

# VARIATIONS IN THE EPIPHYTIC INVERTEBRATE COMMUNITY STRUCTURE ON *POTAMOGETON PERFOLIATUS* L. IN TRAUNSEE (AUSTRIA): PATCHINESS VERSUS IMPACTS BY INDUSTRIAL TAILINGS

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**Abstract.** The epiphytic invertebrates found on *Potamogeton perfoliatus* L. in Traunsee, an oligotrophic Alpine lake in Austria, were investigated in August and October 1998 in order to study the impact of industrial tailings discharged into the lake. 113 taxa were found, 54 could be identified to the species level. Their total abundance varied between ca. 190,000 and 1,138,000 ind. m<sup>-2</sup> lake bottom area. This epiphytic assemblage was dominated by *Dreissena polymorpha* and *Sida crystallina*, which resulted in a very low overall species diversity. Multivariate statistical analyses revealed significant differences in the community structure between three sites, each of them was located at a different distance from the site of industrial waste emission. These differences were interpreted as variations which reflect the patchiness within highly structured habitats rather than as being the result of the industrial pollution.

**Keywords:** Alpine lake, epiphytic invertebrates, impact of industrial tailings, patchiness

## 1. Introduction

Among the various lake habitats, the littoral zone is characterized by a great structural complexity and productivity which often exceeds that of the pelagic and profundal zones. In particular, macrophytes are inhabited by high numbers of invertebrates (Jónasson, 1978; Wetzel, 1983; Wolfram, 2001).

Detailed and comprehensive quantitative studies on the epiphytic invertebrate communities are, however, rare in lakes of the eastern Alps, or they are restricted to singular faunal groups. Schiemer (1967) investigated the fauna on *Elodea* stands in the Lunzer Untersee. Reiss (1968) studied chironomids at Lake Constance. In several Bavarian lakes, Riss (1992) focused on epiphytic chironomids of reed stems, whereas Hess (1992) mainly studied the chironomids on artificial substrates. Some faunistic information on the littoral zoobenthos of Traunsee, mostly dealing only with microcrustaceans, dates back to the 19th century (reviewed in Pesta, 1923/24).



A more extensive, but also qualitative, study on the littoral invertebrate fauna of Traunsee was carried out by Gusenleitner (1953).

Traunsee, an oligotrophic Alpine lake in Austria, has been affected by soda-producing and salt-mining industries since the 1920s. The release of up to 720 tons of liquid and 387 tons of solid tailings per day in the Bay of Ebensee has resulted in increased chloride concentrations of up to  $170 \mu\text{g L}^{-1}$  (Jagsch *et al.*, 2002), at least local impacts of the enhanced suspended matter at the emission site on the phytoplankton (Teubner and Dokulil, 2002), and the deposition of mobile, alkaline (up to a pH of 12.5), sludges in the profundal of Traunsee (Müller *et al.*, 2002). According to Wunsam *et al.* (2002), the littoral chloride concentration varied between 40 and  $85 \text{ mg L}^{-1}$  during the period of investigation and was at its highest during the summer of 1999. Hence, the littoral invertebrate communities might be affected by:

- (1) the physiological stress due to enhanced chloride concentrations; and
- (2) disturbances of the particulate industrial emissions lowering the potential of epiphytic colonization.

This article presents a quantitative examination of the epiphytic invertebrate communities on *Potamogeton perfoliatus* L. in Traunsee, with the aim of evaluating possible effects of the industrial tailings on the invertebrate community structure. *P. perfoliatus* was selected for this study as this macrophyte is abundant and widely distributed in Traunsee (Wyckera and Humpesch, 2002).

## 2. Material and Methods

### 2.1. STUDY SITES

For sampling of epiphytic invertebrates, three sites were selected (Figure 1):

- (a) the Bay of Ebensee (EB) in the SW of the lake, in the immediate vicinity of the industrial effluents;
- (b) the Bay of Rindbach (RB) in the SE of the lake, which is separated from the effluents by the inflow of the River Traun (Figure 1). The average discharge of the River Traun is about  $64.2 \text{ m}^3 \text{ s}^{-1}$  (Hydrographischer Dienst, 2000).
- (c) the Bay of Viechtau (VI) in the NW part of Traunsee, as a more remote reference site (at a distance of 6.5 km from site EB);

All three sites are characterized by extensive stands of *Potamogeton perfoliatus*. The macrophytes were sampled on August 17–19 and on October 10–12, 1998. During the first sampling programme, *P. perfoliatus* was blooming and had nearly

