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Introduction

The impact of Climate Change on biodiversity patterns has been investigated and predicted in a large number of recent case studies addressing amongst others mammals (Guralnick 2007), birds (Julliard et al. 2004, Simmons et al. 2004), amphibians (Bernado & Spotila 2006, Pounds et al. 2006), terrestrial insects (Wilson et al. 2005), spiders (Gobbi et al. 2006), terrestrial plants (Skov & Svenning 2004, Fosaa et al. 2004), combinations of different taxonomic groups (Thomas et al. 2004, Harrison et al. 2006) and hypothetical species (Travis 2003). Frequently used attempts for the prediction of Climate Change effects on the distribution and extinction of species include Population Viability Analysis (Maschinski et al. 2006), a large number of modelling techniques (recent reviews by Araujo & Rahbeck 2006 and Elith et al. 2006) ranging from the local (del Barrio et al. 2006) to the global scales (Thomas et al. 2004), the quantification of climatically suited areas under future climatic conditions (Ohlemüller et al. 2006) and the use of Red List Criteria (Akcakaya et al. 2006) and species traits (Svenning & Skov 2006).

Only a limited number of studies, however, address changes in biodiversity patters of freshwater ecosystems, e.g. of phytoplankton communities (Elliott et al. 2006) and fish (Xenopoulos et al. 2005). This is despite the fact that Climate Change could have serious impacts on freshwater ecosystems (Gipson et al. 2005, Schippers et al. 2005, Wrona et al. 2006) and with great effects likely on most freshwater organism groups, particularly those with limited dispersal capacity. However, most of the above mentioned approaches to model the effects of Climate Change are not applicable for taxa whose ecology has been less intensively investigated, such as most aquatic invertebrates, since they depend on a detailed knowledge of the species distribution, autecology and population ecology. In this study, we address the potential impacts of changing climate on the aquatic insect order Trichoptera (caddisflies) and evaluate the possibilities for simple predictions.

The order Trichoptera includes more then 12,000 described species (http://entweb.clemson.edu/database/trichopt/), more than 1,000 of which occur in Europe. A very diverse range of ecological traits are found within the Trichoptera; the feeding strategies of the larvae include the breakdown of leaves and wood, the collection of drifting material by nets or specialized mouthparts, scraping of algae, sucking of algae cells and predation. Trichoptera species inhabit most freshwater ecosystem types, including springs, small streams, large rivers, lakes and wetlands; some species even live in brackish water. Like most aquatic insects, the egg, larval and pupal stages are mainly aquatic, while the adults live in the terrestrial environment (the genus *Enoicyla* lives (semi)terrestrial in all stages). As a species-rich and ecologically diverse insect order caddisflies are well-suited to reflect the intensity of different stressors on aquatic ecosystems. While several studies address the impact of organic pollution (e.g. Zelinka & Marvan 1961, Armitage et al. 1983, Statzner et al 2001), hydromorphological degradation (e.g. Statzner et al. 2001, Buffagni et al. 2004, Lorenz et al. 2004), acidification (e.g. Townsend et al. 1983, Sandin et al. 2004) and pesticides (Schulz 2004) on Trichoptera and other aquatic invertebrates, this study aims at estimating the potential impact of Climate Change on European Trichoptera biodiversity, by:

- Compiling all available data on autecology and distribution of European Trichoptera taxa;
- analysing the sensitivity of the species for Climate Change impacts, based on their distribution and selected autecological parameters;
- comparing the share of species potentially endangered by Climate Change between the European ecoregions.

This analysis is based on the following hypotheses:

- Species with restricted distribution ("endemic species") characterized by a restricted ecological niche and limited dispersal capacity are more severely threatened by Climate Change than widely distributed species, as shown for vascular plants (Malcolm et al. 2006).
- Species inhabiting the potamal zone (larger rivers) may react to rising temperatures by colonizing upstream river reaches; species inhabiting the crenal zone (springs) can not move further upstream, and are thus more threatened by Climate Change. In general, species living in high altitudes are particularly endangered by Global Warming (Fossa et al. 2006).

- Species adapted to low water temperatures ("cold-stenothermic species") are threatened by Climate Change rather than eurythermic species.
- Species with restricted ecological niches (specialists), e.g. specialized food sources, are more sensitive to large-scale changes, such as Climate Change, than species with broad niches (generalists).

Methods

Data compilation

A total of 19 parameters describing Trichoptera autecology and distribution were selected and for each parameter a coding system was defined (Table 1). For some parameters (occurrence in ecoregions, occurrence in altitude ranges) we coded data as "yes" (occurring) and "no" (not occurring). Other parameters, such as pH preference and reproduction techniques, were coded by selecting one category out of a given list of categories (one assignment). In most cases the coding systems are based on the 10-point-system according to Zelinka & Marvan (1961): 10 points are distributed among different categories of a given ecological parameter according to e.g. to the preference of a species for a microhabitat. This coding system was applied to all parameters, for which the species autecology is characterized by different categories of the parameter.

Table 1: Autecological and distribution parameters and coding system.

