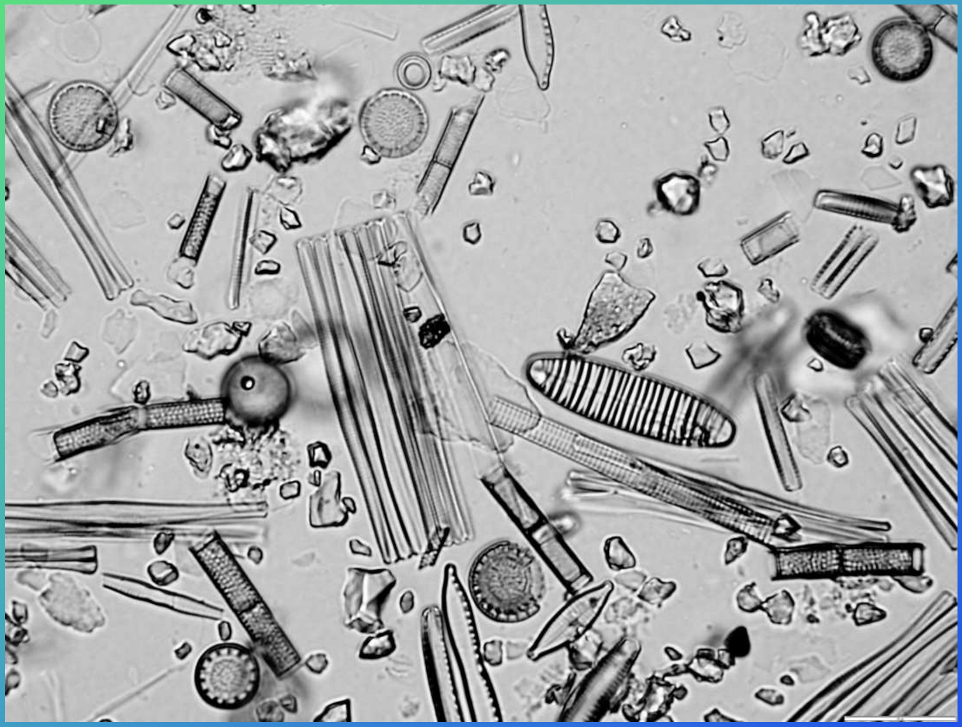
Hodnocení ekologického stavu toků podle fytobentosu u nás a jinde v Evropě

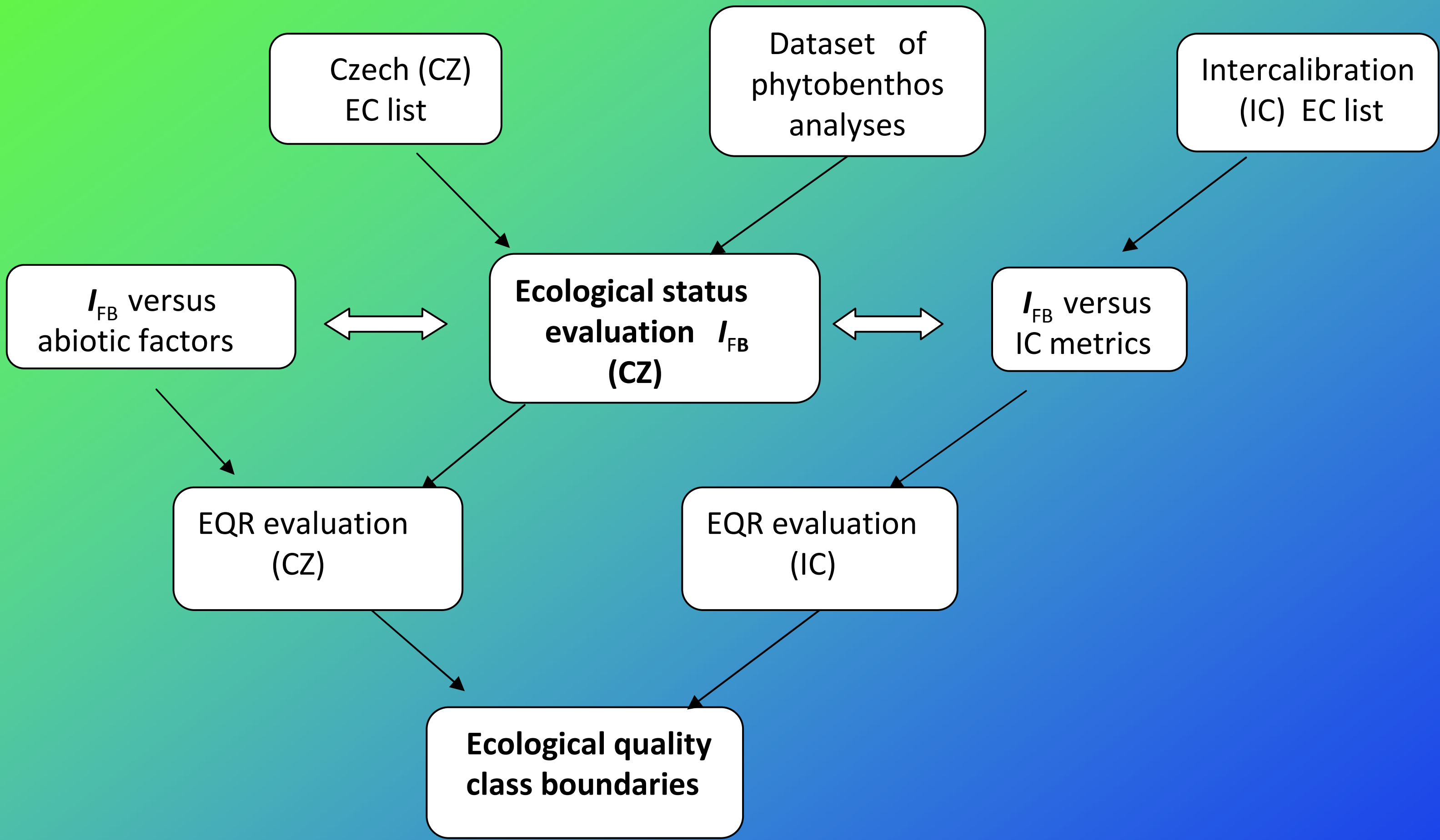
Petr Marvan, Libuše Opatřilová,
Markéta Fránková

Aim of this talk

- To compare Czech approach to ecological status evaluation based on riverine phytobenthos diversity with that accepted for intercalibration purposes. Will we find agreement?



Scheme of the method development



Two-step revision of the list of water quality indicators

- taxonomic delimitation
- ecological characteristics

Dataset of phytobenthos samples composition

- In total 1940 samples from both reference and surveillance monitoring river sites
- Analysts: T. Bešta, B. Brabcová, J. Buchtová, M. Fránková, R. Geriš, J. Heteša, P. Marvan, K. Sukačová, Z. Žáková
  + Water authorities staff
- Sampling method:
  www.mzp.cz/cz/prehled_akceptovanych_metodik_tekoucich_vod.
- in accordance with EN 15708 (2009): Water quality – Guidance standard for the survey, sampling and laboratory analysis of phytobenthos in shallow running waters - single habitat sampling strategy

Ecological status evaluation – Czech method

- as in traditional Czech pre-WFD monitoring (but ignoring heterotrophs)
- basic metric used:

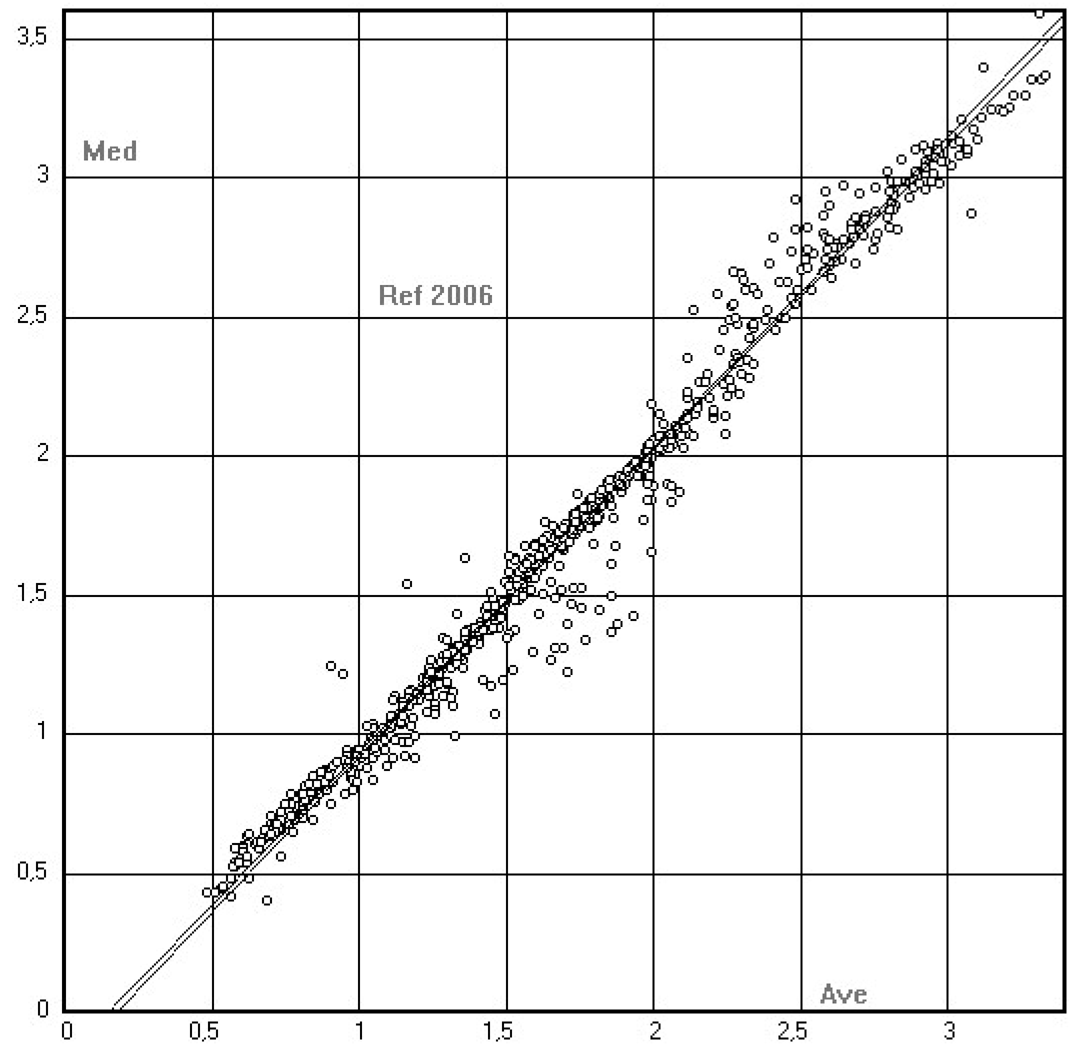
$$I_{FB} = \sum_i h_i w_i S_i \;/\; \sum_i h_i w_i$$

