0
Hochlecken-Großhöhle	1567/29	OÖ	3																10	13
Höllenloch	1612/1	OÖ																	1	1
Konradhöhle	2644/1	STMK																	1	1
Lurgrotte	2836/1	Stmk		X[1]	X[1]	X[1]	X[1]	X[1]	X[1]	X[1]	X[1]	X[1]		X[1]		X[1]	X[1]	X[1]		0
Mailoch	1722/5	STMK																	1	1
Nestelberghöhle	1816/11	NÖ																	1	1
Schneckenloch	1126/1	Vbg																	3	3
Schönberghöhlensystem	1626/300	OÖ																	1	1
Tonion-Höhlensystem	1762/1	NÖ																	1	1
Trübbachhöhle	1211/4	VBG	1																	1
Wildbaderhöhle	1625/150	Stmk	6																	6
Wilhelminenhöhle	1823/7	NÖ						X[37]											31	31
sum			19																56	75

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Ich habe mich bemüht, sämtliche Inhaber*innen der Bildrechte ausfindig zu machen und ihre Zustimmung zur Verwendung der Bilder in dieser Arbeit eingeholt. Sollte dennoch eine Urheberrechtsverletzung bekannt werden, ersuche ich um Meldung bei mir.

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Annex

Tab. AX 1: Physico-chemical parameters. The name of the cave belonging to the individual sample ID can be found in the table Tab. AX 5.

sample ID	Water temp. [°C]	Air temp. [°C]	pH	EC [µS/cm]	Na^+ [mg/L]	K^+ [mg/L]	Ca^{2+} [mg/L]	Mg^{2+} [mg/L]	Cl^- [mg/L]	NO_3^- [mg/L]	NO_2^- [µg/L]	NH_4^+ [µg/L]	SiO_4^{4-} [mg/L]	SO_4^{2-} [mg/L]	Ortho PO_4^{3-} [µg/L]	Soluble P [µg/L]	Total P [µg/L]
ALSH105	7.8	7.5	8.7	332	0	0	47.23	12.36	1.3	2.14	7.23	4.54	2.76	3.83	2.1	5.59	7.06
AMAH151	6.5	7	8	612	0	1.57	102	14.92	2.41	2	1.53	29.16	10.46	197.7	1.5	2.94	27.65
BARH140	6.5	7	7.9	445	0	2.54	74.83	7.18	1.37	2.15	6.57	278	13.49	35.9	2.41	2.65	3.53
BAE135	9.2	9.5	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
BAE123	10	10	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
BALH6	9.5	n.a.	8.7	261	3.5	7.1	41.5	2.2	5.3	0.7	2.4	8	3.5	5.2	3	3	8
BALH7	9.5	n.a.	8.6	433	6.4	5.9	67.5	3.9	4.1	9	3.5	11	4.9	5.9	167	55	71
BASH138	11	n.a.	8.5	636	11.87	2.7	88.74	10.13	35.62	7.83	93.29	18.62	7.58	20.89	13.23	7.65	50
BRUH136	8.5	9	8.1	338	0.99	2.23	57.35	5.17	5.61	2.45	41.61	4.57	3.45	13.28	3.31	2.35	0
BULH21	5	5.5	7.7	69	1.5	1	25.1	3.4	2.1	0.4	1.8	20	1	2.3	1	1	0
BURH157	7	11	8.2	350	2.96	0.46	47.05	17.43	5.16	10.73	15.77	6.44	2.88	16.5	1.8	5.29	17.94
DAMH32	2.8	3.1	8.2	218	3.7	5.7	24.6	6.4	6.5	2.7	6.8	21	1.5	2.3	13	21	106
DAMH129	5	6.5	7.9	206	0.24	0.08	36.43	4.36	0.56	3.07	9.42	29.86	3.03	0.96	6.31	3.53	3.82
DAMH130	5	6	8.1	196	0.35	0.03	32.76	4.14	0.43	3.04	2.41	17.56	2.88	0.88	4.51	3.82	5.59
DARH33	1.6	2.5	8.1	210	1.9	2.5	30.4	6.4	3.2	1.3	3.1	18	1.1	2.1	2	11	0
DAVH146	6.5	7	8	233	0	0	36.84	4.48	0.6	2.87	1.53	13.76	4.43	6.87	1.8	2.65	10.29
DAVH147	6.5	7	8.1	200	0	0	36.64	0.96	1.81	2.29	3.94	6.15	2.44	1.41	4.51	12.94	22.65
DAVH168	7	7	7.8	236	0.04	0	43.11	1.37	1.47	3.11	2.63	9.37	2.02	1.83	0.9	8.24	21.76
DAVH142	7	7	8.2	294	0	0	50.09	1.09	2.33	1.71	2.96	2.34	3.55	2.5	66.73	34.71	38.53
EISH108	14	13.3	7.2	569	0	0.57	74.27	28.52	6	10.8	17.41	1.95	11.82	20.74	122	40.29	58.53
EISH109	14.7	13.6	7.8	662	0	0	98.12	20.84	7.57	7.2	12.15	2.54	8.27	22.25	1.2	5.29	5.88
EIGH176	2	3	8.4	288	2.18	0	36.17	14.78	3.08	1.83	6.35	14.05	2.29	1.61	14.43	10	40.88
ELUH122	2.3	2.2	8.1	171	0	0	30.34	3.41	0.2	1.92	3.29	12.29	2.41	0.68	2.71	1.18	11.47
ELMH53	4.3	3.8	7.9	162.6	0.4	0	31.4	1.1	0.2	0.9	2	3	1.3	0.7	2	2	12
ELMH60	4.3	4.3	7.8	178.2	0.9	0.1	32.7	1.9	1.2	1.1	1.5	2	1.3	2.3	2	4	16
ELMHH169	4.9	4.7	7.9	155	0.35	0.02	30.71	2.22	1.22	1.04	2.74	16.39	2.07	2.46	6.31	2.06	15.29
ERWH18	3	3	7.8	67.7	2.6	1.6	24.4	1	3.7	0.3	3.5	12	0.4	2	5	4	0
ERWH19	3	3	n.a.	69.7	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
ERWH20	3	3	7.9	n.a.	1.2	0.8	27.5	1.7	2	1.4	1.8	7	0.7	3.7	1	1	0
FAL_1	14.9	n.a.	8	432	6.7	1.9	68.7	5.7	3.8	0.7	18.1	151	3.6	7.5	6	4	1057
FAL_2	14.9	n.a.	8	432	6.7	1.9	68.7	5.7	3.8	0.7	18.1	151	3.6	7.5	6	4	1057
FEIH56	6.5	7	7.3	337	0.4	0.2	63.3	5.3	0.7	1.5	2.2	2	4.1	4	2	4	10
FISH144	7	7	8.3	370	0	0	42.04	17.54	0.8	1.42	1.64	1.76	4.43	29.74	5.41	4.71	6.76
FLAH149	7.5	9.5	8.3	312	0	0.27	55.49	4.51	0.77	2.88	3.94	35.6	3.37	7	2.41	2.94	10.88
FMLH29	4.7	5.1	7.7	201	5.9	0.9	31.3	1.4	3.1	0.3	196.4	11	1.6	2.3	2	4	11
FRSH50	8	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
FRSH52	8	n.a.	8.1	305	0.9	1.2	53.2	1.3	1.1	0.8	8.3	18	2.9	2.3	4	10	697
FRSH57	8	n.a.	8.1	210	0	1.3	41.1	2.9	3.1	2.2	9.6	24	3.5	4.6	2	6	12
FRSH59	8	n.a.	7.9	167.1	0.3	0.6	33.5	0.5	0.8	1.6	5.9	12	1.8	0.7	2	9	29
FRSH67	8	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
FRSH70	8	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
FSSH31	5	6	8.2	233	3.3	0.7	36.8	1	3	2	11	5	1.3	2.5	23	12	31
FSSH121	4	4	8.1	214	0	0	36.45	0.54	0.31	3.88	2.85	6.44	3.74	1.36	2.71	2.06	6.18
FSSH120	4	5	7.7	196	0	0	35.53	0.62	0.99	4.05	15.33	7.03	3.52	1.62	1.8	4.41	18.82