Parameter	Categories	Coding system
Occurrence in ecoregions	27 ecoregions according to Illies (1978)	yes/no
Stream zonation preference	• eucrenal (spring) • hypocrenal (spring-brook) • epirhithral (upper-trout region) • metarhithral (lower-trout region) • hyporhithral (greyling region) • epipotamal (barbel region) • metapotamal (brass region) • hypopotamal (brackish water) • littoral • profundal	10 point system
Altitude preference (altitude I)	• nival • subnival • alpin • subalpin	10 point system

Parameter	Categories	Coding system
	• montan • submontan • collin • planar	
Altitude preference (altitude II)	• >800 m • 200-800 m • <200 m	yes/no
Current preference	• limnobiont • limnophil • limno to rheophil • rheo to limnophil • rheophil • rheobiont • indifferent	one assignement
Substrate/microhabitat preference	• pelal (mud; grain size < 0.063 mm) • argyllal (silt, loam, clay; grain size < 0.063 mm) • psammal (sand; grain size 0.063-2 mm) • akal (fine to medium-sized gravel; grain size 0.2-2 cm) • micro-/mesolithal (coarse gravel to hand-sized cobbles; grain size 2-20 cm) • macro-/megalithal (stones, boulders, bedrock; grain size > 20 cm) • hygropetric (thin layers of water over bedrocks; water-falls) • algae (Micro- and macroalgae) • macrophytes (macrophytes, including moss and Characeae as well as living parts of terrestrial plants) • particulate organic matter • woody debris (woody debris: twigs, roots, logs; size > 10 cm) • madicol (at the edge of water bodies in moist sub-strates, mostly in macrophytes, mosses and dead woody debris)	10 point system
Temperature preference (maximal morning tem-perature in summer/mean maximum in summer)	• very cold (<6°C) • cold (<10°C) • moderate (<18°C) • warm (>18°C) • eurythermic (no preference)	10 point system
Temperature range prefer-ence	• cold stenotherm • warm stenotherm • eurytherm	one assignement
Hydrologic preference	• eupotamon (main channel and connected side arms) • parapotamon (side arms connected only at the down-stream end at mean water levels) • plesiopotamon (no connectivity with the main channel at mean water levels; coverage by macrophytes does not exceed 20%) • palaeopotamon (no connectivity with the main channel at mean water levels; coverage by macrophytes exceeds 20%; pools & ponds included) • temporary water bodies (temporary pools, water level primarily dependent on ground water levels)	10 point system

Parameter	Categories	Coding system
pH preference	• acid • neutral to alkaline • indifferent	one assignement
Feeding type	• grazer/scraper • miner • xylophagous • shredder • gatherer/collector • active filter feeder • passive filter feeder • predator • parasite • other feeding type	10 point system
Locomotion type	• swimming/scating • swimming/diving • burrowing/boring • sprawling/walking • (semi)sessil • other locomotion type	10 point system
Life duration	• ≤ 1 year • > 1 year	one assignement
Aquatic stage	• egg • larva • nymph • pupa • adult	10 point system
Resistance/resilience to droughts	• no drought resilience • egg diapause • larvae diapause • adult diapause • unknown resistance type	one assignement
Reproduction	• ovoviviparity • isolated eggs, free • isolated eggs, cemented • clutches, cemented or fixed • clutches, free • clutches, in vegetation • clutches, terrestrial • asexual reproduction • parasitic	one assignement
Respiration	• tegument • gill • plastron • spiracle (aerial) • hydrostatic vesicle (aerial) • tapping of air stores of aquatic plants • extension/excursion to surface	yes/no
Duration emergence period	• long • short	one assignement
Emergence period	• winter • spring	10 point system

Parameter	Categories	Coding system
	• summer • fall	

Furthermore, we collected data on the following parameters: habitat specialist, reproductive life cycle, dissemination strategy, resistance form, salinity, larval development, rare species, red list species, FFH species, disjunct isolated populations, r-, K-strategy, sensitive species, alien species, occurrence in large quantities, dispersal capacity, indicator species. However, these data were available for < 5% of the taxa and thus not further regarded in this study.

More then 1,400 literature references on distribution and autecology of European Trichoptera taxa were evaluated. The literature review covered published and “grey” literature, such as Master- and PhD-theses. Distribution and autecology of the taxa were coded according to the system explained in Table 1. The data were stored in a database, which is available at www.freshwaterecology.info (Euro-Limpacs consortium 2006, Graf et al. 2006).

Description of the database

Overall, we collected data on 1,165 European Trichoptera species and subspecies. For several autecological parameters only limited information could be extracted from the literature. Table 2 gives an overview of the completeness of parameters, which ranges from 5.92% to 100%. Besides the parameter “distribution in ecoregions” (all species and subspecies classified), particularly high shares of classified taxa were obtained for the parameters “current preference” (83.95%), “stream zonation preference” (67.41%) and “substrate/microhabitat preference” (66.70%).

Table 2: Completeness of autecological information for the 1,165 European Trichoptera taxa.

Parameter	Share of classified species and subspecies (%)
Distribution in ecoregions	100.00
Stream zonation preference	67.41
Altitude preference (altitude I)	58.03
Altitude preference (altitude II)	59.40
Current preference	83.95
Substrate/microhabitat preference	66.70
Temperature preference	5.92
Temperature range preference	8.07
Hydrologic preference	14.59
pH preference	10.64
Feeding type	27.55
Locomotion type	8.24
Life duration	9.01
Aquatic stage	14.08
Resistance/resilience to droughts	7.81
Reproduction	11.59
Respiration	20.94
Duration emergence period	18.71
Emergence period	50.13

Data evaluation

All steps of data evaluation were related to the lowest possible taxonomic level, either subspecies or species. Based on the hypotheses outlined in the introduction the following parameters were defined as indicating high sensitivity to Climate Change impacts ("sensitivity parameters"): endemism, preference for springs, restricted ecological niches in terms of feeding types and habitat preferences, and preference for cold water temperatures.