S_i - individual (species specific) autecological characteristics

h_i - product of class coverage value (set according to Tab. 1)

w_i - indicator weight

(Concerning S_i a w_i, see ARROW database taxalist http://hydro.chmi.cz/isarrow/)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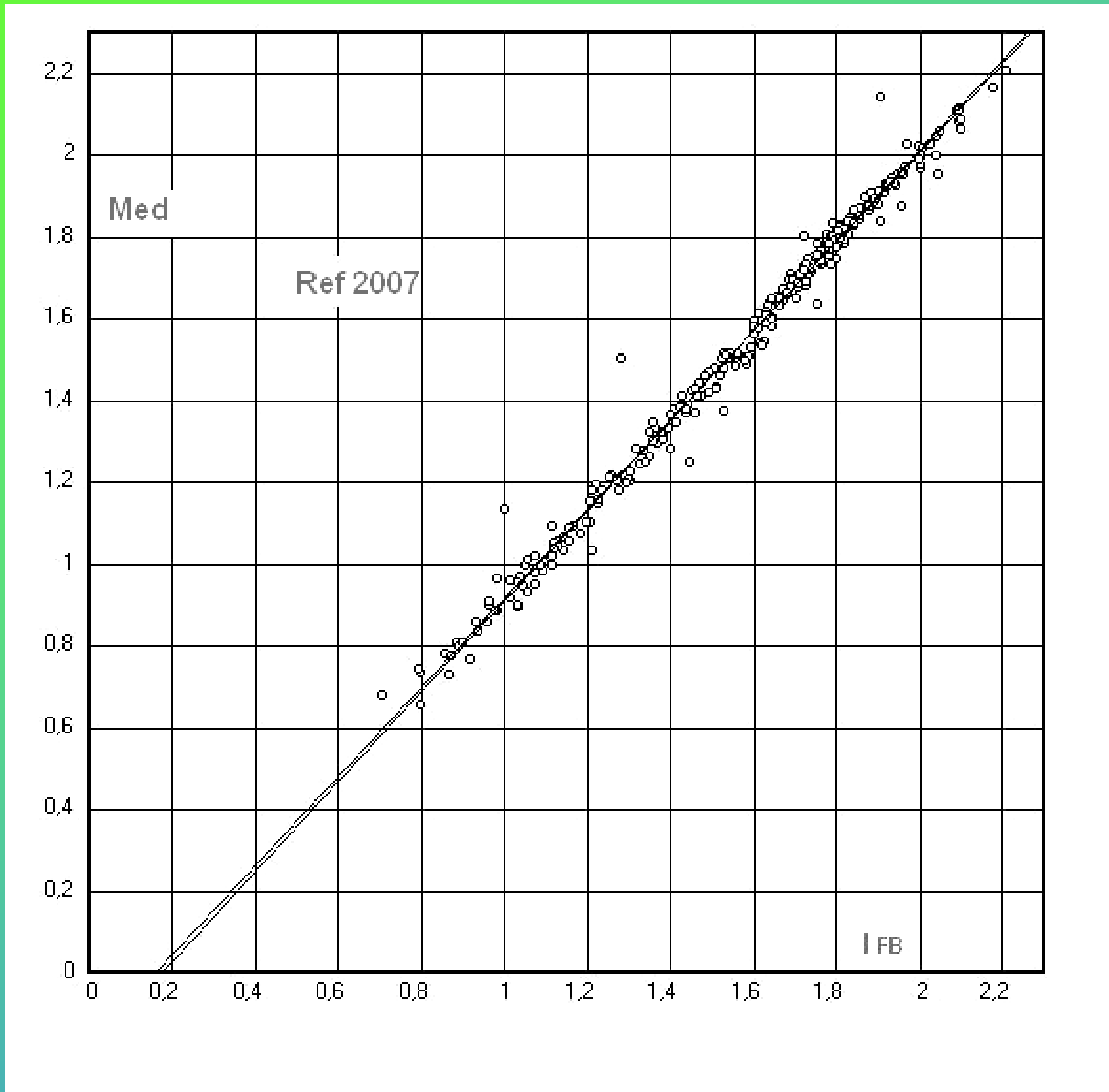
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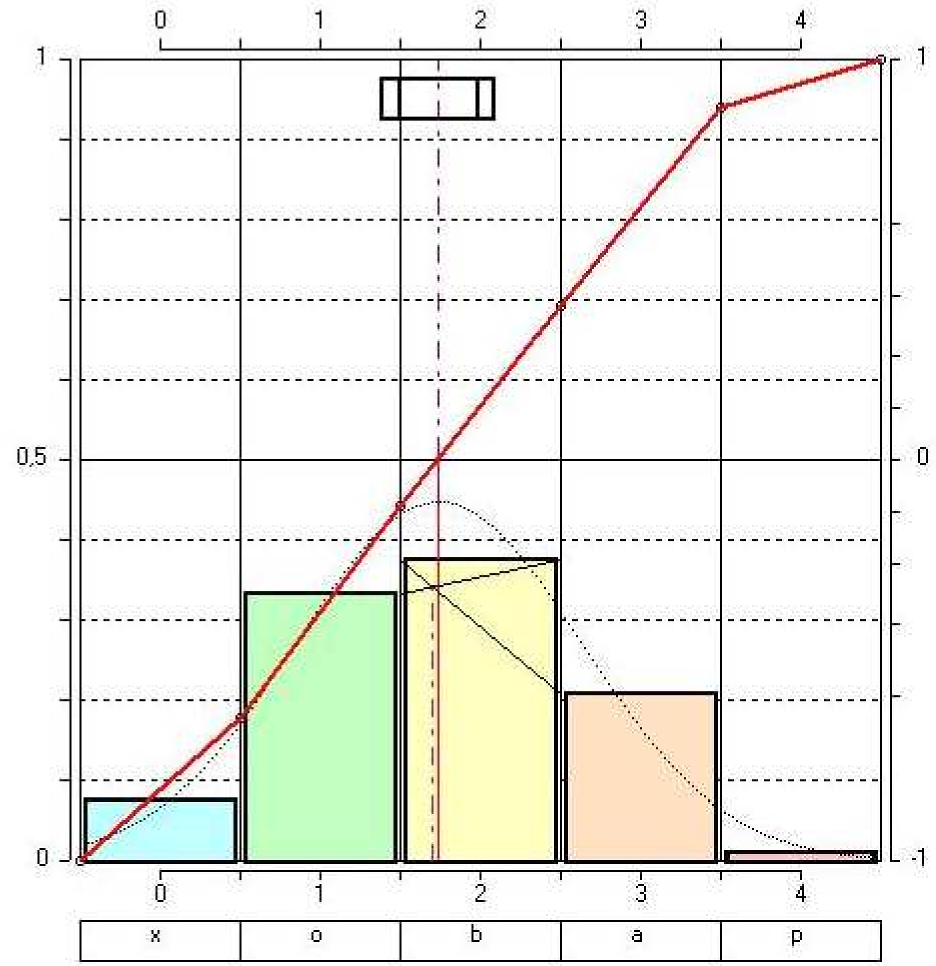