Tab. AX 2: Physico-chemical parameters. The name of the cave belonging to the individual sample ID can be found in the table Tab. AX 6.

sample ID	Water temp. [°C]	Air temp. [°C]	pH	EC [µS/cm]	Na^+ [mg/L]	K^+ [mg/L]	Ca^{2+} [mg/L]	Mg^{2+} [mg/L]	Cl^- [mg/L]	NO_3^- [mg/L]	NO_2^- [µg/L]	NH_4^+ [µg/L]	SiO_4^{4-} [mg/L]	SO_4^{2-} [mg/L]	Ortho PO_4^{3-} [µg/L]	Soluble P [µg/L]	Total P [µg/L]
GGHH63	6.5	8.5	7.9	282	0.2	0.1	32.6	12.5	2.3	6.8	26.7	311	1.3	2.7	4	6	7
GRBH1	n.a.	n.a.	8.4	465	3.8	1.5	19.5	44.3	3.3	0	1.6	21	6	35.9	2	2	0
GRBH171	10.5	10	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
GUEH44	14	14	8.2	339	1	0.3	28	25.2	1.6	7.1	64.8	19	5.5	13.1	2	1	61
HAMH97	10	11	7.7	376	4.14	1.06	58.16	6.93	8.05	0.16	5.48	5.85	11.74	9.3	3.61	0.39	19.8
HEM	7.9	n.a.	8.4	354	4	1	68.5	3.3	3.8	0.8	4.27	81.27	2.96	7	3.07	7	11
HINH179	15	15	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
HERH83H94	9.5	9.5	7.8	321	0	0	52.28	4.74	1.41	3.58	5.58	15.81	3.96	2.83	2.71	5.44	182.8
HIGH40	2.4	n.a.	8.2	238	5.1	0.8	32.1	10.1	2.6	0	2.4	9	1.6	2	2	3	4
HIGH139	2	4	7.9	221	0	0	26.23	8.64	1.99	1.88	9.64	12.59	0.76	1.09	9.02	4.71	22.06
HILH107	4	5	7.6	147	0	0	27.86	3.09	0.36	1.17	15.88	1.95	1.11	1.25	3.01	1.18	5
HILH79	6	6	7.9	180.4	0.3	0.1	33.4	2.7	0.3	1.5	20.6	7	1.3	1.2	1	1	24
HFAH180	8	8.5	7.9	305	5	12.8	53.7	4.5	10.3	6.4	8.3	35	3.3	4.5	0	15	0
HOGH91	n.a.	n.a.	7.7	166.7	0	0	25.7	4.3	0.5	1.3	1.31	19.91	0.54	0.5	0	1.08	4.61
HOFH159	3	3	7.8	208	3.09	0.4	66.75	8.62	8.57	2.13	59.35	0	1.7	94.02	3.61	3.24	16.18
HKSH178	7.5	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
HOHH95	n.a.	n.a.	8	426	0	0	63.6	14.5	1.7	1.5	46.21	2.78	3.84	3.8	2.71	2.06	15
HOLH96	9	8	7.8	321	0.6	0.3	59.8	3	1.3	2.9	7.4	3	4.4	5	0	0	4
HWQH173	4.9	8	7.6	291	0	0	47.45	2.73	2.05	12.35	5.58	3.63	2.27	2.04	1.8	3.24	17.94
HUAH43	6	6	8	271	1.9	0.8	49.7	4.7	2.1	2.3	10.5	3	1.4	2.2	1	1	199
KJFH141	8	8	8.8	228	0	0	41.5	0.81	1.24	4.31	2.19	3.95	1.43	2.47	12.92	10.88	70.59
KAMH102	7	7	8.3	344	0	0.3	63.9	2.5	1.8	8.6	1.97	0.59	8.64	11.3	23.45	8.92	9.22
KLAH82H85H93	10	10	7.6	533	0	0.68	90.73	10.99	1.67	5.71	3.83	13.47	8.03	7.35	0.9	3.68	26.03
KLGH150	5.5	7	8.1	469	1.76	4.25	49.87	20.25	0.84	2.71	2.63	20.96	15.71	80.01	2.41	3.24	21.76
KOHH9	n.a.	n.a.	8.7	1039	3.8	1.8	147.1	29.7	0	1	1.1	84	4.3	367.9	5	3	4
KOHH137	9	9	8.2	1109	0	0.22	172.5	39.59	1.26	2.14	2.63	2.81	4.7	423.9	2.41	3.24	4.41
KOHH174	8	9	8.1	1157	0.97	0.12	42.55	182.4	2.26	1.2	2.63	5.27	5.05	463.3	6.31	8.82	11.47
KOSH34	4.5	4.5	n.a.	n.a.	4.7	0.7	25.2	11.2	2.9	1.4	4.2	2	1.2	4.1	2	7	12
KONH155	5.5	2.5	7.9	131	0	0.1	15.55	3.37	0.72	2.27	4.38	1.64	9.5	8.4	2.41	3.82	5
KONH156	4.5	4	7.7	85	0	0.44	8.64	2.08	0.37	2.4	3.5	2.22	9.65	3.71	3.31	2.35	4.41
KOPH124	7	8	8.1	173	1.63	0.2	33.3	3.51	2.78	1.64	6.35	8.78	3.18	4.65	8.12	4.71	9.12
KOPH128	6.5	7.5	8	180	0.16	0.01	31.39	3	0.61	1.49	8.1	7.61	2.66	1.19	7.21	3.82	5
KREH125	10	10	8	378	0.16	0.09	57.7	12.06	0.51	2.03	4.82	22.25	3.69	1.23	6.31	3.53	6.76
KREH175	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
KREH153	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
KUEH15	9	9	8.1	199	2.2	0.7	33.3	1.5	2.5	0.8	3.5	6	1.7	2.2	2	5	6
KUEH38	9	10	8	250	3.1	0.7	47.6	2.3	2.1	0.6	3.5	11	2	2.4	3	3	9
LBHH98	12	15	7.8	306	6.2	0.8	40.7	8.1	9.6	4.6	16.21	6.44	7.31	10.5	5.41	0.39	2.75
LSSH35	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
LURH58	9	9	8.2	499	0.6	0.3	74	1.3	1	0.7	1.5	4	5.7	14.8	2	6	37
LURH160	10	10	8.3	456	0	0.4	74.79	4.41	3.04	7.21	3.5	3.98	8.99	14.65	18.04	6.96	7.65
LURH161	10	10	8.3	351	0	0.13	66.5	1.28	1.37	6.21	1.53	3.98	5.52	16.55	19.54	6.47	7.06
LURH162	10	10	8	406	0	0.38	73.9	1.95	2.05	6.36	3.5	2.81	8.4	32.88	8.72	3.53	74.12
LURH163	10	10	8.3	335	0	0.26	58.72	2.12	2.12	7.59	2.63	3.4	10.24	32.7	3.31	2.06	4.41