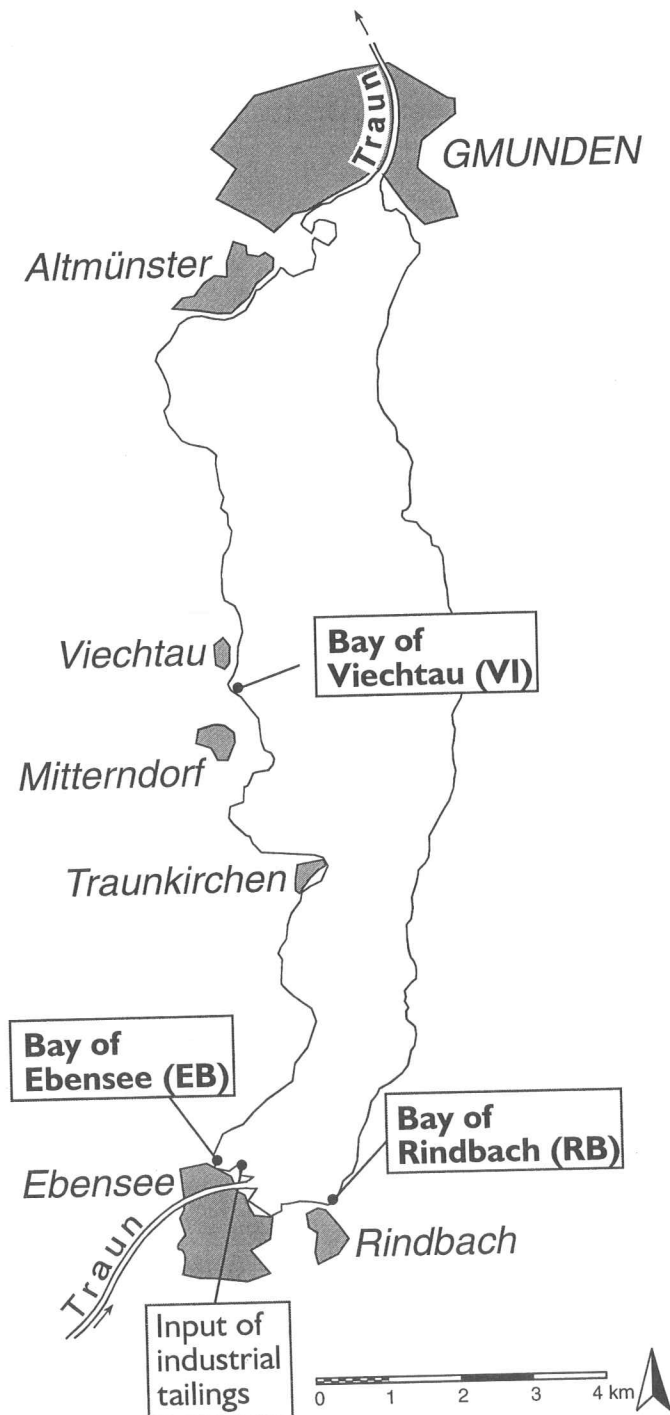


Figure 1. Map of Traunsee showing the sampling sites.

exceeded its maximum biomass (Wyche, unpubl.). In October, at the end of the vegetation period, they showed the first symptoms of decomposition.

## 2.2. SAMPLING PROCEDURE

Six quantitative samples were taken on each date at each of the three sites, giving a total of 36 samples. The macrophytes were sampled by SCUBA divers with the use of a Downing sampler (Downing and Peters, 1980), modified by Weigand (1990), with a size of  $30 \times 20 \times 10$  cm (6 L). For comparison, the macrophytes were sampled at each site at water depths between 3 and 5 m. All samples were taken from the middle zone of the *P. perfoliatus* stems in order to obtain homogeneous samples. The zone near the sediment was excluded to minimise bias due to vertical zonation of invertebrates (Schiemer, 1967; Weigand, 1996) or short term colonisation by sediment-dwelling invertebrates (cf. Kornijów, 1992). The zone near the water surface, which corresponds to the most active growth zone of *P. perfoliatus*, was expected to be colonised to a lesser extent by invertebrates and was also not considered.

On land, the plant stems protruding from the sampler were first cut off. Then the water was slowly (90 sec) drained off with a drain cock and sieved through a  $100 \mu\text{m}$  net. The fraction  $<100 \mu\text{m}$  was subsampled and 1 L was used for the subsequent analyses of epiphytic material. Finally, the macrophytes themselves were preserved together with the attached invertebrates and the sieved residue in 4% formalin.

## 2.3. SAMPLE PREPARATION

In the laboratory, the epiphytic material and animals attached to the macrophytes were rinsed off. The epiphytic matter  $<100 \mu\text{m}$  was sieved through Whatman GF/C glass fibre filters and was subsequently dried at  $90^\circ\text{C}$  together with the epiphytic matter  $>100 \mu\text{m}$  (after sorting out the animals). After weighing (dry mass), the material was heated at  $500^\circ\text{C}$  for 2 hr. The ash-free dry mass was calculated as the difference between dry mass and ash mass (Schwoerbel, 1993).

The macrophytes were separated into stems and leaves. The surface of the leaves was digitised and the area determined using a programme by Dirry (unpubl.). The length and diameter of the stems were measured with a slide caliper, and the surface area was calculated as for a cylinder. The relationship between surface and dry mass was calculated after drying at  $90^\circ\text{C}$ .

Animals were collected from the organic and inorganic materials with the use of a stereo microscope at  $\times 16$  magnification. Taxonomic groups with higher species numbers and/or individual densities (Gastropoda, Bivalvia, Oligochaeta, Ctenopoda, Anomopoda, Copepoda, Trichoptera and Diptera) were treated in further statistical analyses.

The following literature was used for determination: Mollusca: Glöer and Meier-Brook (1998), Oligochaeta: Sperber (1948), Brinkhurst and Jamieson (1971), Cten-

opoda and Anomopoda: Flössner (1972), Copepoda: Einsle (1993), Janetzky *et al.* (1996), Ephemeroptera: Bauernfeind (1994, 1995), Trichoptera: Waringer and Graf (1997), Chironomidae: Wiederholm (1983), Cranston (1982), Schmid (1993), Moller-Pillot (1984a, b), Janecek (1998).