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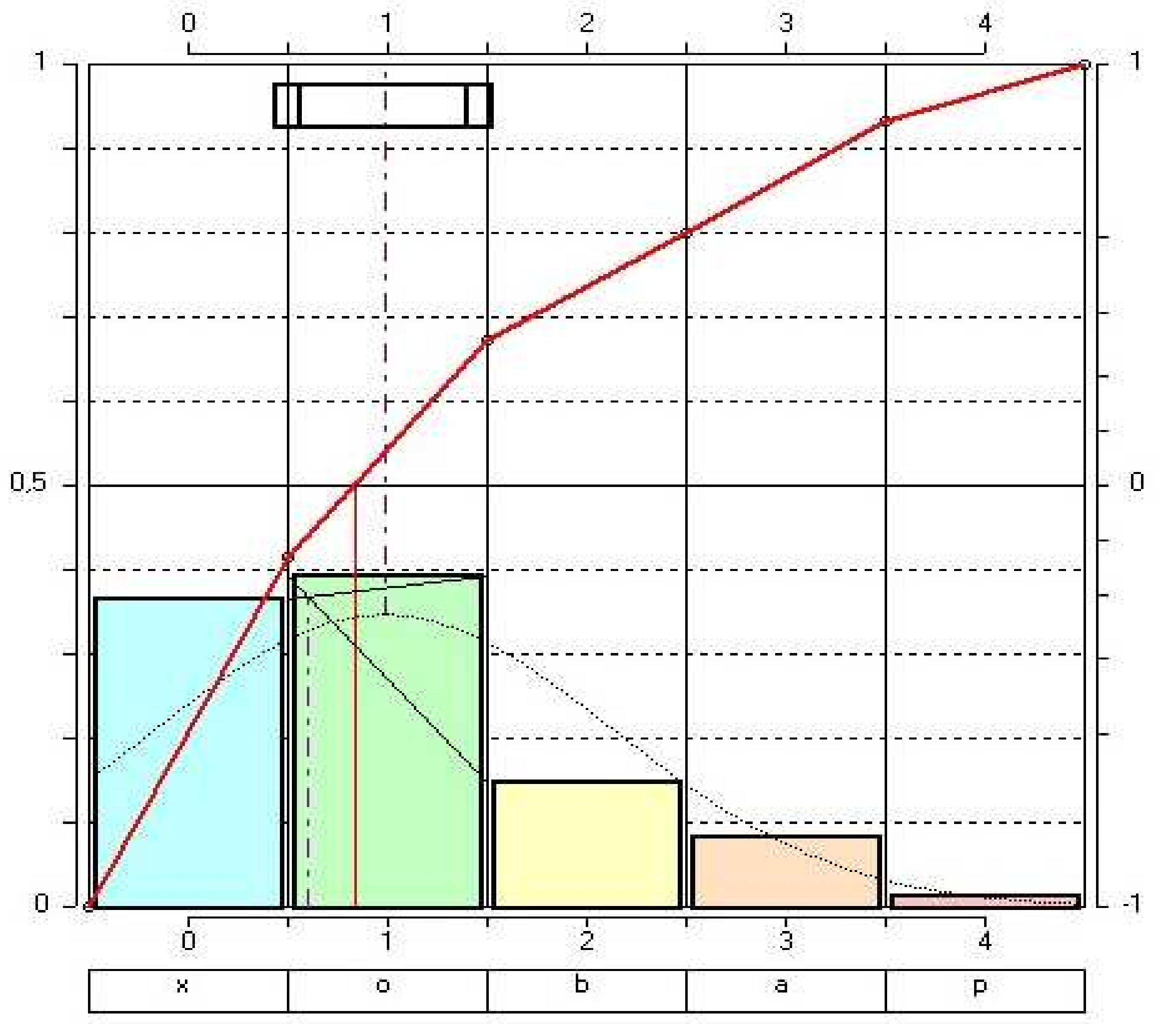
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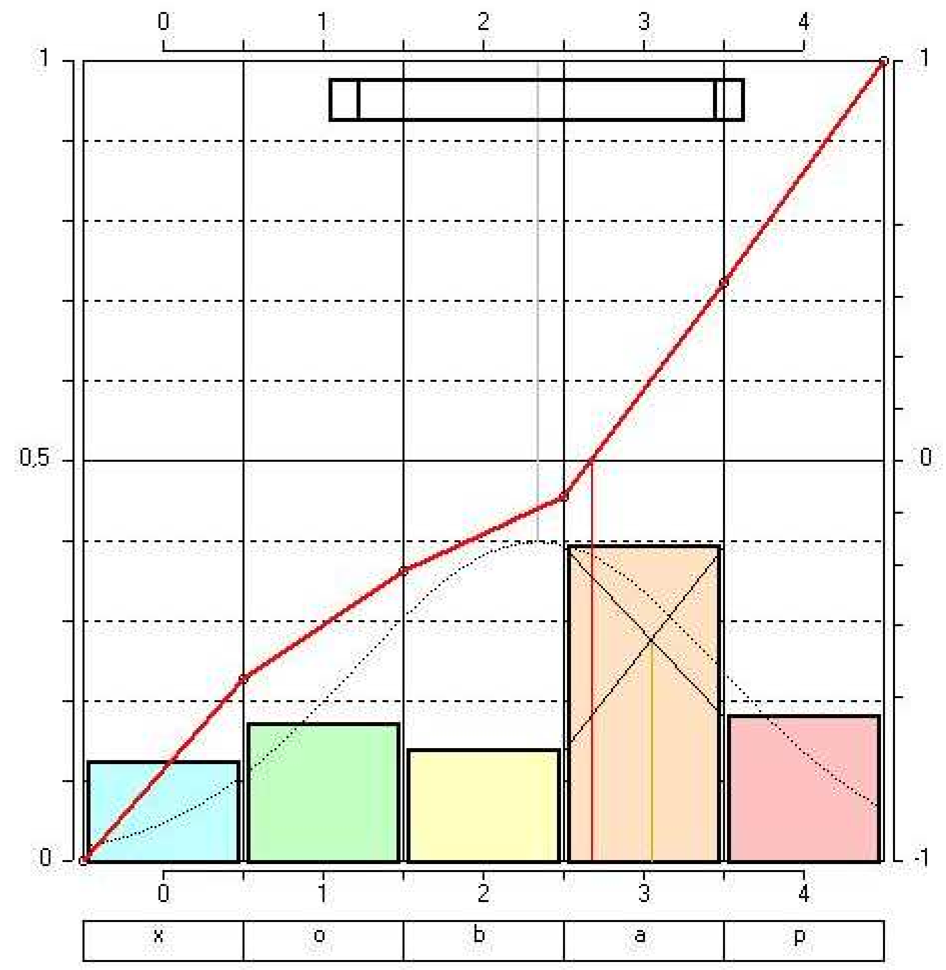

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Ecological quality ratio

$$\mathbf{EQR = (2{,}9 - \mathit{I}_{FB}) \;/\; (2{,}9 - \mathit{I}_{FB\ ref})}$$

- Conversion I_{FB} metric to EQR and setting boundary values of ecological status classes

high – good – moderate – poor - bad

(class boundaries 0.8, 0.6, 0.4 and 0.2)

- $\boldsymbol{I}_{\mathbf{FB\ ref}}$ **–** different for different combinations of typological parameters (Langhammer, 2009): altitude, Strahler stream order, and acid neutralisation capacity (ANC, "alkalinity") or electric conductivity

$\boldsymbol{I}_{FB}$ (ref) = 1,1 – 0,0004 *Alt* + 0,025 *Str* (if ANC $\geq$ 0,75 mmol/l)

$\boldsymbol{I}_{FB}$ (ref) = 1,1 – 0,0004 *Alt* + 0,025 *Str* - 0,4 (0,75 – ANC)

Taxa quantification

scale_ARROW	original scale	description	coverage	
			range	mean
7	6	mass developed	90 – 100 %	95
6	5	very frequent	50 – 90 %	70
5	4	frequent	20 – 50 %	33
4	3	quite frequent	5 – 20 %	10,6
3	2	rare	1 – 5 %	2,3
2	1	very rare	0,1 – 1 %	0,33
1	+	sporadic	do 0,1 %	0,03

*acc. to Sládečková & Marvan 1978

Method reliability

- Standard deviation of I_{FB}

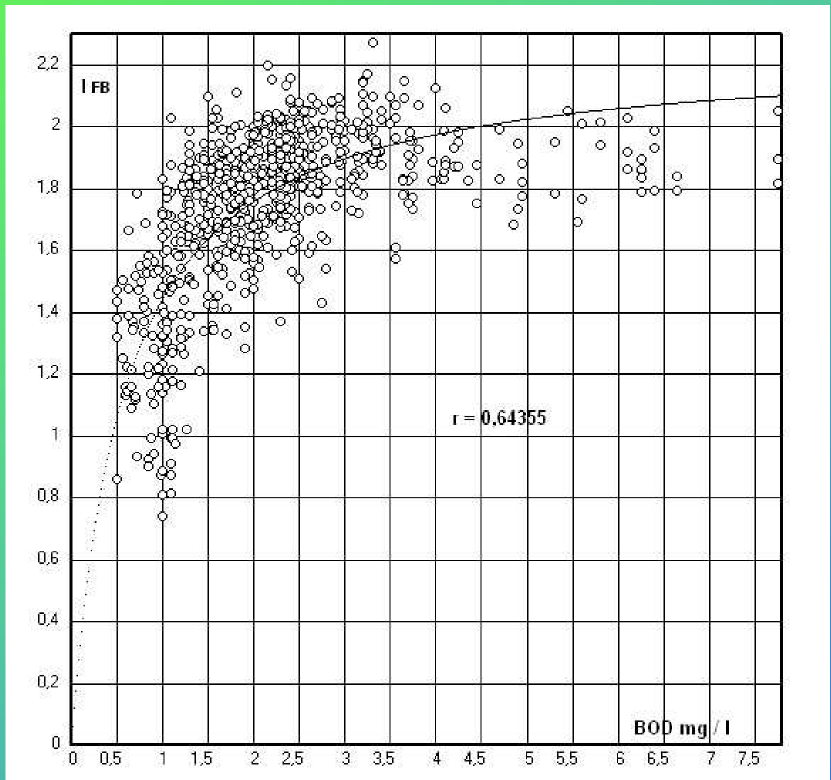
$$\mathbf{D} = \sum \left(S_i - I_{FB} \right)^2 h_i\, w_i \,/\, \left[(n-1) \sum h_i\, w_i \right]$$

- Sum of w_i (indicator weight)

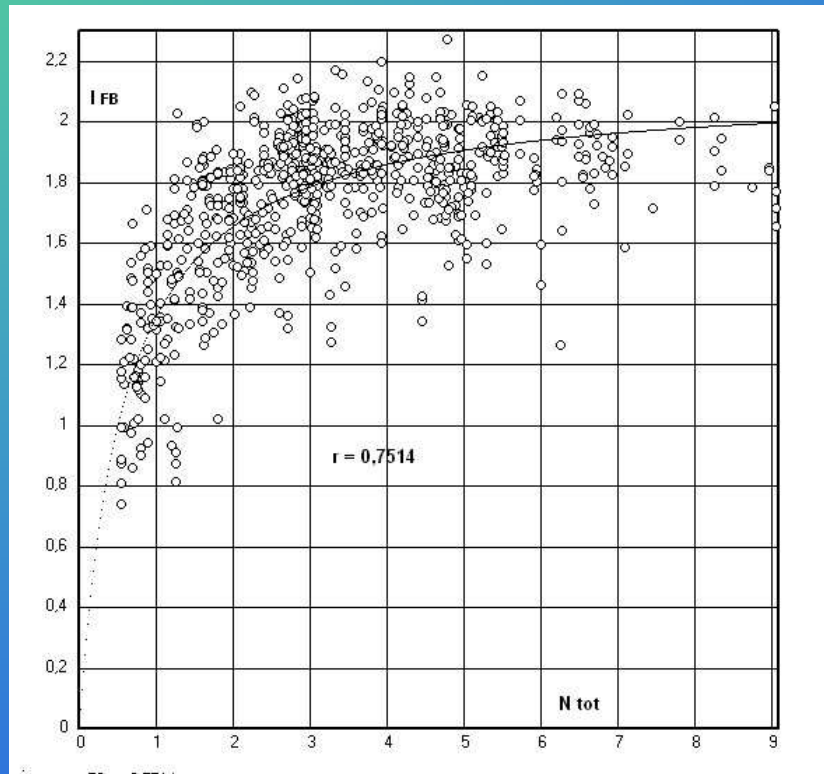
Relations of I_{FB} to:

- **environmental data** (P and N concentration, BOD_5, altitude, Strahler stream order, components of basic mineral composition of water) using Pearson correlation coefficient (linear – log-transformed – hyperbolic)