Tab. AX 3: Physico-chemical parameters. The name of the cave belonging to the individual sample ID can be found in the table Tab. AX 7.

sample ID	Water temp. [°C]	Air temp. [°C]	pH	EC [µS/cm]	Na^+ [mg/L]	K^+ [mg/L]	Ca^{2+} [mg/L]	Mg^{2+} [mg/L]	Cl^- [mg/L]	NO_3^- [mg/L]	NO_2^- [µg/L]	NH_4^+ [µg/L]	SiO_4^{4-} [mg/L]	SO_4^{2-} [mg/L]	Ortho PO_4^{3-} [µg/L]	Soluble P [µg/L]	Total P [µg/L]
LURH110	n.a.	n.a.	n.a.	n.a.	1.9	0.7	81.8	3.8	4.3	n.a.	n.a.	n.a.	n.a.	16.6	n.a.	20	31
LURH111	n.a.	n.a.	n.a.	n.a.	1.9	0.7	81.8	3.8	4.3	n.a.	n.a.	n.a.	n.a.	16.6	n.a.	20	31
LURH112	n.a.	n.a.	n.a.	n.a.	1.9	0.7	81.8	3.8	4.3	n.a.	n.a.	n.a.	n.a.	16.6	n.a.	20	31
LURH113	n.a.	n.a.	n.a.	n.a.	1.9	0.7	81.8	3.8	4.3	n.a.	n.a.	n.a.	n.a.	16.6	n.a.	20	31
LURH114	n.a.	n.a.	n.a.	n.a.	1.9	0.7	81.8	3.8	4.3	n.a.	n.a.	n.a.	n.a.	16.6	n.a.	20	31
LURH115	n.a.	n.a.	n.a.	n.a.	1.9	0.7	81.8	3.8	4.3	n.a.	n.a.	n.a.	n.a.	16.6	n.a.	20	31
LURH117	n.a.	n.a.	n.a.	n.a.	1.9	0.7	81.8	3.8	4.3	n.a.	n.a.	n.a.	n.a.	16.6	n.a.	20	31
MAIH16	7	8	8.1	271	3.4	0.8	49.1	3.1	2.7	2.1	2.3	2	2.5	4.4	2	7	9
MAUH84H86	10	10	7.6	481	3.03	0.53	59.43	22.73	7.61	5.05	3.39	18.73	2.86	3.09	4.51	4.26	14.56
MYAH4	n.a.	n.a.	8	419	3.2	0.7	49.7	18.7	2.3	5.7	2.4	2	2.2	4.3	8	3	6
MYAH41	15	16	8	405	2.6	0.8	47.5	20.4	2.3	4.6	0.7	25	2.3	3.3	0	2	12
MYAH47	9	10	8	409	4.2	1.5	49.6	21.1	3	4	1.8	51	2.5	3.9	2	2	26
MYAH8	7.5	n.a.	8.4	388	3.7	0	44.6	16.2	2.8	4	5.3	3	2.3	3.7	12	6	7
NAGH73	6.5	7.2	7.7	192.4	0.9	0.4	35.6	1.2	0.7	1.6	9.4	67	2	0.7	2	1	133
NASH26	6.6	7.8	7.9	321	3.8	0.9	58.3	3.7	2.5	4	1.5	3	2.9	4.9	7	3	5
NASH74	9.5	11	8.1	355	0	0.02	56.64	3.2	0.51	4.73	1.86	7.03	3.08	3.06	0	1.32	3.68
NBHH27	8	11	7.7	76	1.9	0.8	51.1	8.6	2.1	2.4	2	4	2.8	26.8	4	3	8
NWSH51	3.5	4	8.1	199.4	0.6	0.3	74	1.3	1	0.7	1.5	4	5.7	14.8	2	6	37
OSBH13	8	9	8.1	144	2.5	0.8	27	1.3	2	0.4	3.5	7	1.2	2	2	3	4
OSBH36	8	9	7.8	204	4.1	0.7	41.1	1.7	0	0.2	5.3	14	1.9	2.1	2	1	3
OTHH106	6	6	8.3	292	0	2.03	56.04	2.2	1.54	4.64	7.45	1.61	4.6	9.2	43.58	15.59	19.12
OTHH2	6	6.5	8.3	295	3.1	1	56.2	1.6	2.4	2.8	17.8	8	4.4	4.1	2	2	0
OTHH5	6	6.5	8.4	310	3.1	0.9	55.7	4.2	2.5	0.8	5.1	11	4.1	5.1	1	1	0
PAPH39	5	5	8.1	190.3	4.6	0.8	33.2	3.8	2	0.6	3.9	9	1	2.2	3	4	11
PAUH3	n.a.	n.a.	8.6	429	4.9	1	44.9	25.7	2.7	6.3	6.2	6	2.3	3.8	1	1	0
PAUH143	10	10	8.6	429	0	0	38.18	29.45	0.86	4.2	1.31	3.95	1.87	2.31	3.01	2.06	8.53
PIEH64	6.2	6.5	7.7	246	0	0	32.1	5.9	0.5	2	7.4	54	1.1	1.1	2	1	7
RISH10	n.a.	n.a.	8.7	1012	118.7	1.5	58.5	5.4	178.3	0.6	8.8	91	2.4	11.5	2	2	5
RUDH45	11.7	11.9	7.8	699	8.2	1.9	100.2	33.9	13.6	61.3	4.4	1	18.1	36.3	6	4	13
RUDH46	11.5	11.5	8.2	602	10.6	3.7	61.7	29.8	21.3	13.9	2.6	2	23	58.6	3	4	6
RUDH99	11.6	11.7	8.1	1057	14.3	3.3	112.2	39.2	124.5	33.1	5.26	12.15	20.24	54.1	2.71	2.06	18.82
RWAH22	9	10	7.5	77.3	3.6	1.3	58.7	3.2	2.2	1.4	3.9	2	12.4	7.2	23	9	0
RETH126	7.5	8.5	7.9	233	0.54	0.16	37.01	5.69	0.74	2.49	2.63	43.91	2.73	1.03	6.31	3.53	5
RETH127	7.5	8.5	8.1	228	0.25	0.03	36.73	5.82	0.59	2.31	3.07	24	2.73	0.89	7.21	3.82	5.29
SAEH62	4	6.5	7.9	207	0	0	36	2.8	0.3	2.1	2.8	5	1	0.9	1	1	2
SAEH68	3	4	8	237	0	0	39.9	2.2	0.4	1.4	15.5	5	1.3	1.2	2	1	2