The coded data on distribution and autecology were transformed to test if sensitivity parameters were matched:

- Taxa (species or subspecies) distributed in only one ecoregion were defined as "endemic taxa".

- Taxa with 9 or 10 point for the categories eucrenal and hypocrenal (parameter: stream zonation preference) were defined a specialists for springs.
- Taxa with 9 or 10 points for a single feeding type category (e.g. grazers or xylophagous taxa) were defined as taxa with specialized feeding types.
- Taxa with 9 or 10 points in a single habitat type category, e.g. akal (gravel) or psammal (sand) were defined as habitat specialists (parameter: substrate/microhabitat preference). The categories macrophytes/algae were combined. Taxa with a strong preference for lithal (stones) were not regarded as habitat specialists, since this is the dominant substrate in most European rivers.
- In addition, cold-stenothermic taxa were defined as sensitive (parameter: temperature range preference).

For each European ecoregion the number and relative share of taxa matching each sensitivity parameter was calculated. Due to a limited amount of data we did not consider the ecoregions Caucasus (24), Caspic Depression (25), North Africa (X) and Middle East (Y).

Results

Number of taxa per ecoregion

The number of taxa per ecoregion ranges between 11 (Iceland) and 374 (Alps) but is between 200 and 300 in 15 out of 23 ecoregions (Table 3).

Table 3: Number of species and subspecies per ecoregion according to Illies (1978).

Ecoregion name	Ecoregion number	Number of taxa
Iberic - Macaronesian Region	1	323
Pyrenrees	2	222
Italy, Corsica, Sardegna and Malta	3	343
Alps	4	374
Dinaric Western Balkan	5	275
Hellenic Western Balkan	6	283
Eastern Balkan	7	252
Western Highlands	8	271
Central Highlands	9	282
The Carpathians	10	297
Hungarian Lowlands	11	188
Pontic Province	12	110
Western Plains	13	240
Central Plains	14	248
Baltic Province	15	215
Eastern Plains	16	203
Ireland and Northern Ireland	17	171
Great Britain	18	200
Iceland	19	11
Borealic Uplands	20	206
Tundra	21	147
Fenno-Scandian Shield	22	210
Taiga	23	222

Sensitivity of Trichoptera species and subspecies

The individual sensitivity parameters are met by 17-48% of the taxa for which the parameter was classified (Table 4). A particularly high share is obtained by taxa with a limited distribution: 561 species and subspecies (48.15%) are limited to a single European ecoregion ("endemic taxa"), while only 126 are distributed in more than 15 ecoregions. All these taxa are adapted to potamal or wetland habitats. Four species occur in all regarded European ecoregions: *Grammotaulius nigropunctatus*, *Limnephilus affinis*, *L. auricula* and *L. sparsus*.

128 taxa have a strong preference for the crenal zone (springs), most of which belong to the families Limnephilidae (30 taxa), Glossosomatidae (17 taxa), Hydroptilidae (17 taxa), Beraeidae (13 taxa) and Apataniidae (12 taxa). 171 taxa are almost exclusively limited to the rhithral (small streams), 11 taxa to the potamal (larger rivers) and 75 taxa have a strong preference for lakes (littoral). Crenal species of mountainous regions show the highest percentages of endemism reflecting the effects of spatial separation on speciation.

Table 4: Number of sensitive Trichoptera taxa according to the sensitivity parameters.

Parameter	Number of specialized taxa	Number of classified taxa	Share of specialized taxa in relation to classified taxa (%)	Share of specialized taxa in relation to all taxa (%)
Endemism (distribution limited to one ecoregion)	561	1,165	48.15	48.15
Crenal specialists (9 or 10 points in the categories “eucrenal” and “hypocrenal”)	128	782	16.37	10.99
Cold stenothermic taxa	37	94	39.36	3.18
Feeding type specialists (9 or 10 points in a single feeding type category)	116	321	36.13	9.96
Grazer/scraper	13			
Shredder	9			
Gatherer/collector	3			
Passive filter feeder	13			
Predator	78			
Habitat type specialists (9 or 10 points in a single habitat type category)	133	777	17.12	11.42
Akal	1			
Hygropetric zones	20			
Algae and macrophytes	90			
Particulate organic matter	1			
Wood	2			
Madicol	19			

Among the 37 taxa, which have been defined as cold stenotherm, 20 are representatives of the family Rhyacophilidae, and eight representatives of the Glossosomatidae. Of the 53 eurythermic species 32 belong to the Leptoceridae and 12 to the Phryganeidae.

The feeding type specialists are mainly predators (78 out of 116 taxa), among which the Rhyacophilidae prevail (55 taxa). The 13 specialized passive filterers are all Philopotamidae (genera *Philopotamus* and *Wormaldia*), while six of the 13 specialised grazers are Goeridae.