I_{FB} vs. BOD_5

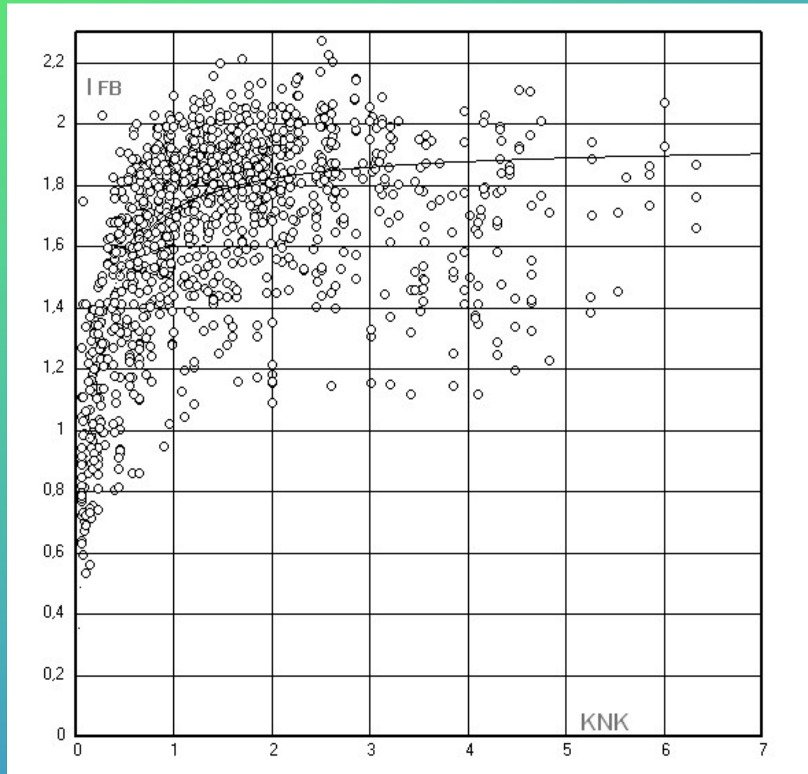


I_{FB} vs N_{tot}



Relations of I_{FB} to:

- **acid neutralisation capacity** (alkalinity)
- **macrozoobenthos** analyses (mainly saprobic index)
- metrics from **other EC systems**

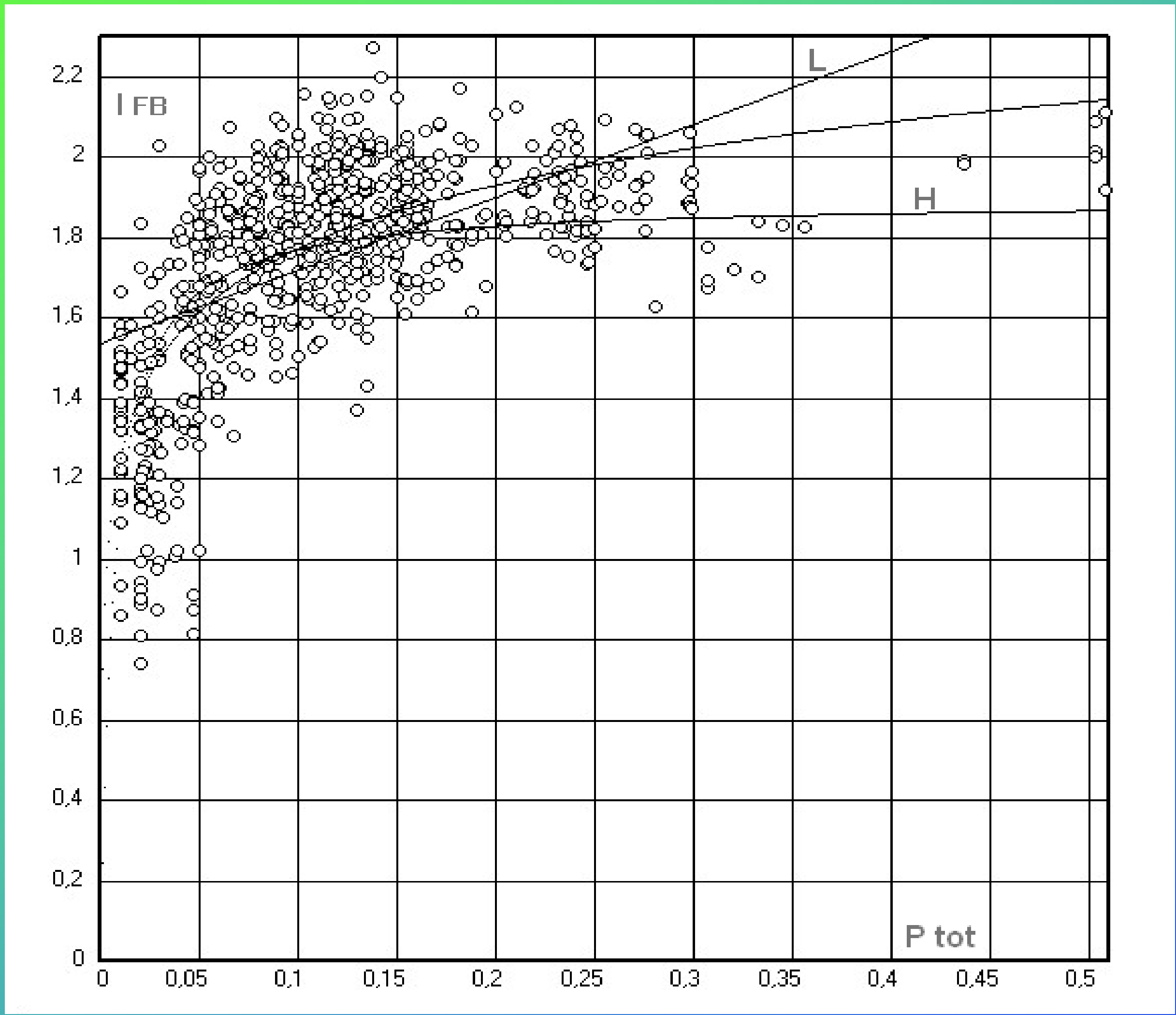


- two s.c. intercalibration metrics
- SI (Rott et al., 1997 - in PBS scale slightly worse quality)

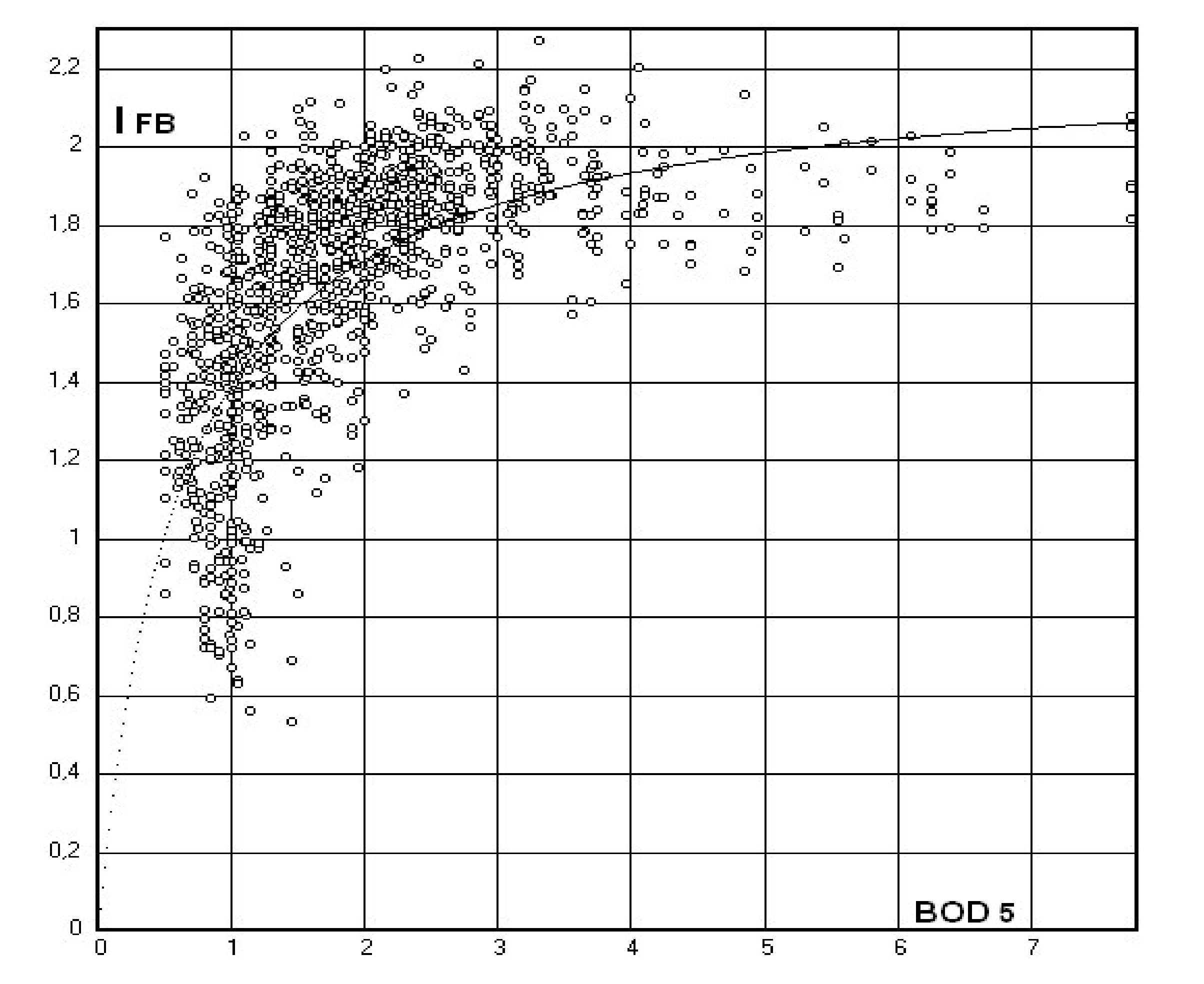
Tab. 5 : Vztah I_{FB} k živinám a BSK_5 (pro Sw >49) ; vysvětlivky symbolů jako u Tab. 3

y	y^{-1} =	*r*	*n*	*p*	$I_{FB\ max}$	r_2	Graf
Ptot	0,5290 + 0,00363 / *x*	0,60910	769	0,00005	1,89	0,70973	9
$P\text{-}PO_4$	0,5550 + 0,00090 / *x*	0,60104	766	0,00004	1,80	0,63646	10
Ntot	0,4710 + 0,26560 / *x*	0,75140	766	0,00002	2,12	0,68641	11
$N\text{-}NO_3$	0,5100 + 0,11400 / *x*	0,68659	768	0,00003	1,96	0,62453	
$N\text{-}NO_2$	0,5226 + 0,00075 / *x*	0,72398	768	0,00003	1,91	0,75395	12
$N\text{-}NH_4$	0,4700 + 0,00727 / *x*	0,59205	509	0,00005	2,13	0,59644	
BOD_5	0,4440 + 0,24930 / *x*	0,64855	768	0,00003	2,25	0,65074	14

Graf 9: Index I_{FB} versus P tot; L regres. přímka, H křivka pro hyperbolickou závislost, prostřední křivka pro logaritmickou závislost