Tab. AX 4: Physico-chemical parameters. The name of the cave belonging to the individual sample ID can be found in the table Tab. AX 8.

sample ID	Water temp. [°C]	Air temp. [°C]	pH	EC [µS/cm]	Na^+ [mg/L]	K^+ [mg/L]	Ca^{2+} [mg/L]	Mg^{2+} [mg/L]	Cl^- [mg/L]	NO_3^- [mg/L]	NO_2^- [µg/L]	NH_4^+ [µg/L]	SiO_4^{4-} [mg/L]	SO_4^{2-} [mg/L]	Ortho PO_4^{3-} [µg/L]	Soluble P [µg/L]	Total P [µg/L]
SBHH30	4.2	4.8	8	157.7	5.4	1	28.7	1.3	2.2	0.9	16.6	16	1.3	2.3	1	1	8
SBHH145, H165	3.5	3.5	7.9	163	0	0	28.7	2.58	0.3	2.56	3.29	8.49	1.72	2.52	7.21	7.65	22.35
SWRH170	8	8	7.8	278	0	0	46.8	5.2	0.72	2.01	28.03	15.22	1.87	1.54	2.71	3.53	10
SEEH158	11.5	13	8	3280	71.9	8.5	542.5	152	166.4	16.77	3.72	26.35	16.55	995.9	5.41	3.24	7.35
SCHH11	8.5	n.a.	8	532	4.2	1.8	92.2	8.6	2.5	5.3	4.2	4	3.5	96.2	4	3	0
SCHH12	9	n.a.	8.4	323	4.1	1.1	61.8	1.2	3.5	3.6	9.9	20	3	5.2	98	37	0
SCHH133	9	10	7.9	315	0	0	53.29	0.88	2.29	16.68	12.05	4.68	4.65	10.93	75.75	33.24	49.12
SCHH134	10	10	7.9	965	0.8	0.27	165.3	17.45	2.64	6.84	11.61	1.17	3.84	355.9	3.61	3.53	5
SNLH48H71H72	7	n.a.	7.9	189.7	0.5	0.5	37.9	0.8	0.5	3	3.9	18	2.4	3.2	2	4	4
SNLH49	7	n.a.	7.9	191.9	0.3	0.4	35.9	1.2	0.4	1.4	2.6	17	1.6	4.3	2	2	12
SNLH54	7	n.a.	8	191.2	0.2	0.3	36.1	1.2	0.2	1	7.9	14	1.6	4	2	2	2
SNLH66	7	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
SNLH92	7	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
SPAH77	4.5	4.5	7.9	153.9	12.3	1.2	63.2	14.1	17.8	1.8	3.5	48.01	3.52	61.4	1.8	1.37	12.06
SPAH80	4.5	5	7.8	144.5	12.4	0.9	67.2	13.9	19	1.6	2.19	39.23	2.27	60.5	2.41	0.88	5.59
SSSH24	5	6.5	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
SSSH25	5	6.5	7.8	73.2	2.2	1	35.8	13.1	2.2	1.9	37	2	1.9	2.6	7	4	0
STSH76	1.1	n.a.	8.3	270	2	0.1	35.8	7.9	10	1.1	1.5	73	0.7	0.7	1	1	8
SGSH119	12	15	8.5	541	4.5	0.51	49.82	37.24	4.54	3.58	1.53	5.27	24.79	61.49	3.61	1.47	9.12
SFLH148	3	0	7.8	369	1.57	1.18	44.49	16.06	5.84	18.62	20.59	2.22	7.66	9.85	3.31	6.18	10
TAUH177	2.5	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
TBHH42	7	13	7.8	350	0	0.4	68.9	1.6	1.4	8.5	3.5	14	2.5	5	2	4	58
TEUH104	3	3	8	207	0	0	37.48	1.2	0.54	2.2	1.53	12.53	2.24	1.16	0.9	1.91	73.38
THOH17	9	11	8	147	3.4	0.8	28.5	1.2	2	0.5	3.9	13	1.7	2	2	3	5
TOWH28	6.9	6	7.9	338	6.3	1.1	47.4	10.5	2.5	1.7	2	12	3.3	6.8	2	1	0
TOWH131	5.9	6.4	7.8	354	1.28	0.42	54.79	12.71	2.2	4.53	24.75	41.57	5.98	6.93	5.41	2.06	3.53
TOWH132	5.8	6.4	7.9	349	0.6	0.2	65.89	3.02	1.16	11.2	6.57	14.05	5.47	3.81	5.41	2.06	2.65
TRLH101	7	7	n.a.	n.a.	0	0	27.86	3.09	0.36	1.17	15.88	1.95	1.11	1.25	3.01	1.18	5
TRLH23	9.5	14	7.7	341	2.6	0.7	58.3	3.3	2.4	3.3	2.6	5	3.6	4.3	0	0	0
TRLHS	6.6	7.8	8	298	3.33	0.88	52.01	4.66	2.27	6.28	6.57	3.22	2.46	4.03	0.3	1.18	5.69
TRLWGS	6.6	7.8	7.9	323	4.16	0.91	60.05	3.27	2.15	3.59	1.75	3.22	3.5	4.19	1.2	1.47	2.75
TRUH65	7	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
TRUH69	7	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
TRUH75	7	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
TRUH87	7	n.a.	8	2210	0.9	0.6	559.2	36	3	0.9	0.7	30	2.9	883.8	1	1	6
TRUH88	7	n.a.	7.9	2200	0.5	0.9	519.4	33.3	2.8	0.8	5.3	36	2.7	842.4	2	2	5
TRUH89	7	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
TRUH90	7	n.a.	8	2210	1.3	0.7	557.1	35.7	3.1	0.8	1.1	35	2.7	881.8	1	2	3
TUEH100	11	16	7.3	736	1.3	1	107.3	12.3	2.5	6.2	7.2	102	6.9	19.9	2	1	4
TUFH154	8	15	8.4	489	0	0	64.46	16.92	1.2	6.9	2.96	0.12	5.66	44.01	0.9	0.59	16.76
TSSH152	9.5	10	8.2	428	0	0	74.61	5.25	1.15	0.2	2.74	1.76	5.32	8.56	0.9	2.35	2.94
USBH14	9	9	8.2	188	2.4	0.7	37.7	1.6	1.9	0.6	2.8	5	1.4	2.2	2	2	4
USBH37	10	10	8	267	5.1	0.8	51.6	1.6	0	0.5	3.9	13	1.8	2.3	2	2	5
WBHH61	2	2	7.8	189.3	0.2	0.1	39.4	1.2	0.6	1.2	2.8	1	1	1.1	2	2	471
WHLH78H81	10	10	7.8	272	0	0.32	42.83	8.42	0.72	3.56	4.27	21.66	4.11	2.92	9.92	6.91	37.5
WLSQ131	12	13	7.8	759	6.5	1.4	89.5	39	5.9	26.8	15.5	49	22.5	110	2	1	7
WMLH103	8.5	8.5	8.1	231	0	0	38.4	3.3	0.7	3.3	2.41	0.59	2.73	2.6	7.21	3.92	7.16