The main habitat for habitat specialist are macrophytes and algae (90 taxa), followed by hygropetric zones (20 taxa) and madicol habitats (moist substrates at the edge of water bodies, mostly macrophytes, mosses and dead woody debris; 19 taxa). The madicol preferring taxa are almost exclusively crenal species, such as representatives of the family Beraeidae and *Crunoecia* sp. (Lepidostomatidae). The taxa preferring hygropetric zones are also crenal species, mainly *Stactobia* sp. (Hydroptilidae; 18 out of 20 taxa). Among the 90 taxa mainly living in macrophytes 63 are Hydroptilidae.

764 out of 1,165 Trichoptera taxa (65.6%) meet at least one sensitivity criterion. The majority of those (588; 50.4%) meet only a single parameter, 144 taxa (12.4%) meet two and 33 taxa (2.8%) meet three parameters. If only the parameters “endemism”, “crenal preference” and “cold stenothermy” are regarded, 642 taxa (55%) are defined as sensitive to future climate change.

Distribution of sensitive taxa in the European ecoregions

The taxa potentially sensitive to Climate Change impacts are unevenly distributed between the European ecoregions. In general, there is a strong South-North gradient, with a high number of sensitive taxa in Southern Europe and a low number in Northern Europe. Furthermore, the altitudinal gradient is obvious, with a high number of sensitive taxa in the Alps, the Pyrenees and the Carpathians, and a low number in the lowland ecoregions, such as the Central, the Western and the Eastern Plains. These patterns can be observed for all sensitivity parameters (Table 5).

Table 5: Number of Trichoptera taxa meeting the sensitivity parameters in the European ecoregions.

Ecoregion name	Ecoregion number	Number of endemic taxa	Number of crenal specialists	Number of cold stenothermic taxa	Feeding type special-ists	Habitat type special-ists	Number of sensitive taxa (all parameters)	Number of sensitive taxa (endemic taxa, crenal specialists, stenothermic taxa)
Iberic - Macaronesian Region	1	141	25	18	44	51	214	167
Pyrenrees	2	24	23	22	43	31	104	59
Italy, Corsica and Malta	3	115	44	10	68	52	211	145
Alps	4	50	51	20	73	59	187	104
Dinaric Western Balkan	5	32	30	12	49	33	124	65
Hellenic Western Balkan	6	72	26	9	30	34	144	97
Eastern Balkan	7	27	19	13	34	36	110	56
Western Highlands	8	5	28	19	60	36	111	44
Central Highlands	9	1	26	18	61	39	112	40
The Carpathians	10	48	28	16	49	35	146	83
Hungarian Lowlands	11	1	13	10	39	35	77	19
Pontic Province	12	1	7	2	19	25	43	9
Western Plains	13	2	18	18	51	44	103	33
Central Plains	14	4	14	12	41	45	93	24
Baltic Province	15	0	9	8	35	43	76	16
Eastern Plains	16	1	6	6	34	36	68	11
Ireland and Northern Ireland	17	0	9	8	12	34	68	16
Great Britain	18	2	12	12	36	40	81	23
Iceland	19	0	0	2	1	1	4	2
Borealic Uplands	20	0	5	9	11	34	65	14
Tundra	21	2	1	9	22	18	44	12
Fenno-Scandian Shield	22	1	6	9	11	34	67	16
Taiga	23	1	4	10	11	37	70	15

Endemic taxa are most frequently occurring on the Iberian and Italian peninsulas (Ecoregions 1 and 3; Figure 1). In both ecoregions the endemic taxa are particularly representing the most species rich families, such as Hydroptilidae, Limnephilidae and Rhyacophilidae. No endemic taxa are found in the Baltic Provice (Ecoregion 15), Ireland (17), Iceland (19) and the Borealic Uplands (20). The few endemic taxa in the Central and Northern European ecoregions are almost exclusively subspecies, such as *Psilopteryx psorosa bohemosaxonica* (Limnephilidae) in the ecoregion Central Highlands (9) or various parthenogenetic *Apatania* sp. (Limnephilidae) in Ecoregion 14 (Central Plains).

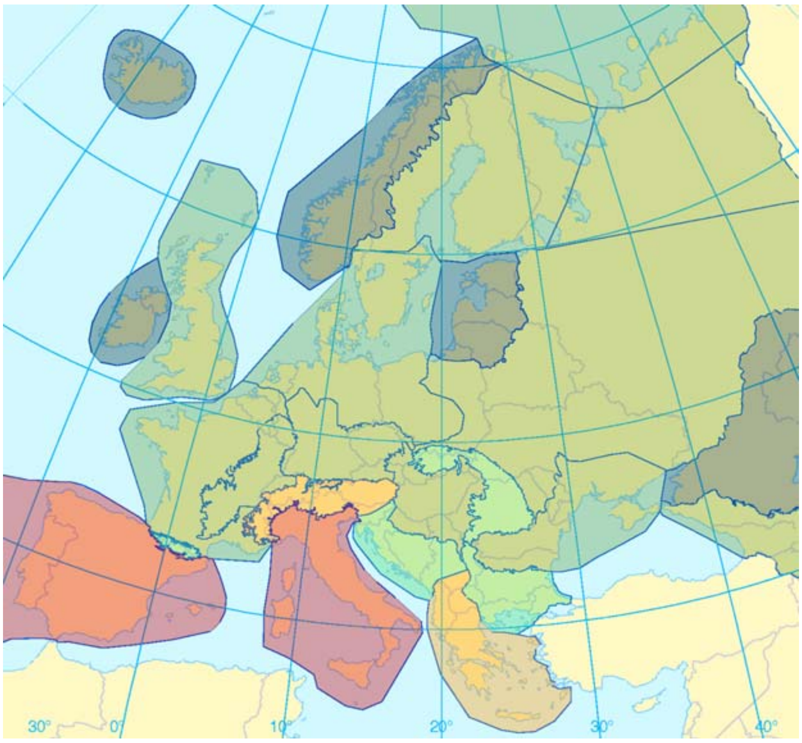

Figure 1: Number of endemic Trichoptera taxa in the European ecoregions.