Graf 13: Index I_{FB} versus BSK_5; křivka pro hyperbolickou závislost



Tab. 5 : Vztah I_{FB} k živinám a BSK_5 (pro Sw >49)

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N-NH4	0,4700 + 0,00727 / x	0,59205	509	0,00005	2,13	0,59644	
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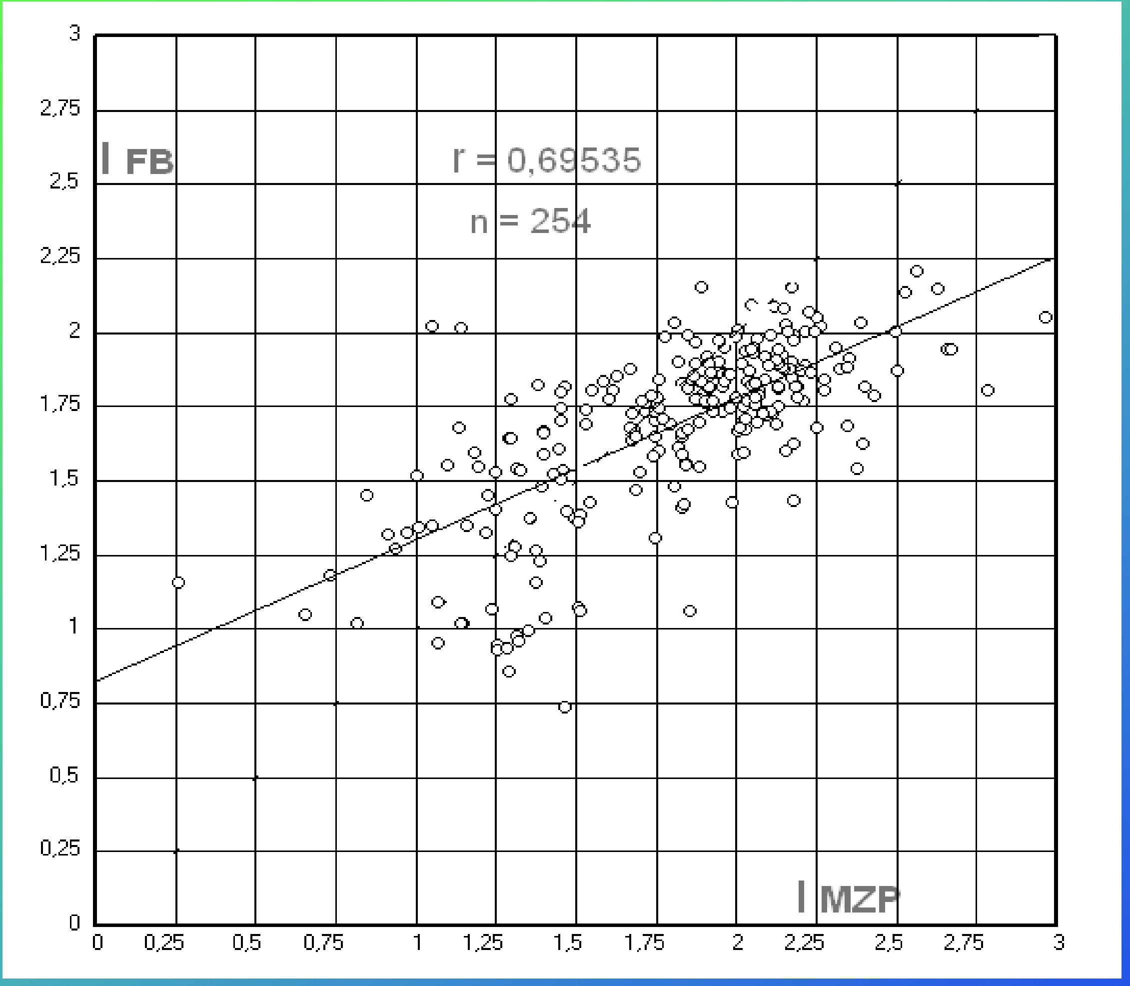
7.1.Výsledky rozboru epibryonu a epilitonu

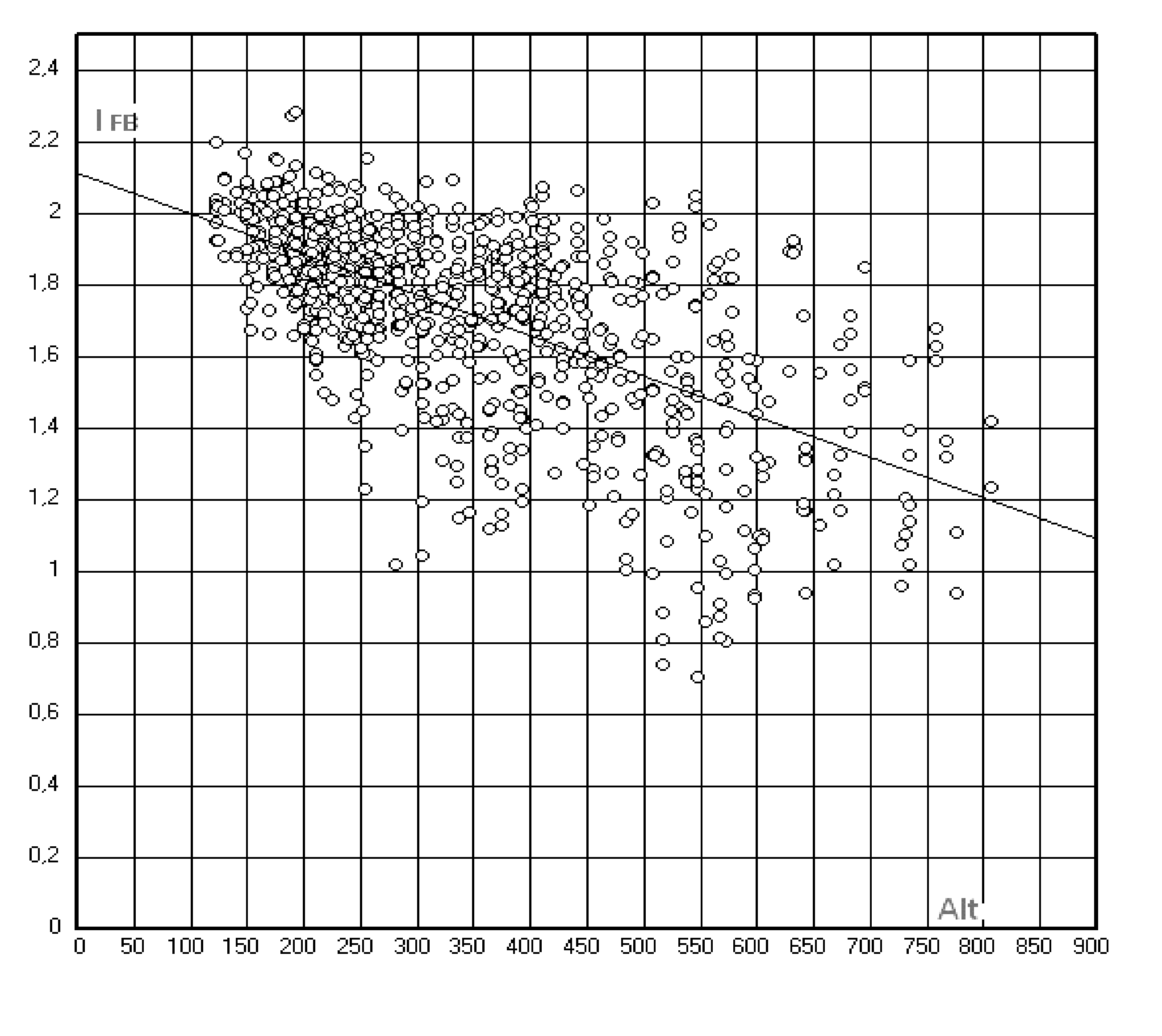
K dispozici je 79 dvojic paralelně odebíraných vzorků epilitonu a epibryonu, zčásti pocházejících z úseků toků s velmi slabým rozvojem fytobentosu v důsledku slabého osvětlení. :

	Epiliton	Epibryon
Prům.počet indikátorů	15,14	17,51
Prům. hodnota Sw	37,40	43,71
Prům. I_{FB}	1,157	1,164

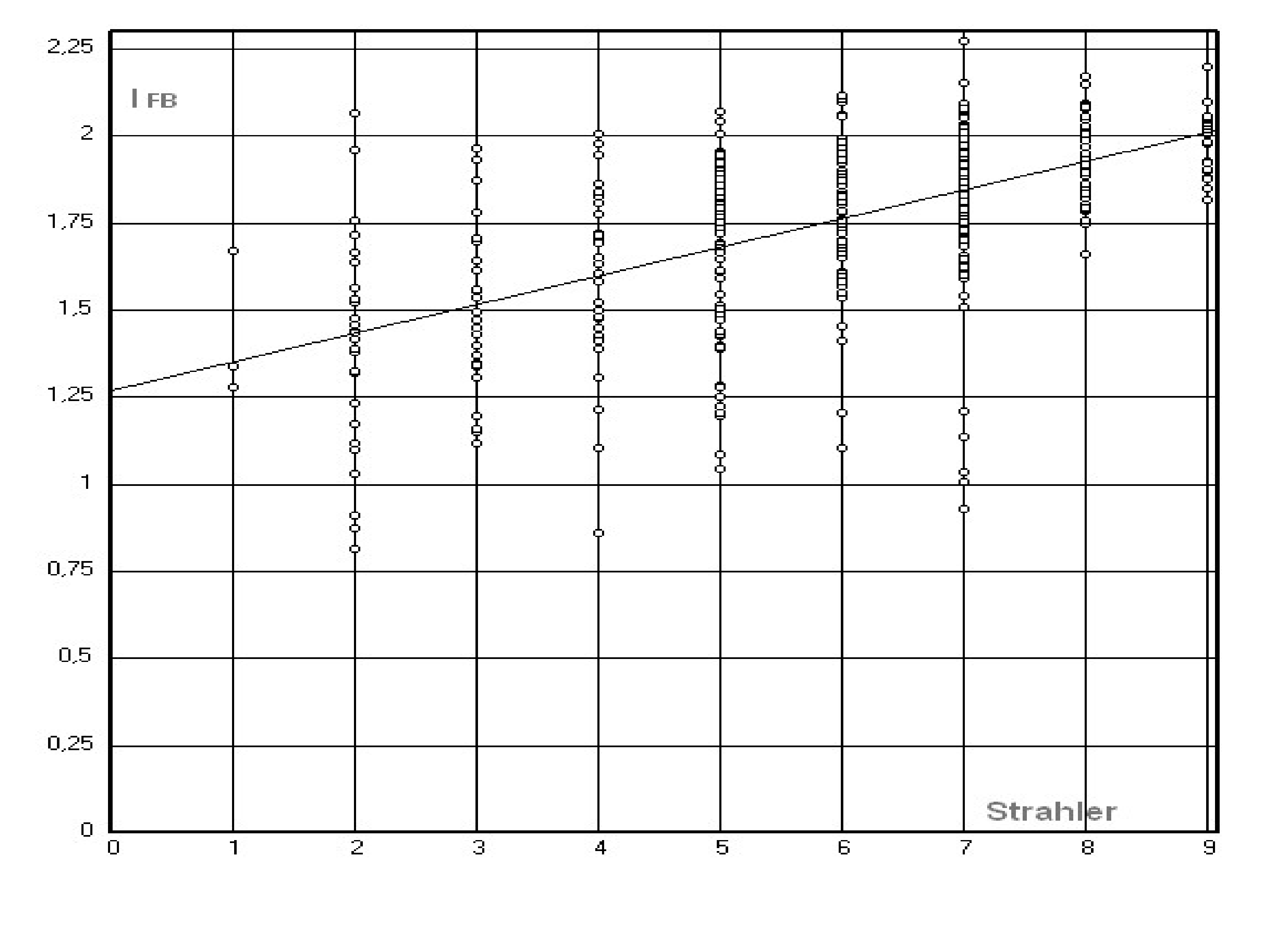
Graf 15: Vztah I_{FB} k I_{MZB} , vzorky z jara 2007 se Sw ≥ 50