Tab. AX 5: Information on individual samples.

sample ID	Sampling Date yyyymmdd	Cave name	Water body type	Water body stability	Water body movement	Infiltration	Sediment type	Water body size	Water body connection	Observer on site
ALSH105	20250209	Altenbergschacht	stream	perennial	flowing	diffuse	coarse	big	connected	L. Plan
AMAH151	20250225	Amanda Unterbau	pool	perennial	stagnant	diffuse	fine	medium	unknown	H. Mixanig, K. Krainer. W. Kramer
BARH140	20250204	Barbarastollen	stream	perennial	flowing	diffuse	coarse	small	connected	H. Mixanig,K.Krainer, R. Schiegl
BAE135	20250405	Bärenloch	pool	perennial	stagnant	unknown	coarse	small	unknown	K. Bürger, L. Plan
BAE123	20250405	Bärenloch	siphon	perennial	stagnant	unknown	coarse	medium	unknown	K. Bürger, L. Plan
BALH6	20240302	Bärenlucke	pool	perennial	stagnant	diffuse	fine	small	connected	K. Bürger, Linus A., Caspar S.
BALH7	20240302	Bärenlucke	stream	episodic	flowing	diffuse	fine	small	connected	K. Bürger, Linus A., Caspar S.
BASH138	20250213	Baschghöhle	stream	perennial	flowing	diffuse	coarse	big	connected	W. Breuß
BRUH136	20250212	Brühlhöhle	stream	episodic	flowing	diffuse	coarse	medium	connected	W. Breuß
BULH21	20240513	Bullenhöhle	pool	episodic	stagnant	diffuse	fine	small	isolated	L. Plan, B. Funk, R. Seebacher, M. Nagl, K. Bürger
BURH157	20250817	Burianhöhle	stream	perennial	flowing	diffuse	fine	tiny	connected	K. Bürger, Linus A., A. Muttenthaler
DAMH32	20240531	Dachstein-Mammuthöhle	driplet pool	perennial	stagnant	diffuse	fine	small	isolated	L. Altersberger, L. Plan
DAMH129	20250607	Dachstein-Mammuthöhle	stream	perennial	flowing	diffuse	coarse	small	connected	I. Sedlmayr, R. Michtner
DAMH130	20250607	Dachstein-Mammuthöhle	pool	perennial	stagnant	diffuse	coarse	small	unknown	R. Michtner, Lina Rummler, L. Plan
DARH33	20240601	Dachstein-Rieseneishöhle	pool	perennial	stagnant	diffuse	fine	medium	isolated	Lukas Plan, Richard Michter
DAVH146	20250518	Da-Vinci-Höhle	pool	perennial	stagnant	diffuse	fine	small	unknown	J. Landertshammer
DAVH147	20250518	Da-Vinci-Höhle	stream	perennial	flowing	diffuse	fine	small	connected	J. Landertshammer
DAVH168	20250706	Da-Vinci-Höhle	siphon	perennial	stagnant	diffuse	fine	small	unknown	J. Landertshammer
DAVH142	20250416	Eggerloch	pool	episodic	stagnant	diffuse	coarse	tiny	unknown	H. Mixanig,
EISH108	20241220	Eisensteinhöhle	pool	episodic	stagnant	diffuse	fine	tiny	isolated	L. Plan, I. Sedelmayr, M. Hiptmair, R. Michter
EISH109	20241220	Eisensteinhöhle	driplet pool	perennial	stagnant	diffuse	fine	medium	connected	L. Plan, I. Sedelmayr, M. Hiptmair, R. Michter
EIGH176	20250609	Eisgrabenschacht	driplet pool	perennial	flowing	diffuse	coarse	small	unknown	D. Wundsam
ELUH122	20250429	Eislüg	pool	unknown	stagnant	diffuse	fine	medium	unknown	L. Plan, Heli Steinmaßl
ELMH53	20240722	Elmhöhlensystem	stream	perennial	flowing	diffuse	coarse	small	connected	Lukas Plan, Linus Altersberger
ELMH60	20240722	Elmhöhlensystem	stream	perennial	flowing	diffuse	coarse	small	connected	Lukas Plan, Linus Altersberger
ELMHH169	20250810	Elmhöhlensystem	stream	perennial	flowing	diffuse	coarse	medium	connected	Jasmin Landertshammer, Lukas Plan
ERWH18	20240511	Eisriesenwelt	pool	perennial	stagnant	diffuse	fine	small	isolated	K. Bürger, D. Wundsam
ERWH19	20240511	Eisriesenwelt	pool	unknown	stagnant	diffuse	none	small	isolated	K. Bürger, D. Wundsam
ERWH20	20240511	Eisriesenwelt	pool	perennial	stagnant	diffuse	coarse	medium	isolated	K. Bürger, D. Wundsam
FAL_1	20221007	Falkensteinhöhle	driplet pool	episodic	stagnant	diffuse	fine	tiny	isolated	Christian Griebler
FAL_2	20231007	Falkensteinhöhle	driplet pool	episodic	stagnant	diffuse	fine	tiny	isolated	Christian Griebler
FEIH56	20240810	Feistringgrabenhöhle	siphon	perennial	stagnant	diffuse	fine	big	connected	D. Wundsam, J. Zollner
FISH144	20250427	Fischeralmstollen	pool	perennial	stagnant	unknown	coarse	medium	isolated	H. Mixanig, J. Kogler, R. Röbl
FLAH149	20250212	Fladung-Hochobir	lake	perennial	stagnant	diffuse	fine	big	unknown	H. Mixanig,K.Krainer, R. Schiegl
FMLH29	20240519	Frauenmauer-Langsteinhöhle	stream	perennial	flowing	diffuse	coarse	small	connected	D. Wundsam, K. Bürger
FRSH50	20240803	Freschenhöhle	driplet pool	perennial	stagnant	diffuse	fine	tiny	unknown	Klaus Ritter
FRSH52	20240825	Freschenhöhle	driplet pool	perennial	stagnant	diffuse	fine	tiny	unknown	Klaus Ritter
FRSH57	20240825	Freschenhöhle	driplet pool	perennial	stagnant	diffuse	fine	tiny	unknown	Klaus Ritter
FRSH59	20240825	Freschenhöhle	driplet pool	perennial	stagnant	diffuse	fine	tiny	unknown	Klaus Ritter
FRSH67	20240803	Freschenhöhle	driplet pool	perennial	stagnant	diffuse	fine	tiny	unknown	Klaus Ritter
FRSH70	20240803	Freschenhöhle	driplet pool	perennial	stagnant	diffuse	fine	tiny	unknown	Klaus Ritter
FSSH31	20240608	Tonion-Höhlensystem	lake	perennial	stagnant	diffuse	none	small	isolated	Nastia, Barbara
FSSH121	20250412	Tonion-Höhlensystem	pool	unknown	stagnant	diffuse	coarse	small	unknown	L. Altersberger
FSSH120	20250412	Tonion-Höhlensystem	pool	perennial	stagnant	diffuse	coarse	medium	unknown	L. Altersberger