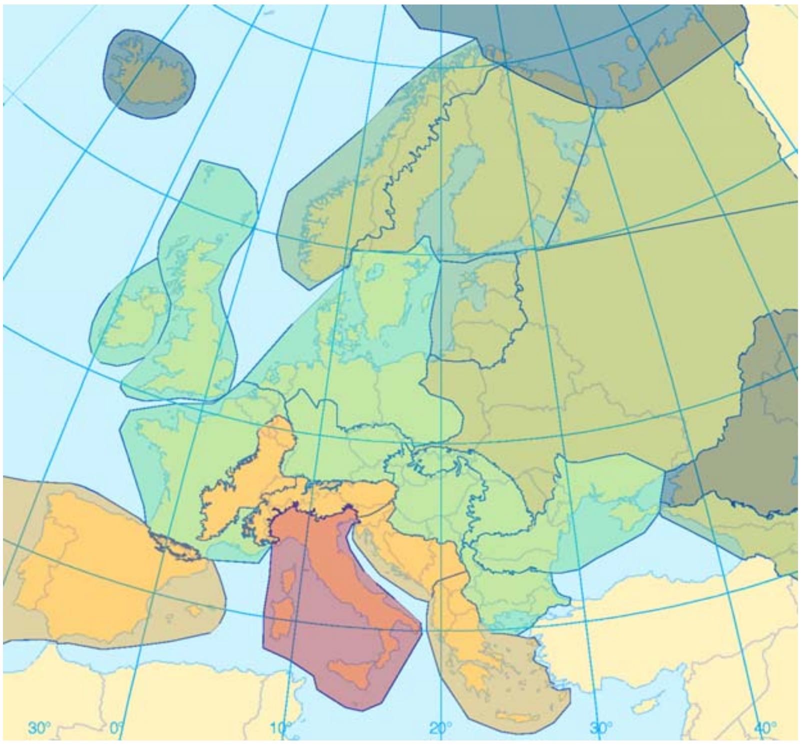

Figure 2: Share of crenal preferring Trichoptera taxa in the European ecoregions.

Similarly, crenal specialists are particularly species rich Southern Europe and in the high mountain ranges (Figure 2). The Alps are characterized by the highest absolute number of crenal specialists (51 taxa), and Italy by the highest percentage (16.4% of all occurring taxa). In contrast to the Alps, both the Carpathians (28 taxa) and the Pyrenees (23 taxa) hold a comparatively low number of crenal specialists; however, this may partly reflect the better knowledge on autecology of species occurring in the Alps.

Although only limited data are available on temperature preference, the highest number of cold stenothermic taxa can clearly be found in the higher and lower mountain ranges (Figure 3), particularly in the Pyrenees (22 taxa). However, only two of these taxa are endemic to the Pyrenees (*Rhyacophila meridionalis, R. angelieri*). A very limited number of cold stenothermic species occur in the Northern European ecoregions; e.g., in Iceland only *Limnephilus fenestratus* and *L. pictoratus*.