## 2.4. STATISTICAL ANALYSES

Abundances are given as arithmetic means. The 95% confidence limits were calculated from log-transformed values (Elliott, 1977). The Shannon-Wiener diversity index, as well as Simpson's index, were calculated using the programme 'Species Diversity and Richness' (PISCES Conservation Ltd); confidence limits were estimated using the Jackknife method (Smith and Van Belle, 1984) in MS Excel®97. 'Species Diversity and Richness' was also used to adopt species accumulation curves. The samples were randomly shuffled (500 times) to smoothen these curves. The faunal composition of the sites was clustered by Principal Component Analysis (PCA) using the program Canoco for Windows Version 4.0 (Ter Braak, 1995). For the PCA, the abundances were log-transformed and the relative proportions of feeding guilds square root-transformed. The feeding guilds were determined according to Moog (1995). A multiple comparison (intra-site and intra-date) of mean abundances (ANOVA, after log-transformation of the data) was performed for selected species using the statistical package SYSTAT®. The significance of the differences between sample pairs was tested with Scheffé's post hoc test (Sachs, 1992).

Spearman's rank correlation was carried out to evaluate the relationship between faunal abundances (ind. g<sup>-1</sup> dry weight of macrophytes) and the amount of epiphytic matter on the aquatic plants (mg g<sup>-1</sup> dry weight of macrophytes).

## 3. Results

### 3.1. SPECIES COMPOSITION AND RICHNESS

113 taxa were found, 54 could be identified to the species level (Appendix 1). The chironomids were richest in the number of taxa (30), followed by chydorids (12), and naidids (9). In Figure 2 the species accumulation curves for the total number of taxa of the different groups of invertebrates are illustrated. The slopes of the lines approach an asymptote for all groups except the chironomids.

### 3.2. SPECIES ABUNDANCE AND DIVERSITY

Total abundance of epiphytic invertebrates varied between 189,141 and 1,137,518 ind. m<sup>-2</sup> lake bottom area (Table I, Figure 3). Two species dominated the assemblage: *Dreissena polymorpha* (mainly juvenile stages) and *Sida crystallina* (especially at site RB in October 1998; Table I). Due to its large size, *Endochironomus*

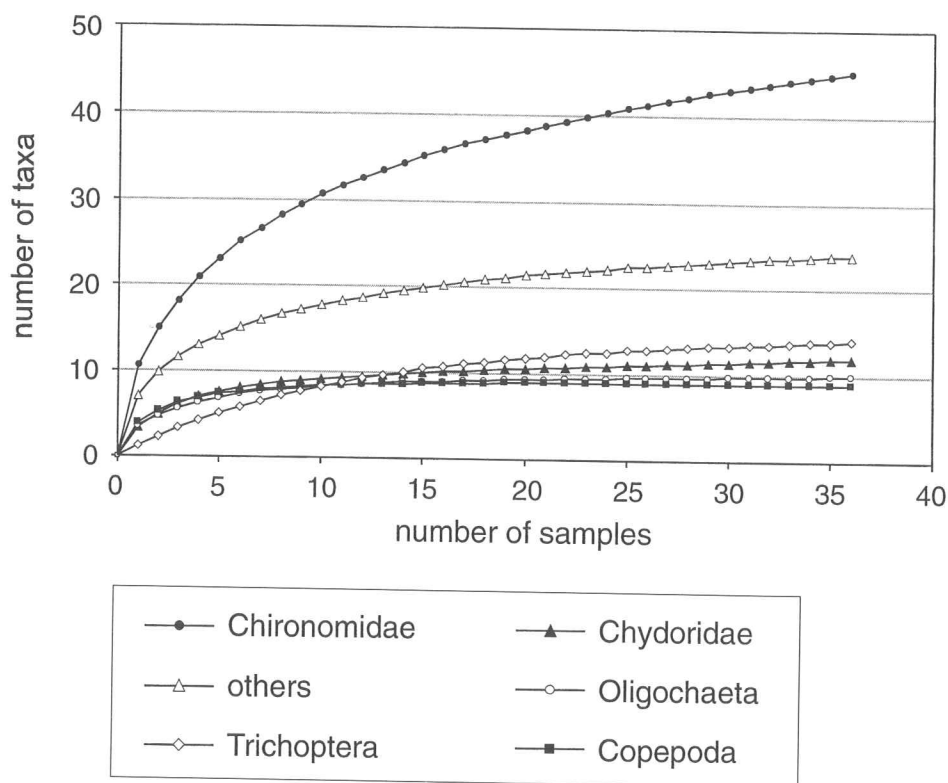


Figure 2. Species accumulation curves of the dominant invertebrate taxa found on *Potamogeton perfoliatus* in Traunsee.

*albipennis* dominated in terms of biomass (unpubl. data), although its abundances were an order of magnitude lower than those of *D. polymorpha*.

As a consequence of the dominance of these two species, diversity was rather low at all sites and dates. The Shannon-Wiener diversity index ranged from 0.33 to 1.41, Simpson's D was between 1.12 and 2.73 (Table IIa). These values are significantly correlated with the abundances of *D. polymorpha* and *S. crystallina*, thus showing the dominance of these species rather than the structure of the whole community. The index was therefore recalculated after exclusion of the two dominant species, resulting in distinctly higher diversity indices (Table IIb). A significant difference ( $p < 0.05$ ) between sites on the same date was found only for sites RB and EB in October, the latter showing a significantly higher diversity. An intra-site comparison of the dates revealed significant differences only for site RB, where diversity was lower in October than in August.