Tab. AX 6: Information on individual samples.

sample ID	Sampling Date yyyymmdd	Cave name	Water body type	Water body stability	Water body movement	Infiltration	Sediment type	Water body size	Water body connection	Observer on site
GGHH63	20240821	Griesgrabenhöhle	pool	perennial	stagnant	diffuse	coarse	tiny	isolated	M. Hiptmair, R. Michtner
GRBH1	20240205	Grillenbergwerk	pool	episodic	stagnant	diffuse	fine	tiny	isolated	K. Bürger, Bernhard Umreich
GRBH171	20250728	Grillenbergwerk	lake	perennial	stagnant	diffuse	coarse	medium	unknown	K. Bürger, Bernhard Umreich
GUEH44	20240727	Güntherhöhle	pool	episodic	stagnant	diffuse	fine	tiny	isolated	R. Michtner
HAMH97	20241112	Hammerbach-Ursprung	stream	perennial	flowing	point recharge	fine	big	connected	I. Sedlmayr
HEM	20231105	Hermannshöhle	driplet pool	unknown	stagnant	diffuse	fine	big	isolated	
HINH179	20250828	Hinterbergerbach-Schwinde	stream	perennial	flowing	diffuse	coarse	small	connected	R. Pavuza, P. Cech
HERH83H94	20241027	Herdengelhöhle	driplet pool	unknown	stagnant	diffuse	fine	small	unknown	C. Griebler, K. Bürger
HIGH40	20240613	Hirschgrubenhöhle	driplet pool	perennial	stagnant	diffuse	coarse	medium	isolated	Eva Kaminsky
HIGH139	20250508	Hirschgrubenhöhle	pool	episodic	stagnant	diffuse	none	small	unknown	R. Michtner, E. Kaminsky
HILH107	20250105	Hirlatzhöhle	siphon	perennial	stagnant	diffuse	fine	big	unknown	B.Wielander, M. Mundschitz
HILH79	20240803	Hirlatzhöhle	siphon	perennial	stagnant	diffuse	fine	medium	connected	B. Wielander, Claudia Teissl, Rafäl Wagner
HFAH180	20240526	Hirschfallhöhle	pool	perennial	flowing	diffuse	fine	small	unknown	B. Wielander, K. Bürger
HOGH91	20241007	Hochlecken-Grosshöhle	pool	perennial	stagnant	diffuse	unknown	unknown	unknown	C. Roither,
HOFH159	20250823	Hofertalschacht	driplet pool	perennial	stagnant	diffuse	coarse	small	unknown	D. Wundsam, J. Wallner
HKSH178	20250914	Hochkarschacht	pool	perennial	stagnant	diffuse	fine	medium	isolated	R. Michtner
HOHH95	20241026	Hohlensteinhöhle	stream	perennial	flowing	diffuse	coarse	small	connected	L. Plan, H. Korbel
HOLH96	20241124	Höllenloch	siphon	perennial	stagnant	diffuse	coarse	big	unknown	B. Wielander, Olesia Riznyk
HWQH173	20250309	Höllwandqülle	siphon	perennial	stagnant	diffuse	coarse	big	connected	L. Plan
HUAH43	20240716	Hundalm Eishöhle	lake	unknown	stagnant	diffuse	fine	medium	isolated	C. Spötl
KJFH141	20250212	Kaiser-Josephi-Fundgrube	pool	perennial	stagnant	diffuse	fine	small	isolated	K. Bürger, L. Altersberger, M. Hiptmair
KAMH102	20241219	Kammschacht	pool	episodic	stagnant	diffuse	fine	tiny	isolated	L. Atlersberger, B. Funk, K. Bürger
KLAH82H85H93	20241027	Klafflingbrunnen	stream	perennial	flowing	diffuse	coarse	big	connected	C. Griebler, K. Bürger
KLGH150	20250209	Klausengrube	lake	perennial	stagnant	diffuse	coarse	medium	unknown	H.Mixanig, J. Kogler
KOHH9	20240223	Kohlerhöhle	lake	perennial	stagnant	diffuse	coarse	big	isolated	K. Bürger, David W., Caspar S., Jürgen T.
KOHH137	20250224	Kohlerhöhle	lake	perennial	stagnant	diffuse	coarse	medium	unknown	K. Bürger, D. Geich , C. Schönthaler, M. Wicher, Sabine
KOHH174	20250709	Kohlerhöhle	lake	perennial	stagnant	diffuse	coarse	medium	unknown	K. Bürger, G. & R. Winkler
KOSH34	20240630	Komfort-Schluchthöhle	pool	unknown	stagnant	diffuse	fine	small	isolated	D. Wundsam, J. Wallner
KONH155	20250221	Konradhöhle	stream	perennial	flowing	point recharge	coarse	medium	connected	L. Plan
KONH156	20250221	Konradhöhle	stream	perennial	flowing	point recharge	coarse	small	connected	L. Plan
KOPH124	20250609	Koppenbrüllerhöhle	stream	perennial	flowing	diffuse	coarse	medium	connected	L. Altersberger, I. Sedlmayr
KOPH128	20250609	Koppenbrüllerhöhle	pool	episodic	stagnant	diffuse	coarse	medium	unknown	L. Altersberger, I. Sedlmayr
KREH125	20250601	Kreidelucke	pool	perennial	stagnant	diffuse	fine	small	unknown	W. Buchbauer, M. Dornmayr
KREH175	20250601	Kreidelucke	lake	perennial	stagnant	diffuse	fine	medium	unknown	W. Buchbauer, M. Dornmayr
KREH153	20250601	Kreidelucke	unknown	unknown	unknown	unknown	unknown	unknown	unknown	W. Buchbauer, M. Dornmayr
KUEH15	20240430	Kühlloch	stream	perennial	flowing	diffuse	coarse	small	connected	Barbara Wielander, Georg Gasser
KUEH38	20240704	Kühlloch	stream	perennial	flowing	diffuse	coarse	small	connected	Barbara Wielander, Clemens Pausz
LBHH98	20241107	Leitenhöhle	pool	perennial	stagnant	diffuse	fine	small	isolated	I. Sedlmayr
LSSH35	20240618	Luftschutzstollen Enzesfeld	pool	unknown	stagnant	diffuse	unknown	unknown	isolated	A. Reischütz, E. Christian, O. Moog
LURH58	20240803	Lurgrotte	stream	perennial	flowing	point recharge	fine	small	connected	D. Wundsam, J. Zollner
LURH160	20250222	Lurgrotte	stream	perennial	flowing	diffuse	coarse	medium	connected	I. Sedlmayr
LURH161	20250222	Lurgrotte	driplet pool	perennial	stagnant	diffuse	fine	small	connected	I. Sedlmayr
LURH162	20250222	Lurgrotte	driplet pool	perennial	stagnant	diffuse	fine	small	isolated	I. Sedlmayr
LURH163	20250222	Lurgrotte	driplet pool	perennial	stagnant	diffuse	fine	medium	isolated	I. Sedlmayr