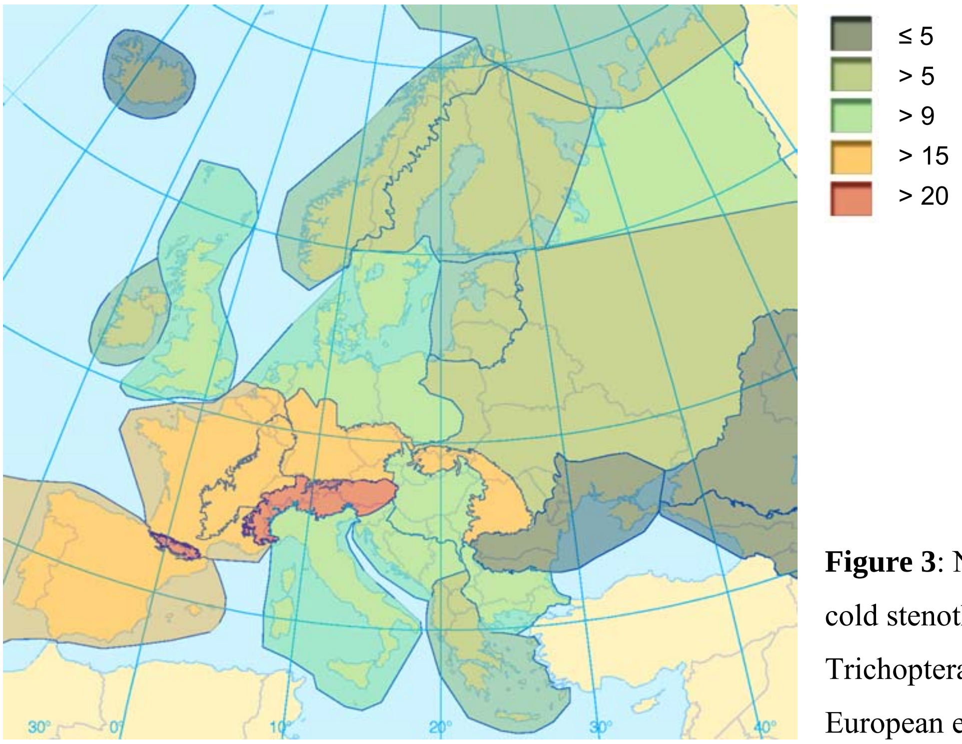

Figure 3: Number of cold stenothermic Trichoptera taxa in the European ecoregions.

Taxa with small niches, e.g. special habitat requirements and specialized feeding types (Figure 4), are mainly found in the Southern European ecoregions and high mountain areas. Most taxa with specialized feeding types occur in the Alps (73 taxa), while the highest share is observed on the Iberian Peninsula (40% of all classified taxa). In the Alps, the feeding type specialists are mainly predators (47 taxa, 29 of which are *Rhyacophila* sp.), while the share of predators is a little lower on the Iberian Peninsula (24 out of 44 taxa).

Similarly, the highest number of habitat specialists are found in the Alps (59 taxa) and the Iberian Peninsula (51 taxa). 40 (Alps) and 34 (Iberian Peninsula) of these species are specialists for macrophytes, eight (Alps) and nine (Iberian Peninsula) for hygropetric zones, nine (Alps) and five (Iberian Peninsula) for madicol.

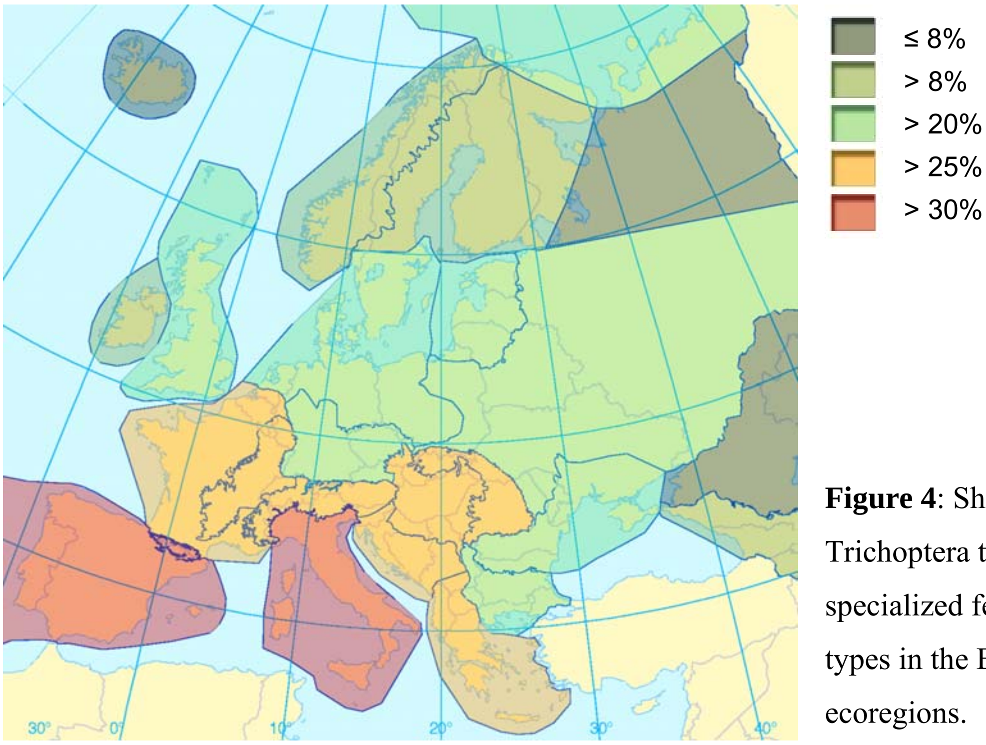

Figure 4: Share of Trichoptera taxa with specialized feeding types in the European ecoregions.

Summing up all taxa potentially sensitive to Climate Change according to these parameters a distinct South-East – North-West gradient is revealed. The share of potentially endangered taxa ranges from 25% (Iceland) to 66.25% (Iberian Peninsula).

If only those taxa meeting the criteria endemism, crenal preference and cold stenothermy are regarded, the gradient is even more obvious (Figure 5). In all ecoregions of North-West Europe (Pontic Province, Central Plains, Eastern Plains, Baltic Province, Borealic Uplands, Tundra, Fenno-Scandian Shield, Taiga) the share of potentially endangered taxa is lower than 10%, while the share is 51.7% on the Iberian Peninsula and 42.3% in Italy. Also the Balkan ecoregions and the high mountain ranges (Alps, Pyrenees, and Carpathians) are characterized by more than 25% potentially endangered taxa.