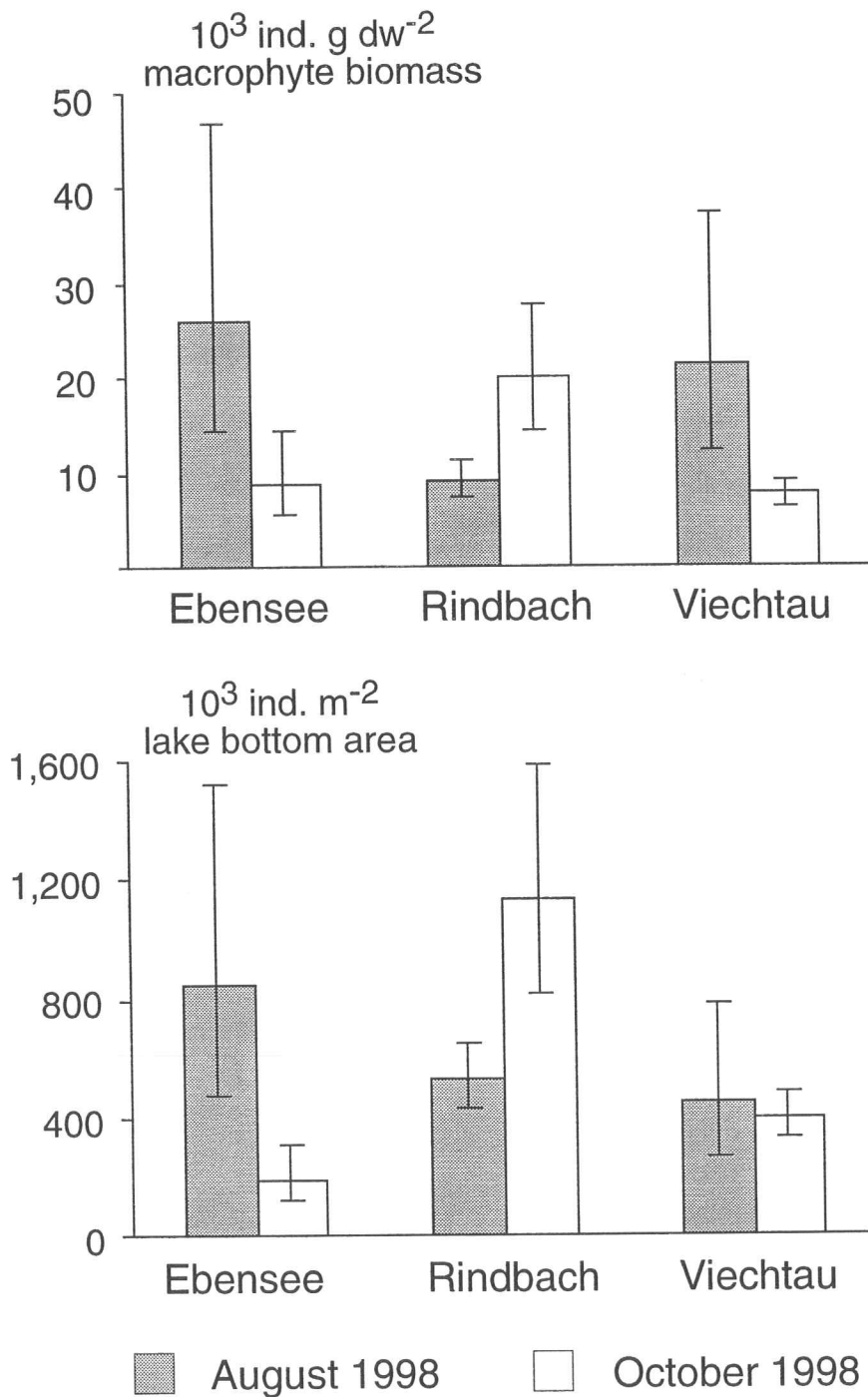


Figure 3. Abundances (arithmetic mean  $\pm$  95% C.L.) of epiphytic invertebrates on *Potamogeton perfoliatus* at the sites Viechtau (VI), Rindbach (RB), and Ebensee (EB) in Traunsee.

TABLE I

Abundance (ind. m<sup>-2</sup> lake bottom area) of the most important taxa at the three sites, Viechtau (VI), Rindbach (RB), and Ebensee (EB) in Traunsee, 1998

	August			October		
	VI	RB	EB	VI	RB	EB
Hydrozoa	131	0	427	5,497	175	999
Hydracarina	1,759	146	8,550	5,981	102	1,534
Gastropoda						
<i>P. antipodarum</i>	6624	0	0	12176	0	0
Bivalvia						
<i>D. polymorpha</i>	406404	438386	802566	213002	527274	97126
Oligochaeta						
<i>N. pseudobutusa</i>	215	2147	317	1252	1884	294
<i>S. lacustris</i>	294	4956	2315	4460	1321	936
Ctenopoda						
<i>S. cristallina</i>	11409	28776	19227	85955	550072	66351
Anomopoda						
<i>E. lamellatus</i>	18	35	2456	645	36	76
<i>G. testudinaria</i>	9231	4552	1890	34455	17090	6894
Copepoda						
<i>C. staphylinus</i>	229	2078	918	2214	702	1911
Chironomidae						
Orthocladiinae juv.	652	6169	2891	2366	3207	4283
<i>O. consobrinus</i>	45	698	126	587	3862	171
<i>P. limb./sord. gr.</i>	941	4925	4295	2601	2061	2279
Chironomini juv.	3541	5489	415	1577	2407	452
<i>E. albipennis</i>	5886	24354	380	23195	26071	1401
Total benthos	450297	529084	849741	401053	1137518	189141