Tab. AX 7: Information on individual samples.

sample ID	Sampling Date yyyymmdd	Cave name	Water body type	Water body stability	Water body movement	Infiltration	Sediment type	Water body size	Water body connection	Observer on site
LURH110	20200818	Lurgrotte	unknown	unknown	stagnant	unknown	unknown	unknown	unknown	S. Gaviria, C. Griebler, A. Retter
LURH111	20200818	Lurgrotte	unknown	unknown	stagnant	unknown	unknown	unknown	unknown	S. Gaviria, C. Griebler, A. Retter
LURH112	20200818	Lurgrotte	unknown	unknown	stagnant	unknown	unknown	unknown	unknown	S. Gaviria, C. Griebler, A. Retter
LURH113	20200818	Lurgrotte	stream	unknown	flowing	unknown	unknown	unknown	connected	S. Gaviria, C. Griebler, A. Retter
LURH114	20200818	Lurgrotte	stream	unknown	flowing	unknown	unknown	unknown	connected	S. Gaviria, C. Griebler, A. Retter
LURH115	20200818	Lurgrotte	driplet pool	unknown	stagnant	unknown	unknown	tiny	unknown	S. Gaviria, C. Griebler, A. Retter
LURH117	20200818	Lurgrotte	unknown	unknown	stagnant	unknown	unknown	unknown	unknown	S. Gaviria, C. Griebler, A. Retter
MAIH16	20240714	Mailoch	pool	episodic	stagnant	diffuse	coarse	medium	connected	T. Exel, W. Fischer, E. Hermann
MAUH84H86	20241027	Mausrodlhöhle	siphon	perennial	stagnant	diffuse	coarse	big	connected	C. Griebler, K. Bürger
MYAH4	20240307	Miralucke	siphon	perennial	stagnant	diffuse	none	big	connected	Liliana Kukacka, Gloria Paveza, Christian Griebler
MYAH41	20240718	Miralucke	pool	episodic	stagnant	diffuse	coarse	medium	connected	G. Paveza, L. Kukacka
MYAH47	20240802	Miralucke	pool	episodic	stagnant	diffuse	coarse	medium	connected	G. Paveza, C. Griebler
MYAH8	20240307	Miralucke	pool	episodic	stagnant	diffuse	coarse	medium	connected	Liliana Kukacka, Gloria Paveza, Christian Griebler
NAGH73	20240718	Naglsteghöhle	siphon	perennial	stagnant	diffuse	coarse	big	connected	M. Nag, L. Plan
NASH26	20240103	Nasses Loch	stream	perennial	flowing	diffuse	coarse	small	connected	Liliana Kukacka
NASH74	20241026	Nasses Loch	stream	perennial	flowing	diffuse	coarse	small	connected	Gloria Paveza
NBHH27	20240505	Nestelberghöhle	stream	perennial	flowing	point recharge	coarse	medium	connected	Barbara Wielander, Rafäl Wagner
NWSH51	20240813	Nordwandschacht	driplet pool	unknown	stagnant	diffuse	fine	medium	isolated	Tanguy Racine
OSBH13	20240430	Obere Schiesserbachhöhle	stream	perennial	flowing	diffuse	none	medium	connected	Barbara Wielander, Georg Gasser
OSBH36	20240704	Obere Schiesserbachhöhle	stream	perennial	flowing	diffuse	none	medium	connected	Barbara Wielander, Clemens Pausz
OTHH106	20250201	ötschertropfsteinhöhle	lake	perennial	stagnant	diffuse	fine	big	isolated	K. Bürger, H. Wahl, K. & T. Horvath
OTHH2	20240209	ötschertropfsteinhöhle	pool	episodic	stagnant	diffuse	fine	small	isolated	K. Bürger, Manül Hiptmair, Hans-Peter Wahl
OTHH5	20240209	ötschertropfsteinhöhle	lake	perennial	stagnant	diffuse	fine	big	isolated	K. Bürger, Manül Hiptmair, Hans-Peter Wahl
PAPH39	20240702	Portal am Pfaffenkappel	stream	unknown	flowing	diffuse	fine	small	connected	Barbara Wielander, Clemens Tirler
PAUH3	20240213	Paulinenhöhle	pool	perennial	stagnant	diffuse	coarse	medium	isolated	K. Bürger, L. Altenberger
PAUH143	20250213	Paulinenhöhle	pool	perennial	stagnant	diffuse	coarse	medium	isolated	L. Altenberger, K. Bürger, M. Hiptmair
PIEH64	20240912	Piessling-Ursprung	stream	perennial	flowing	diffuse	none	big	connected	L. Plan
RISH10	20240223	Rinnender Stein	pool	episodic	stagnant	diffuse	coarse	medium	connected	K. Bürger, David W., Caspar S.
RUDH45	20240723	Rudolfstollen	pool	perennial	stagnant	diffuse	fine	medium	isolated	Rudolf Pavuza, Walter Greger
RUDH46	20240723	Rudolfstollen	pool	perennial	stagnant	diffuse	fine	medium	isolated	Rudolf Pavuza, Walter Greger
RUDH99	20241110	Rudolfstollen	pool	unknown	stagnant	diffuse	fine	small	isolated	R.Pavuza
RWAH22	20240511	Reichenwaldhöhle	driplet pool	episodic	stagnant	diffuse	fine	medium	isolated	Eva Kaminsky, Tobias Tengler
RETH126	20250601	Rettenbachhöhle	lake	perennial	stagnant	diffuse	fine	medium	unknown	W. Buchbauer, M. Dornmayr
RETH127	20250601	Rettenbachhöhle	lake	perennial	stagnant	diffuse	fine	big	unknown	W. Buchbauer, M. Dornmayr
SAEH62	20240906	Stadelalm-Eiskluft	pool	episodic	stagnant	diffuse	coarse	tiny	unknown	G. Bruckner, D. Gonzalez
SAEH68	20240906	Stadelalm-Eiskluft	pool	perennial	stagnant	diffuse	coarse	medium	unknown	G. Bruckner, D. Gonzalez

Tab. AX 8: Information on individual samples.