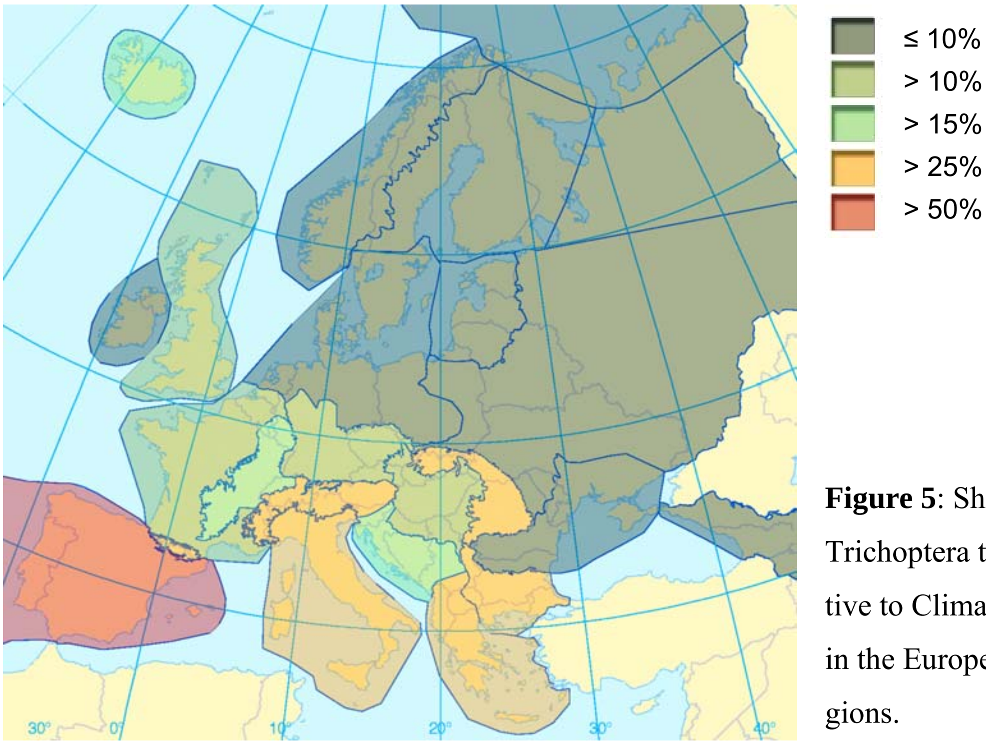

Figure 5: Share of Trichoptera taxa sensitive to Climate Change in the European ecoregions.

Discussion

Methodological discussion

The majority of studies estimating the impact of Climate Change on biodiversity link climate scenarios with habitat requirements of species. In general, this approach is useful for aquatic invertebrates, such as Trichoptera, too. However, knowledge gaps on taxonomy, distribution and ecology limit the applicability of models.

According to Malicky (2005) more than 300 Trichoptera species have been newly described in Europe and neighbouring areas between 1983 and 2007, most of which occur in Turkey, Greece, Italy and on the Iberian Peninsula, while only few new species have been described from mountainous parts of Central Europe: *Rhyacophila ferox* Graf 2006, *Synagapetus padanus* Bertuetti, Lodovici & Valle 2004 , *Stactobia alpina* Bertuetti, Lodovici & Valle 2004, *Hydropsyche incognita* Pitsch 1993, *Hydropsyche subalpina* Botosaneanu & Guidicelli 2004, *Drusus ingridae* Sipahiler 2004, *Drusus kronion* Malicky 2002, *D. slovenicus* Urbanic, Krusnik & Malicky 2002, *D. vinconi* Sipahiler 1992, *Metanoea euphorion* Malicky 2002, *Allogamus fusunae* Malicky 2004, *Allogamus periphetes* Malicky 2004, *Consorophylax carinthiacus* Malicky 1992, *Consorophylax delmastroi* Malicky 2004, *Melampophylax austriacus* Malicky 1990, *Beraeamyia gudrunae* Malicky 2002. In contrast many additional species can be expected in Southern Europe. The still insufficient taxonomic knowledge on European Trichoptera, as on many other insect orders, is a major obstacle for analysing the impact of emerging stressors, such as Climate Change. In particular, several taxa are still not identifiable in the larval stage. The share of species with unknown larvae ranges from 40% (Hellenic Western Balkan) to 82.5% (Hungarian Lowlands). Therefore, the knowledge on the distribution of Trichoptera taxa is still mainly based on adults – the large number of benthos samples, which are taken for river monitoring purposes, do not really add to a better understanding of taxonomy, autecology and distribution patterns. Nevertheless, recent checklists exist for the most European countries; knowledge on Trichoptera distribution is particularly insufficient in France and Russia (Malicky 2005).

Several species traits are well known, making classifications for the majority of taxa possible (habitat preference, current preference). However, very limited information is available on traits, which are of special importance to judge the sensitivity of species, particularly on dispersal capacity and temperature preference. Therefore, we did not regard several traits likely most suited to estimate the impact of Climate Change (e.g. dispersal capacity) because only a minor part of taxa has been classified (temperature preference).

For the purpose of this analysis, we defined "endemism" as the occurrence in only a single European ecoregion, which nevertheless may cover several 100,000 km^2. A more reliable approach may be to focus on microendemic taxa, which e.g. occur only in a restricted mountain range.