### 3.3. SPECIES ORDINATION

The PCA plot based on abundances is shown in Figure 4a. The sample clusters separate the three sites. Moreover, in the case of site VI, and especially site EB, the samples from the two dates form a cluster which is separated from the other sites. Only at site RB are the August samples different from those of the October samples, as well as from the other sites. They are located at the right end of the first axis, whereas the second axis separates the EB samples from the others. With respect to species and their scores, a cluster of seven taxa with scores >0.6 is responsible for the separation of the August RB samples. This cluster includes



TABLE II

Diversity of the epiphytic fauna ((a) = all taxa, (b) = all taxa without *Dreissena polymorpha* and *Sida cristallina*) of the three sites, Viechtau (VI), Rindbach (RB), and Ebensee (EB) in Traunsee, 1998

Date	Site	Shannon-Wiener-Index H'			Simpson-Index D		
		L.C.	H'	U.C.	L.C.	D	U.C.
(a)							
August	VI	0.40	0.57	0.74	1.15	1.27	1.39
	RB	0.70	0.82	0.94	1.34	1.46	1.57
	EB	0.27	0.33	0.38	1.10	1.12	1.15
October	VI	1.21	1.41	1.62	1.81	2.73	3.65
	RB	0.78	0.89	1.00	1.74	2.03	2.32
	EB	0.71	1.10	1.48	1.29	2.07	2.85
(b)							
August	VI	1.87	2.04	2.20	4.45	5.46	6.48
	RB	2.02	2.14	2.27	4.26	4.90	5.54
	EB	1.87	2.23	2.60	3.66	6.43	9.21
October	VI	1.67	1.98	2.28	3.12	4.71	6.29
	RB	1.45	1.57	1.70	2.48	3.10	3.72
	EB	2.04	2.32	2.61	5.02	7.32	9.61

L.C. = 95% lower confidence limit, U.C. = 95% upper confidence limit, sample size = 6.

the microcrustaceans *Chydorus sphaericus*, *Biapertura affinis* and *Eucyclops macruroides*, the naidid *Nais behningi*, juvenile Baetidae, and the two chironomids *Micropsectra* sp. and *Polypedilum convictum*. Their total abundance at site RB in August was 2,347 ind. m<sup>-2</sup> (L.C. = 1,364 ind. m<sup>-2</sup>, U.C. = 4,037 ind. m<sup>-2</sup>).

An additional PCA was carried out on the basis of feeding guilds. Figure 3b shows a biplot with the same samples as in Figure 4a; the feeding guilds are given as arrows. In this analysis, the sites are separated even more clearly than on the basis of abundances. Miners, filter-feeders and predators spread the samples along the first axis, whereas scrapers, detritivores and shredders are located at the edges of the second axis. Scrapers only explain 56% and detritivores 31% of the total variance, whereas the other feeding guilds explain 88–95% of the total variance.

### 3.4. COMPARISON OF MEAN ABUNDANCES

Mean abundances of the species listed in Table I were compared for the three sites. Significantly ( $p < 0.05$ ) higher densities of *P. antipodarum* (both dates) but