Graf 3: Index I_{FB} versus nadmořská výška (r = - 0,63479)



Graf 5: I_{FB} versus Strahlerův řád pro n =140



1.Hraniční hodnoty tříd ekologického stavu

Hraniční hodnoty tříd jsou stanoveny ekvidistantně,
tj pro EQR i-té třídy (*i* = 1 pro velmi dobrou,
i =2 pro dobrou, atd.) í

1.třída	$0{,}8 \leq$ EQR	$I_{FB} \leq 0{,}58 + 0{,}8\, I_{FB}$ (ref)
2. třída	$0{,}6 \leq$ EQR $<$ 0,8	$0{,}58 + 0{,}8\, I_{FB}$ (ref) $< I_{FB} \leq 1{,}16 + 0{,}6\, I_{FB}$ (ref)
3. třída	$0{,}4 \leq$ EQR $<$ 0,6	$1{,}16 + 0{,}6\, I_{FB}$ (ref) $< I_{FB} \leq 1{,}74 + 0{,}4\, I_{FB}$ (ref)
4.třída	$0{,}2 \leq$ EQR $<$ 0,4	$1{,}74 + 0{,}4\, I_{FB}$ (ref) $< I_{FB} \leq 2{,}32 + 0{,}2\, I_{FB}$ (ref)
5. třída	EQR $<$ 0,2	$2{,}32 + 0{,}2\, I_{FB}$ (ref) $< I_{FB}$

My versus Evropa

Agreed intercalibration approach:

- only diatoms
- analyzed following CEN 2003, CEN 2004
- quantification by counting valves in permanent mounts (at least 300 valves, regardless their pairing/chaining)
- two common intercalibration metrics:

  IPS (Index de Polluosensibilité, Coste 1982, fom the original scale transformed to Ominidia scale from 1 (worst) to 20 (best)

  TI (Trophieindex, Rott et al., 1999) in sclae 0 (best) to 4 (worst) quality)

  joint to s.c. ICM (Intercalibration metrics)
- calculated metric: arithmetic mean of species-specific sensitivity values weighted by product of valve count and indicator value (the same index type as in CZ but with different abundance quantification)

Kelly, M. et al., 2009: A comparison of national approaches to setting ecological status boundaries in phytobenthos assessment for the European Water Framework Directive: results of an intercalibration exercise. - Hydrobiologia 621: 169-182.

Basic differences between the proposed Czech method against the international "intercalibration approach"

1.evaluation based on all phototrophs inhabiting phytobenthos sample (less important difference, both approaches bring similar results)

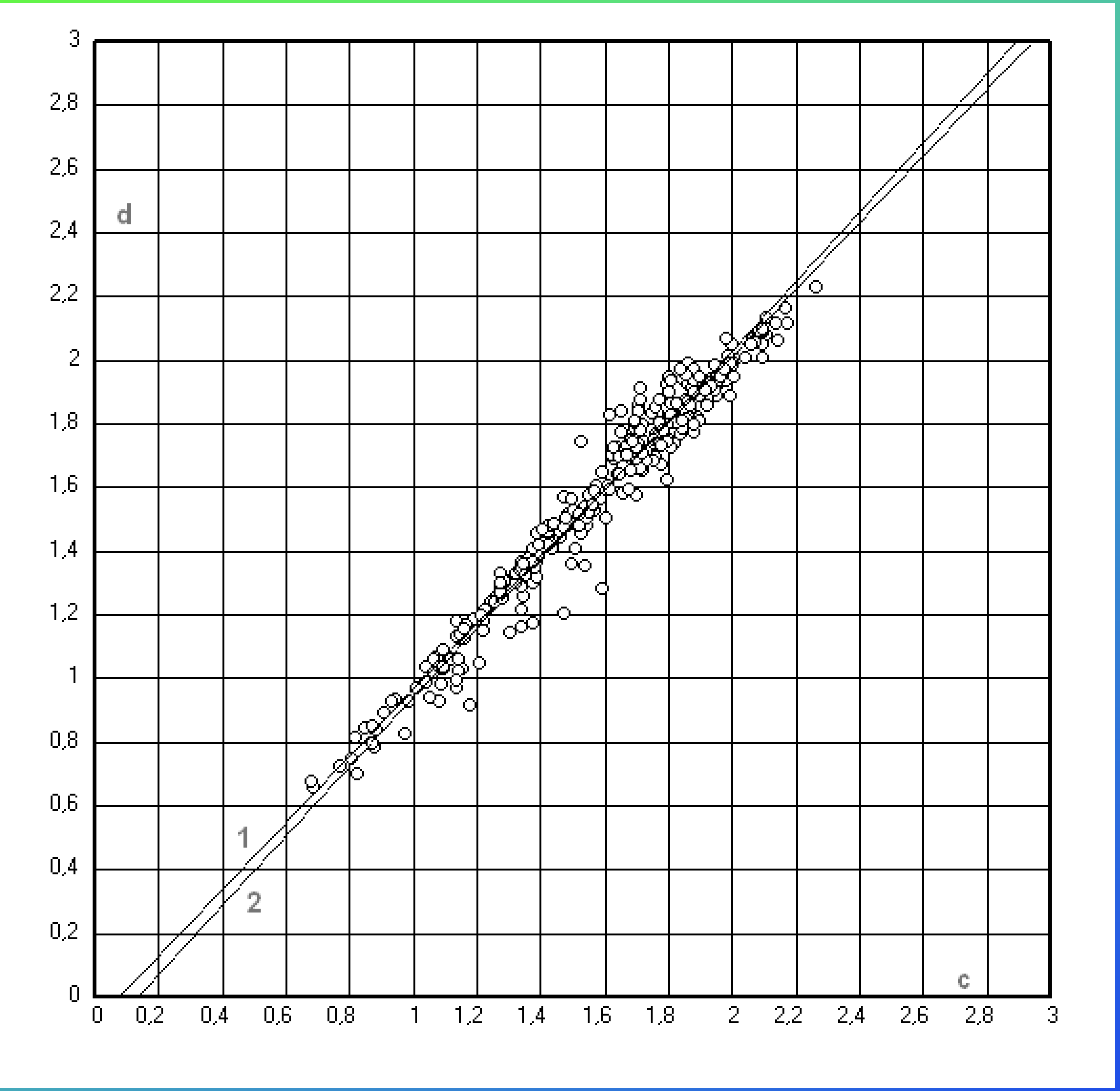
2. abundance quantification using coverage classes instead of valve counts (the most important difference !!)

3. different set of indicator taxa and autecological characteristics

4.differences in inicator concept

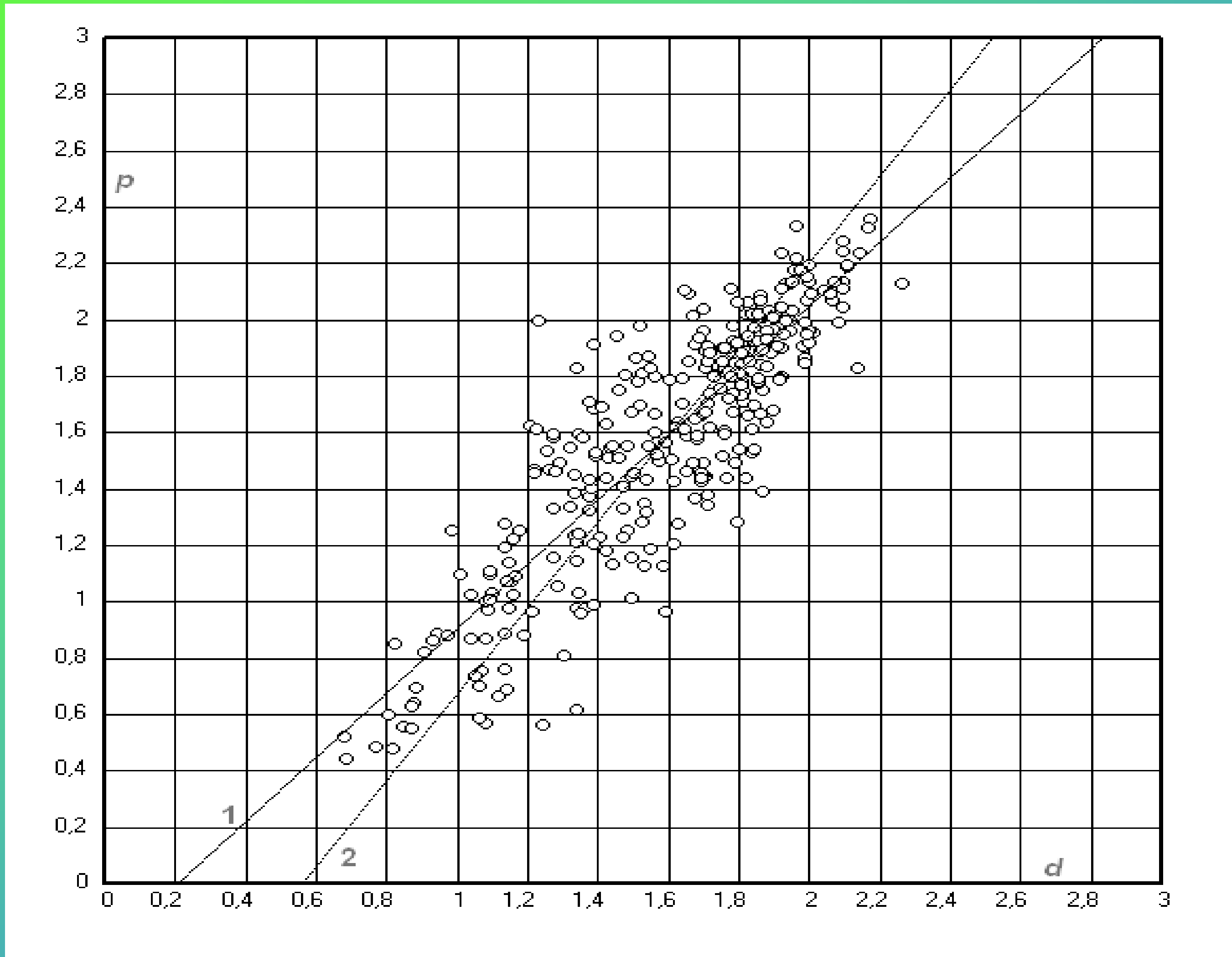
5.different ecological quality criteria for different water types