sample ID	Sampling Date yyyymmdd	Cave name	Water body type	Water body stability	Water body movement	Infiltration	Sediment type	Water body size	Water body connection	Observer on site
SBHH30	20240526	Schönberg-Höhlensystem	driplet pool	perennial	stagnant	diffuse	fine	small	isolated	M. Nag, L. Plan
SBHH145, H165	20250525	Schönberg-Höhlensystem	pool	unknown	stagnant	diffuse	fine	small	unknown	L. Plan
SWRH170	20250704	Schwabenreithhöhle	pool	episodic	stagnant	diffuse	fine	small	unknown	K. Bürger, L. Plan, D. Sulzbacher, M. Wicher
SEEH158	20250814	Seegrotte	lake	perennial	stagnant	diffuse	fine	big	unknown	K. Bürger, M. Wicher
SCHH11	20240331	Schachernhöhle	stream	perennial	flowing	point recharge	coarse	medium	connected	K. Bürger, M. Hiptmair
SCHH12	20240331	Schachernhöhle	pool	episodic	stagnant	diffuse	coarse	small	connected	K. Bürger, M. Hiptmair
SCHH133	20250312	Schachernhöhle	pool	episodic	stagnant	diffuse	coarse	small	isolated	L. Altersbeger, K. Bürger
SCHH134	20250312	Schachernhöhle	stream	perennial	flowing	diffuse	coarse	small	connected	L. Altersbeger, K. Bürger
SNLH48H71H72	20240810	Schneckenloch	driplet pool	unknown	stagnant	diffuse	fine	tiny	isolated	Klaus Ritter
SNLH49	20240824	Schneckenloch	stream	unknown	flowing	diffuse	fine	small	connected	Klaus Ritter
SNLH54	20240824	Schneckenloch	stream	unknown	flowing	point recharge	coarse	small	connected	Klaus Ritter
SNLH66	20240810	Schneckenloch	stream	unknown	flowing	point recharge	coarse	small	connected	Klaus Ritter
SNLH92	20240824	Schneckenloch	driplet pool	unknown	stagnant	diffuse	fine	tiny	isolated	Klaus Ritter
SPAH77	20241002	Spannagelhöhle	stream	perennial	flowing	diffuse	fine	small	connected	R. Tobitsch
SPAH80	20241002	Spannagelhöhle	pool	perennial	stagnant	diffuse	fine	small	unknown	R. Tobitsch
SSSH24	20240509	Siebenschläferschacht	driplet pool	perennial	stagnant	diffuse	fine	small	isolated	Eva Kaminsky, Tobias Tengler
SSSH25	20240509	Siebenschläferschacht	driplet pool	perennial	stagnant	diffuse	fine	small	isolated	Eva Kaminsky, Tobias Tengler
STSH76	20240904	Steinbockschacht	stream	perennial	flowing	diffuse	coarse	small	connected	Eva Kaminsky, Lukas Plan
SGSH119	20250412	Stiller-Graben-Stollen	lake	perennial	stagnant	diffuse	fine	small	unknown	R. Pavuza, P. Cech
SFLH148	20250221	Stollen Flattnitz	lake	unknown	stagnant	diffuse	coarse	big	unknown	R. Pavuza, P. Cech
TAUH177	20250911	Taubenloch	pool	perennial	stagnant	diffuse	none	small	isolated	E. Herrmann, T. Exel, J. Wallner
TBHH42	20240724	Turnerbundhöhle	pool	episodic	stagnant	diffuse	fine	tiny	isolated	M. Hiptmair, R. Michtner
TEUH104	20241029	Tonion-Höhlensystem	driplet pool	perennial	stagnant	diffuse	fine	small	isolated	K. Bürger, L. Plan, C. Schönthaler
THOH17	20240430	T-Höhle	stream	perennial	flowing	diffuse	coarse	medium	connected	Barbara Wielander, Georg Gasser
TOWH28	20240520	Totes Weib	stream	perennial	flowing	point recharge	none	medium	connected	L. Plan
TOWH131	20250621	Totes Weib	lake	perennial	flowing	diffuse	coarse	medium	unknown	Lukas Plan, Petra Platzer
TOWH132	20250621	Totes Weib	pool	perennial	stagnant	diffuse	fine	medium	unknown	Lukas Plan, Petra Platzer
TRLH101	20241216	Trockenes Loch	pool	perennial	stagnant	diffuse	none	medium	unknown	L. Kukacka
TRLH23	20240615	Trockenes Loch	siphon	perennial	stagnant	diffuse	fine	big	connected	Liliana Kukacka
TRLHS	20240103	Trockenes Loch	siphon	perennial	stagnant	diffuse	fine	big	connected	L. Kukacka
TRLWGS	20240103	Trockenes Loch	siphon	perennial	stagnant	diffuse	fine	big	connected	L. Kukacka
TRUH65	20240811	Trübbachhöhle	stream	unknown	flowing	diffuse	fine	small	connected	Klaus Ritter
TRUH69	20240811	Trübbachhöhle	stream	unknown	flowing	diffuse	coarse	small	connected	Klaus Ritter
TRUH75	20240811	Trübbachhöhle	stream	unknown	flowing	diffuse	fine	medium	connected	Klaus Ritter
TRUH87	20240823	Trübbachhöhle	stream	unknown	flowing	diffuse	coarse	small	connected	Klaus Ritter
TRUH88	20240823	Trübbachhöhle	stream	unknown	flowing	diffuse	fine	small	connected	Klaus Ritter
TRUH89	20240823	Trübbachhöhle	pool	unknown	stagnant	diffuse	fine	small	unknown	Klaus Ritter
TRUH90	20240823	Trübbachhöhle	stream	unknown	flowing	diffuse	fine	medium	connected	Klaus Ritter
TUEH100	20240803	Türkenbrunnen	pool	perennial	stagnant	diffuse	fine	small	connected	Tommi Gramanitsch, Silvia Wendelin
TUFH154	20250305	Tuffsteinhöhle	lake	perennial	stagnant	diffuse	fine	big	unknown	R. Pavuza
TSSH152	20250409	Türkenschanzstollen	stream	perennial	flowing	diffuse	fine	small	connected	H. Mixanig,
USBH14	20240430	Untere Schiesserbachhöhle	stream	perennial	flowing	diffuse	coarse	small	connected	Barbara Wielander, Georg Gasser
USBH37	20240704	Untere Schiesserbachhöhle	stream	perennial	flowing	diffuse	coarse	small	connected	Barbara Wielander, Clemens Pausz
WBHH61	20240815	Wildbaderhöhle	pool	perennial	stagnant	diffuse	fine	small	isolated	Robert Seebacher, Sebastian Seebacher
WHLH78H81	20241027	Wilhelminenhöhle	pool	unknown	stagnant	diffuse	fine	small	unknown	C. Griebler, K. Bürger
WLSQ131	20240813	Wasserleitungsstollen	stream	perennial	flowing	diffuse	fine	small	connected	R. Michtner
WMLH103	20241230	Wildemannloch	pool	perennial	stagnant	diffuse	fine	small	unknown	K. Bürger, A. & M. Schildberger, J. Waller, J. Zollner