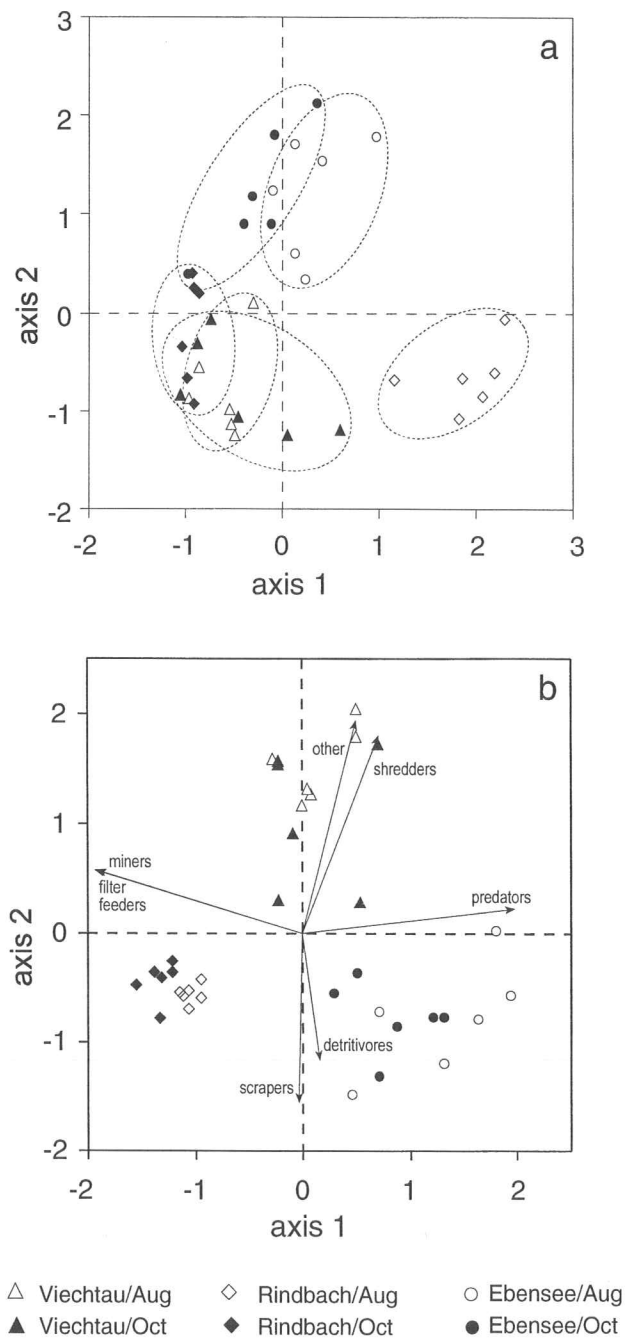


Figure 4. (a) Species centered PCA based on abundances, eigenvalues:  $\lambda_1 = 0.12$ ,  $\lambda_2 = 0.11$ , variance explained by the first two axes: 23%; (b) biplot of a species centered PCA based on the relative proportions of feeding guilds, eigenvalues:  $\lambda_1 = 0.64$ ,  $\lambda_2 = 0.25$ , variance explained by the first two axes: 89%.

TABLE III

Amount of epiphytic material and organic fraction of epiphytic material referring to macrophyte biomass (g dry mass) at the three sites, Viechtau (VI), Rindbach (RB), and Ebensee (EB), 1998

Date	Site	Epiphytic material (mg g <sup>-1</sup> dry mass)				Organic material (mg g <sup>-1</sup> dry mass)			
		L.C.	M	U.C.	N	L.C.	M	U.C.	N
August	VI	2.69	3.19	3.79	6	0.11	0.22	0.43	3
	RB	2.54	3.16	3.93	6	0.13	0.21	0.34	4
	EB	2.72	3.66	4.94	6	0.17	0.23	0.31	4
October	VI	2.92	3.67	4.63	6	0.19	0.26	0.37	6
	RB	1.15	1.47	1.87	6	0.17	0.23	0.31	6
	EB	2.25	3.22	4.61	6	0.18	0.23	0.30	6

M = arithmetic mean, L.C. = 95% lower confidence limit, U.C. = 95% upper confidence limit, N = sample size.

lower abundances of *S. lacustris* and *P. limbatellus/sordidellus* gr. (in August) were found at site Viechtau (VI). In the Bay of Rindbach (RB), *O. consobrinus* was significantly more abundant during August than in October. *D. polymorpha* and *S. crystallina* prevailed in October when compared to the sites VI and EB. In August, *E. lamellatus* was more abundant in the Bay of Ebensee (EB) than at the other sites, and *E. albipennis* showed significantly lower densities than at site RB or VI.

Among the species cluster of the August RB samples of the PCA, *N. behningi*, *C. sphaericus* and *P. convictum* showed significantly higher abundances at site RB than at sites VI or EB, whereas *B. affinis* was more abundant at sites RB and EB than at VI (August samples only). Their mean abundance at RB (August) ranged between 98 and 787 ind. m<sup>-2</sup>.

### 3.5. EPIPHYTIC MATERIAL

The amount of epiphytic material on the surfaces of the aquatic plants showed little variation between sites and dates. It ranged between 3 and 4 mg dry mass per g dry mass of macrophytes (Table III). Lower values were, however, found at site RB in October (mean = 1.47 mg g<sup>-1</sup> dry mass). The organic content of the epiphytic matter was also rather constant throughout the study and ranged from 0.21–0.26 mg g<sup>-1</sup> dry mass of macrophytes.

A Spearman correlation analysis between abundance (per macrophyte biomass) and the amount of epiphytic matter revealed a significant positive relationship ( $p < 0.05$ ) for Hydracarina, *S. lacustris*, *C. staphylinus*, *M. albidus*, Orthocladinae indet., and for the *P. limbatellus/sordidellus* group. The variance in the abundance explained by the amount of epiphytic matter varied between 15 and 40%. Only *N. pseudobtusa* showed a significantly positive correlation with the amount of organic

matter attached on the macrophytes, but only 15% of the variance was explained by this abiotic factor.

#### 4. Discussion

The species accumulation curves suggest that a higher sample effort would not have led to a significant increase in species number for most taxonomic groups. Gusenleitner (1953), who studied the epiphytic fauna on *Potamogeton* in Traunsee fifty years ago, found only a few more species, such as *Chaetogaster diaphanus* (Gruithuisen) and *Pleuroxus truncatus* (Müller). Two neozoan molluscs, *D. polymorpha* and *P. antipodarum*, which were not mentioned by Gusenleitner (1953), however, play a dominant role in the present littoral zone.

Only the slope of the accumulation curve for the chironomids does not approach an asymptote. Hence, several more species of non-biting midges are supposed to have dwelled on *Potamogeton perfoliatus* during the two sampling dates. One reason why this family was not sampled as completely (in terms of taxa number) as the other major taxonomic groups might be the fact that many epiphytic chironomid species have several generations per year. Polyvoltine species are able to quickly colonise new habitats (Armitage *et al.*, 1995). Hence, an greater sampling effort is needed to cover the whole chironomid assemblage than is needed for other epiphytic groups.

Fluctuations in species richness and diversity among sampling dates and sites appear to be affected by abundances of the dominant *D. polymorpha* and *S. crystallina*. Advantages in competition for space and food may explain the pronounced dominance of these species and the low diversity of the epiphytic invertebrate communities. It corresponds with findings obtained by Müller-Liebenau (1956) in the *Potamogeton* zone of lakes in east Holstein.