The hypotheses outlined in the introduction could be supplemented by additional criteria, which demand for additional ecological characteristics. Changing climate may lead to the disappearance of temporary water bodies in parts of Europe, while in other areas permanent streams might be changed to temporary streams. To judge the effects on the biota better knowledge on strategies how to survive the dry season (e.g. by a diapause) is needed.

Differences between regions

In general a north-south gradient regarding biodiversity can be observed. This pattern is mainly a result of the Pleistocene, which was characterized by several range extensions and regressions of most European species (Malicky 2000, Pauls et al. 2006). While glaciers covered most of Northern Europe, species retreated to Southern Europe or to ice free parts of high mountain areas. This isolation of populations resulted in many new species and an overall high diversity. Several distinct areas of speciation have been detected in the Alps (Malicky 2000), at the Balkans (Marinković-Gospodnetić , 1977; Kumanski & Malicky 1984) Pyrenees (Décamps 1967) and the Apennin (Cianficconi et al. 1997). Most of these species are suspected to be specialised either in feeding habits or habitat choice.

After the last ice age mainly generalists and good dispersers recolonized Northern Europe, while more specialized taxa and those with limited dispersal capacity extended their range only slightly. As a consequence, almost all species occurring in the Northern

European ecoregions are distributed in Central and/or Southern Europe, too. Most of these species will likely be capable of dealing with the expected Climate Change impacts, since they are generalists or can colonize other areas. In Southern Europe, however, strong impacts on the more specialized species can be expected.

Temperature increase will be particularly apparent in Northern Europe (Figure 6), while the number and share of Trichoptera taxa potentially endangered by Climate Change is low in Northern and high in Southern Europe (Figure 5).

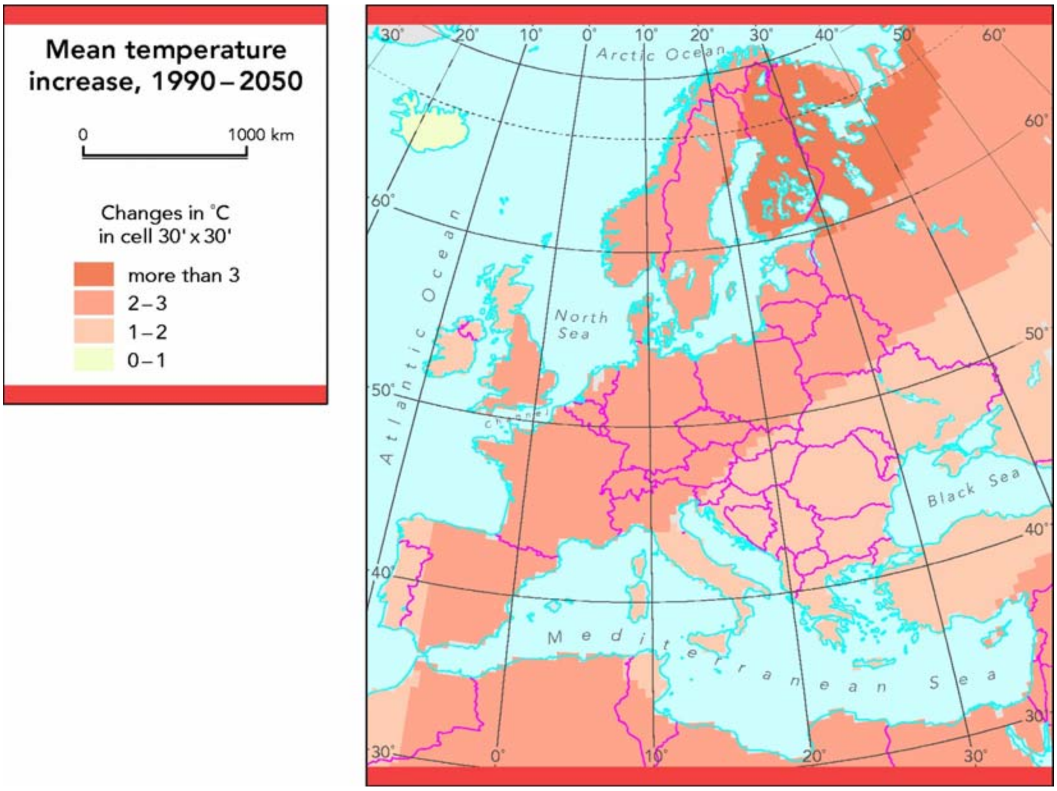

Figure 6: Estimated mean temperature increase in Europe from 1990 to 2050 (www.eea.eu).

Outlook

We established a database containing ecological and distributional information on 1.165 Trichoptera species. This attempt of a comprehensive processing of present knowledge regarding a diverse insect group on a European scale is unique and represents a prerequisite for further analyses. It assures a trans-European standardization of ecological classifications and contributes to future assessment systems of water bodies in the context of Climate Change as and the EU-Water Framework Directive.

While the data set of common Central European species is quite complete, information on Southern and Eastern European species is sometimes scarce and based on few collection data of adults. Comprehensive larval and environmental descriptions are often missing. Thus, the overall data set is heterogeneous and can hardly be compared on a larger geographical scale. During the analyses it became obvious that - due to general morphological similarities -several species within single genera prefer the same habitat and belong to the same feeding type. Further analyses will incorporate this deductive approach to complete the dataset and to allow a more comprehensive modelling of aquatic ecosystems and faunal interactions according to the predicted Climatic Changes.

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