Ad 1: Indexy I_{FB} počítané jen z rozsivek (d) versus ze všech sinic a řas (c)



Ad 2: Indexy I_{FB} počítané z procent pokryvnosti (*p*) versus z tříd pokryvnosti (*d*)

Regresní přímka pro *d* jako nezávisle proměnnou (1) a pro *p* jako nezávisle proměnnou (2)



Ad 2: Class abundances versus counts of valves

- counting mostly applicable only for cleaned material (permanent mounts) - counted live and dead cells undistinguished
- low exactness of counting results (high statistic error, problems of classification of specimens in pleural view, problems of counting single and paired valves)
- proportions *p* of individual taxa enter the calculation of the water quality metric only with meaning of statistical weight, not of the true measured quantity
- in samples with high occurrence of a dominant species use of untransformed frequency values results in water quality metric values practically equal to sensitivity value of the respective dominant

Confidence limits for counts (significance level = 5%) if in total 400 objects (whole frustules, separate valves, cell chains) are counted

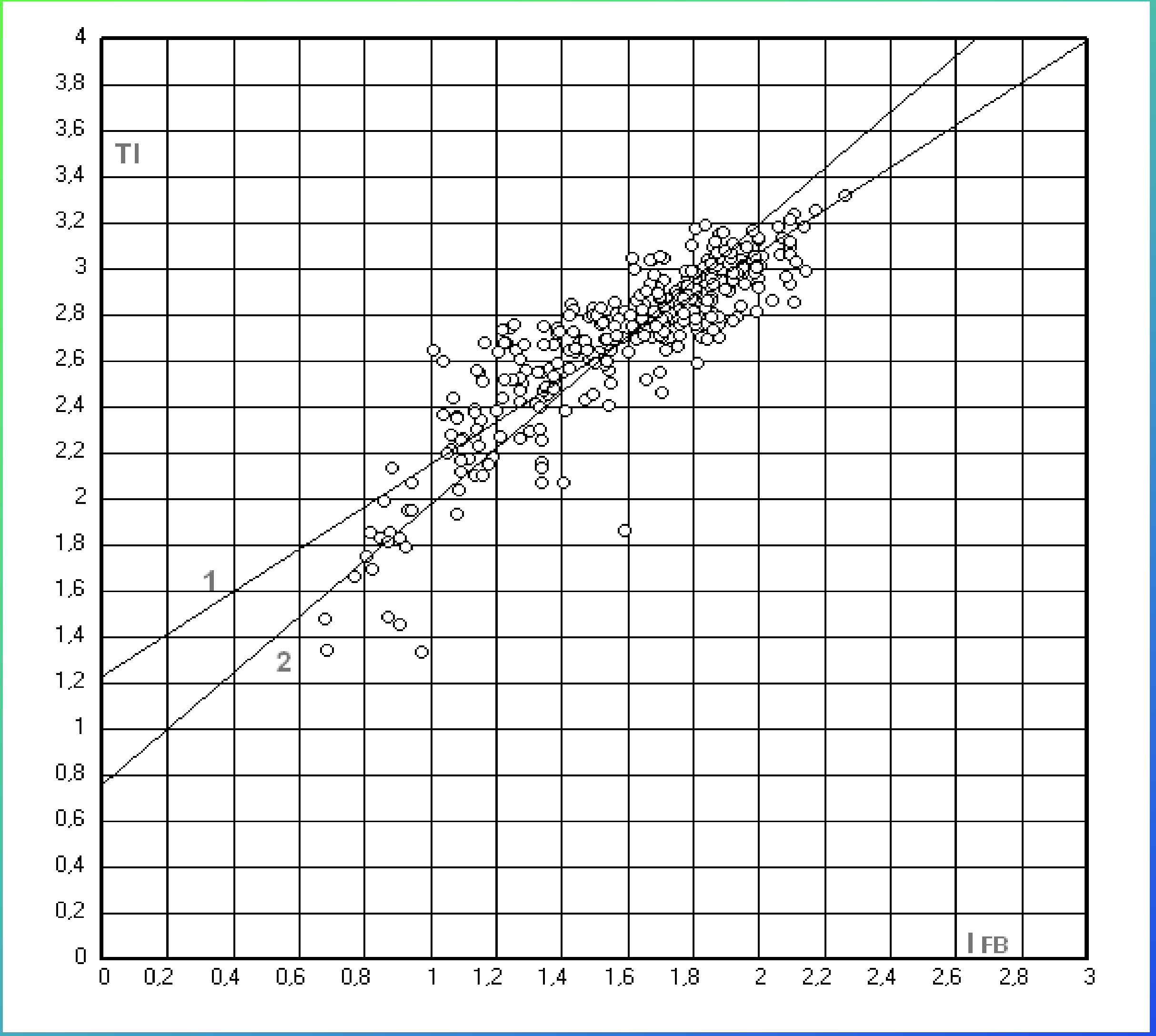
No. of counted objects	in %	confidence limits (in %) (rounded values)
0	0	0.00 - 0.92
5	1.25	0.41 - 2.89
10	2.5	1.21 - 4.55
20	5	3.08 - 7.62
40	10	7.24 - 13.37

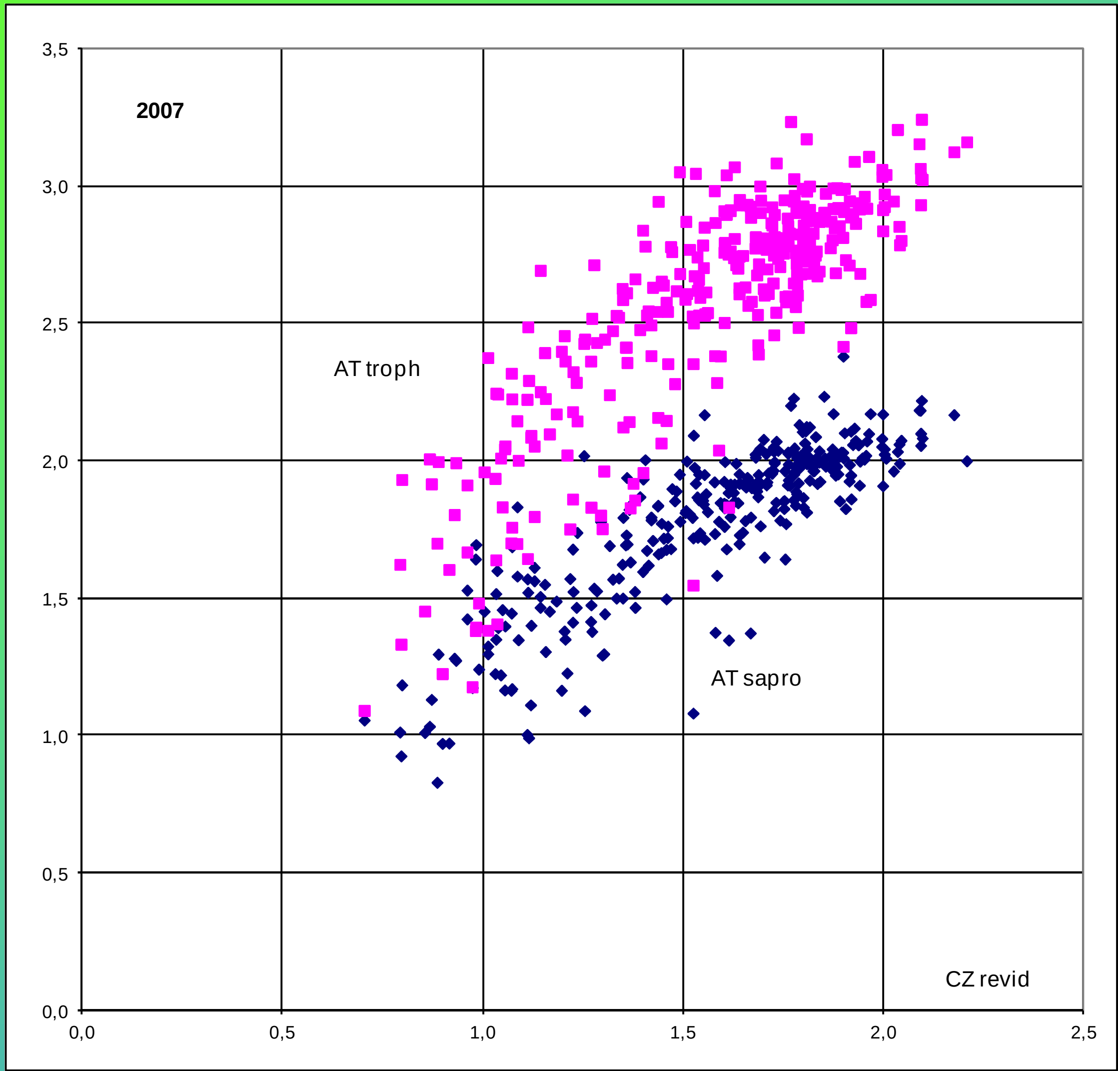
In the set of 400 counted objects there is no significant difference between diatom quantities based on counting of

n = 4 and n = 10 objects,
n = 10 and n = 18 objects.