Site RB differed from the other sites with respect to species composition and abundance in August. Among the different species, *C. sphaericus* and *B. affinis* are known to occur even in eutrophied lakes (Berzinš and Bertilsson, 1989; Flössner, 2000). The chironomids *O. consobrinus* and *P. convictum* were, however, also significantly more abundant in the August RB samples. *P. convictum* is primarily a stream dweller, but also colonises the littoral of oligotrophic lakes (cf. Colling and Schaumburg, 1992). *O. consobrinus* is a circumboreal species which most frequently is found in northern oligotrophic lakes (e.g. Lindegaard, 1992). This contradiction might be explained by hydrological changes of the river Traun resulting in fluctuations of trophy, temperature, and currents in the deltaic area (see Dokulil and Teubner, 2002) and/or large tolerances of the species against these environmental variables.

The three sites differed in terms of the feeding guilds present. The composition of feeding guilds among the invertebrates living on *P. perfoliatus* at Traunsee corresponds with results obtained by Dvorak and Best (1982) for Lake Vechten:

detritivores, periphyton-scrapers and omnivores dominate, followed by predators and seston-feeders. In Traunsee the filter-feeders play an important role, and their relative proportion at the study sites exceeds the proportion found in Lake Vechten. This is due to the dominance of *D. polymorpha* and *E. albipennis*. The latter is a widely distributed lacustrine chironomid, which can be classified primarily as a filter-feeder but which also feeds on detritus and algal periphyton, or mines into the parenchyma of macrophytes (Janecek, 1995). According to Lamberti and Moore (1984), the relative proportion of shredders should increase in late autumn as a result of decomposition, which makes the macrophytes more easily digestible at that time (Kornijów *et al.*, 1990, 1995). This was not the case in Traunsee, where shredders comprised more than 6.9% of all feeding guilds at site VI in August, but only 3.8% in October.

The differences between the three sampling sites in terms of feeding guilds can be attributed to only a few taxa. The abundance of *P. antipodarum* is responsible for the high proportion of shredders in the Bay of Vöckta (VI). Miners and filter-feeders in the Ebensee (EB) samples were less frequent, and *E. albipennis* was significantly less abundant than at the other two sites. Hydrozoa, Turbellaria and Hydracarina were almost completely lacking in the Bay of Rindbach (RB) when compared to Vöckta and Ebensee.

It was questioned if these variations detected at the three sites can be attributed to (1) the increased chloride concentrations, and/or to (2) the impact of enhanced particulate minerogenic matter due to pulses of waste emission in the Bay of Ebensee.

- (1) *E. albipennis*, which occurred at all three sites, is fairly tolerant to chloride. Its tolerance exceeds the maximum chloride concentrations ( $85 \mu\text{g L}^{-1}$ ) measured in the littoral of Ebensee during the time of investigations. In the Netherlands, this species occurs in waters with  $>1000 \text{ mg L}^{-1} \text{ Cl}^{-}$  (weighted mean of chloride concentrations at 476 sampling stations =  $365 \text{ mg L}^{-1}$ ; Steenbergen, 1993). This finding fits to observations of salinity-tolerant or even halophile benthic diatoms in Traunsee (Wunsam *et al.*, 2002). Since the densities of *E. albipennis* at the site Ebensee are, however, significantly lower than at the two other reference sites, at least temporarily increased chloride concentrations at the emission site (see Wunsam *et al.*, 2002) are unlikely to be responsible for these variations in density.
- (2) The inorganic contents, calculated as losses of ignition relative to the total epiphytic matter, of the three sites differed only for the October sample of Rindbach (RB), where it was significantly lower. The Bay of Rindbach is separated from the industrial emissions of the Bay of Ebensee, at least temporarily. This finding was explained by Wunsam *et al.* (2002) as being caused by the discharge of the tributary River Traun. It was, however, impossible to decide if this is the reason for the lower epiphytic minerogenic matter at Rindbach.

## 5. Conclusion

Quantitative evaluation of the epiphytic invertebrate assemblage on *Potamogeton perfoliatus* at three sites in the littoral of Traunsee was carried out by means of a standardised sampling procedure. The findings revealed a distinct temporal variability and spatial heterogeneity of the communities at the three sites sampled. One species (*E. albipennis*) with a high salinity tolerance was observed. However, variations in density of this species between the sampling sites could not be attributed to spatial changes in chloride concentrations. Relations between the epiphytic inorganic material and increased suspended minerogenic matter at the emission site were not observed. As a result, the significant differences in the community structure at the sampling sites most probably reflect the patchiness within highly structured habitats rather than being the result of industrial pollution.

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## Appendix

Species list of invertebrates found on *Potamogeton perfoliatus* L. in Traunsee, 1998. The presence of taxa found at the three sampling sites (see Figure 1) is marked.

	VI	RB	EB
Hydrozoa	+	+	+
Turbellaria	+	+	+
Gastropoda			
Hydrobiidae			
<i>Potamopyrgus antipodarum</i> (Gray)	+		+
Bithyniidae			
<i>Bithynia tentaculata</i> (Linnaeus)	+		+
Lymnaeidae			
<i>Radix ovata</i> (Draparnaud)			+
Planorbidae			
<i>Gyraulus albus</i> (Müller)			+
Bivalvia			
Dreissenidae			
<i>Dreissena polymorpha</i> (Pallas)	+	+	+
Oligochaeta			
Naididae			
<i>Amphichaeta leydigii</i> Tauber	+		+
<i>Chaetogaster cristallinus</i> Vejdovsky	+	+	
<i>Chaetogaster langi</i> Bretscher	+	+	+
<i>Nais behningi</i> Michaelsen	+	+	+
<i>Nais pseudobtusa</i> Piguet	+	+	+
<i>Ophidonais serpentina</i> (Müller)	+	+	+
<i>Stylaria lacustris</i> (Linnaeus)	+	+	+
<i>Uncinais uncinata</i> (Orsted)	+	+	+
<i>Vejdovskyaella intermedia</i> (Bretscher)	+	+	+
Tubificidae			
<i>Psammoryctides barbatus</i> (Grube)			+
Hirudinea			+
Acari	+	+	+
Ctenopoda			
Sididae			
<i>Sida crystallina</i> (Müller)	+	+	+

	VI	RB	EB
Anomopoda			
Chydoridae			
<i>Acroperus elongatus</i> (Sars)	+		+
<i>Acroperus harpae</i> (Baird)	+	+	+
<i>Alona costata</i> Sars	+	+	+
<i>Alona guttata</i> Sars	+	+	+
<i>Alona rectangula</i> Sars	+	+	+
<i>Anchistropus emarginatus</i> Sars			+
<i>Biapertura affinis</i> (Leydig)	+	+	+
<i>Chydorus sphaericus</i> (Müller)	+	+	+
<i>Eurycercus lamellatus</i> (Müller)	+	+	+
<i>Graptoleberis testudinaria</i> (Fischer)	+	+	+
<i>Leydigia quadrangularis</i> (Leydig)	+		+
<i>Picripleuroxus denticulatus</i> (Birge)	+		
Ostracoda		+	+
Copepoda Harpacticoida			
Canthocamptidae			
<i>Canthocamptus staphylinus</i> (Jurine)	+	+	+
Copepoda Cyclopoida			
Cyclopidae			
<i>Eucyclops macruroides</i> (Lilljeborg)	+	+	+
<i>Eucyclops macrurus</i> Sars	+	+	+
<i>Eucyclops serrulatus</i> (Fischer)	+	+	+
<i>Paracyclops fimbriatus</i> Fischer	+	+	+
<i>Macrocyclus albidus</i> (Jurine)	+	+	+
Amphipoda			
Gammaridae	+	+	
<i>Dikerogammarus villosus</i> (Sovinsky)			+
<i>Dikerogammarus haemobaphes</i> (Eichwald)			+
<i>Gammarus</i> sp.			+
Isopoda			+
Ephemeroptera			
Baetidae		+	
<i>Centroptilum luteolum</i> (Müller)	+	+	+
<i>Cloeon</i> sp.	+		+
Plecoptera			+
Trichoptera			
Hydroptilidae	+		+
<i>Hydroptila</i> sp.			+
<i>Oxyethira</i> sp.	+		+



	VI	RB	EB
Polycentropodidae			
<i>Cyrnus trimaculatus</i> (Curtis)			+
Psychomyiidae	+		
<i>Psychomyia pusilla</i> (Fabricius)		+	
<i>Tinodes</i> cf. <i>waeneri</i> (Linnaeus)			+
Leptoceridae			
<i>Athripsodes aterrimus</i> (Stephens)		+	+
<i>Mystacides azurea</i> (Linnaeus)	+	+	+
<i>Mystacides longicornis</i> (Linnaeus)	+	+	+
Diptera			
Chironomidae			
<i>Arctopelopia</i> sp.	+		
<i>Brillia bifida</i> (Meigen)	+		+
<i>Corynoneura</i> cf. <i>scutellata</i> Winnertz		+	
<i>Cricotopus sylvestris</i> gr.			+
<i>Cricotopus</i> cf. <i>cylindraceus</i> (Kieffer)	+		+
<i>Cricotopus fuscus</i> gr.		+	+
<i>Eukiefferiella claripennis</i> agg.		+	
<i>Orthocladius thienemanni</i> gr.		+	+
<i>Orthocladius</i> (s. str.) sp. A		+	
<i>Orthocladius</i> (s. str.) sp. B			+
<i>Orthocladius consobrinus</i> (Holmgren)	+	+	+
<i>Paratrichocladius rufiventris</i> (Meigen)	+		+
<i>Psectrocladius limbatellus/sordidellus</i> gr.	+	+	+
Chironomidae			
<i>Psectrocladius psilopterus</i> (Kieffer)		+	+
<i>Synorthocladius semivirens</i> (Kieffer)		+	+
<i>Dicrotendipes nervosus</i> (Staeger)			+
<i>Dicrotendipes</i> cf. <i>tritonus</i> (Kieffer)			+
<i>Endochironomus albipennis</i> (Meigen)	+	+	+
<i>Glyptotendipes pallens</i> (Meigen)			+
<i>Microtendipes chloris</i> gr.	+	+	+
<i>Parachironomus arcuatus</i> gr.	+	+	+
<i>Parachironomus tenuicaudatus</i> (Malloch)		+	+
<i>Phaenopsectra</i> sp.	+	+	+
<i>Polypedilum convictum</i> (Walker)		+	+
<i>Polypedilum</i> (s. str.) sp. A		+	+
<i>Cladotanytarsus</i> sp.			+
<i>Microsectra atrofasciata</i> (Kieffer)		+	+
<i>Paratanytarsus</i> sp. cf. <i>lauterborni</i> (Kieffer)	+	+	+
<i>Tanytarsus brundini</i> Lindeberg	+	+	+
<i>Virgatanytarsus</i> sp.		+	+

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