Ad 3: Index TI versus I_{FB}

Vyneseny obě regresní přímky (1 pro I_{FB} jako nezávisle proměnnou,
2 pro TI jako nezávisle proměnnou)

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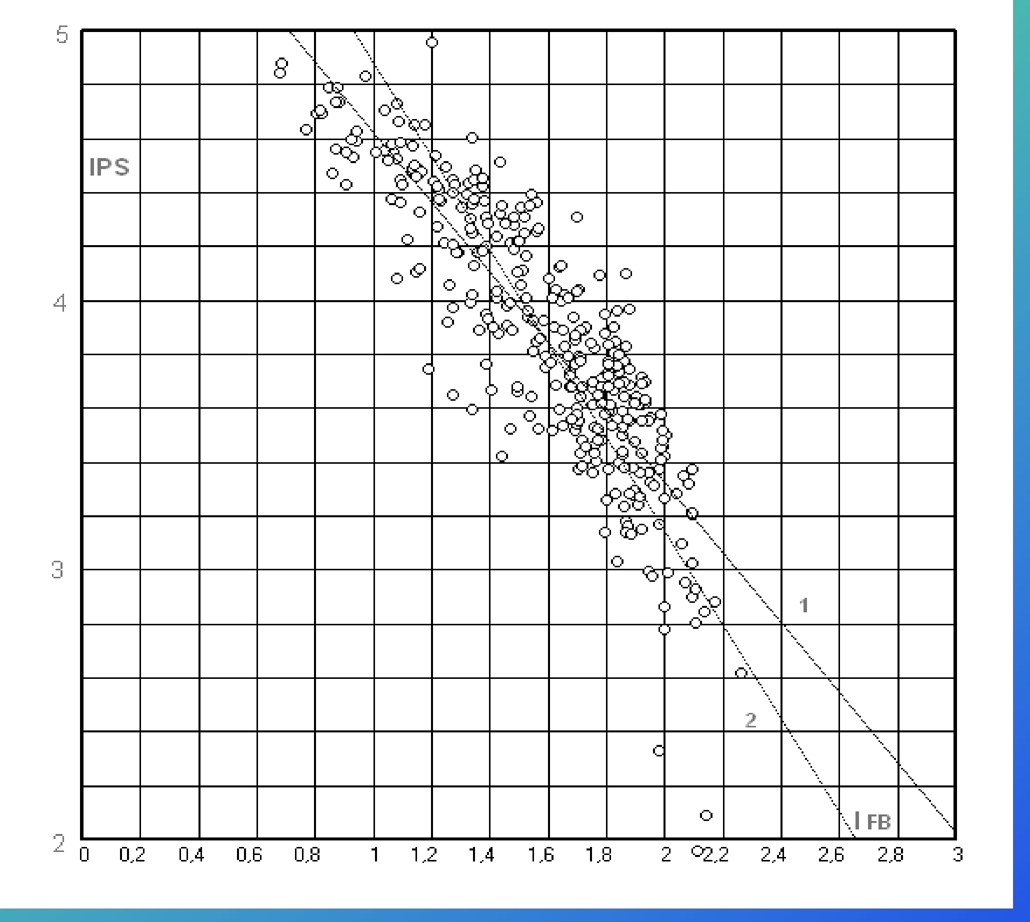
Ad 3: Index IPS versus I_{FB}

1 Regresní přímka pro I_{FB} nezávisle proměnnou, 2 pro IPS nezávisle proměnnou



Ad 3: Korelační koeficienty

v prvním řádku počítané pro Sw ≥ 50 (n = 330),
ve druhém pro Sw ≥ 30 (n = 629)

0	SI	TI	TI *	IPS	IPS *
I_{FB}	0,85416 0,82972	0,86980 0,86686	0,56562 0,64282	- 0,86442 -0,84737	-0,75199 -0,74961
SI		0,90632 0,89977	0,64157 0,64664	- 0,74034 - 0,68964	-0,66797 -0,61417
TI			0,64157 0,64664	-0,74034 -0,68964	-0,66797 -0,61417
IPS					0,83254 0,83940

Ad 3: IPS and TI reference values proposed for intercalibration comparisons

	GIG	Scale		Corresponding I_{FB} (ref)	
		OMNIDIA	PBS		
IPS	CB	15,23	1,004	1,48	1,52 - 1,54
	EU	15,41	0,966	1,45 - 1,47	1,50 - 1,51
TI	CB	13,30	2,59	1,50	1,40 - 1,53
	EU	13.59	2,62	1,53	1,44 - 1,54

Ad 4: Indicators concept (a)- Common problem: substantial differences in taxonomic concept of names in older and more recent identification compendia

- inflation of the classification category “species” hand in hand with inflation of the category “genus”
- this holds true especially for diatoms (cf. concept of the classification category “species” in volumes of Süßwasserflora von Mitteleuropa and younger literature such as Diatoms of Europe)

  examples: *Pinnularia viridis, Frustulia saxonica, Fragilaria capucina*
- changes affected hundreds of diatom names due to
  - raising of infraspecific taxa to the level of separate species
  - descriptions of new morphologically hardly distinguishable species (poorly defined diacritic features)

Ad 4: Indicators concept (b)- **Associated technical problems**

- European taxalists (STAR taxon list, OMNIDIA application etc.): do not distinguish between different concepts, referring only to the last proposed concept

- problems of assigning ecocharacteristics to taxa names with changed concept

  example: *Cymbella minuta / Encyonema minutum* sensu Omnidia and sensu Sládeček 1986

- a lot of „lapsus calami“ in taxa and authors´ names

Ad 4: Indicators concept (c)

– Ringtest 2009 solution

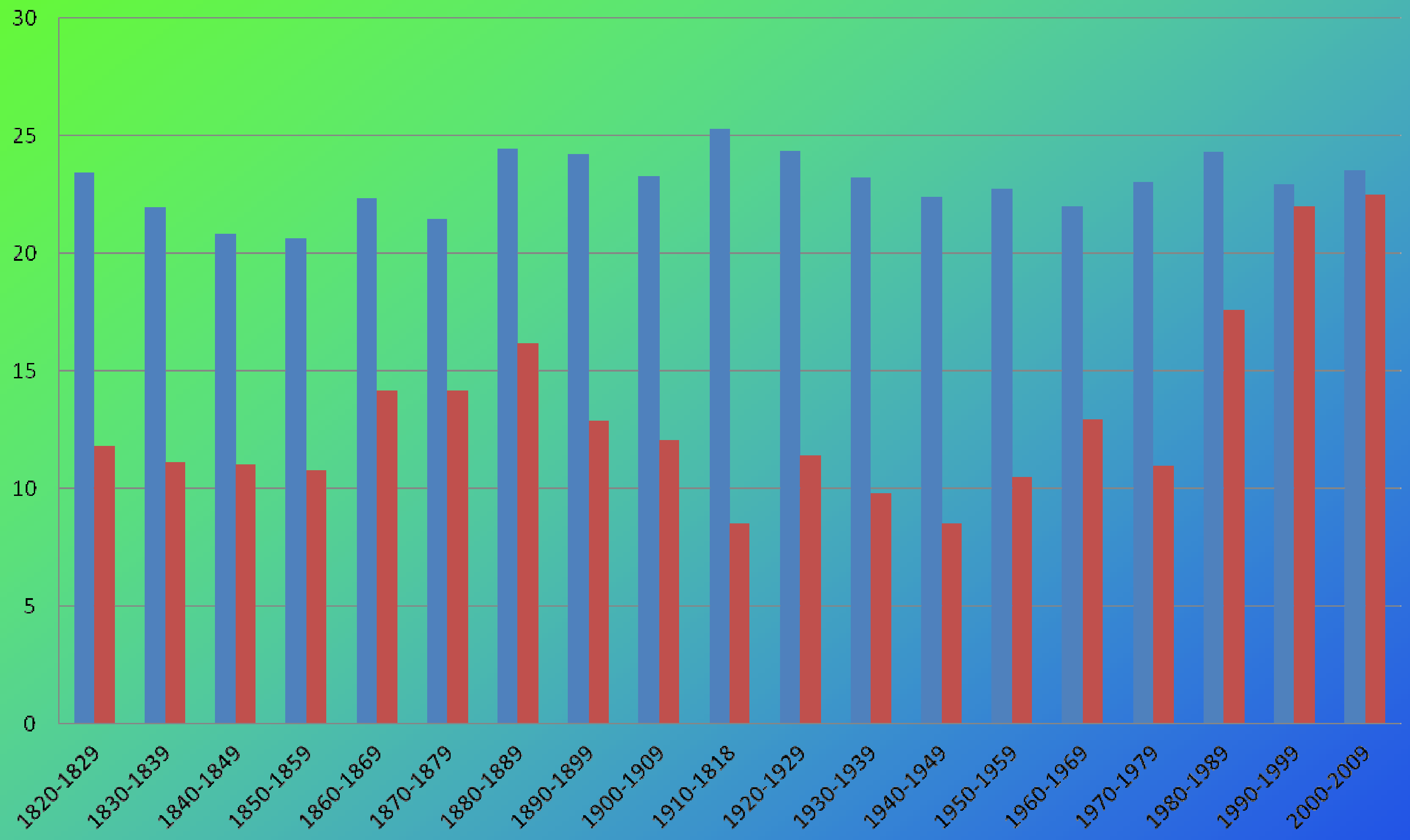
- Proposals of „merged“ taxa

- Czech solution

- definition of a taxon by referring to particular identification literature

- some names appear repeatedly, with different taxonomic content, and , if need, are provided by different indicator weights

Note: citation of author(s) and the year of publication is no more enough for definition or taxonomic content of a name and became practically only matter of appreciation of author´s merits



Blue: taxa names, red: authors

Ad 4: Indicators concept (d) - Different information content of "sensitivity" characteristics

- IPS mostly representing characteristics of optimum; comparing with Czech concept many taxa are ascribed to best water quality class, lying tightly at the margin of the scale

- TI belong to the same type as S_i in the Czech indicator list, i.e., it is derived from valence probabilities ascribed to water quality classes , thus shifted more near to scale centre as is the case for characteristic of optimum used by IPS

Ad 5. Reference and class boundary values and water types

- AT (Austria): for 15 distinguished regions, 18 river stretches, 3 altitude segments, 5 a priori distinguished trophic and 3 saprobic water types

- DE (BRD): 12 water types (regions - geology-s ize of catchment area -ANC/ alkalinity)

- CZ: typology according to Langhammer (2009), i.e. but using altitude (Alt), Strahler river order (Str) and acid neutralisation capacity (ANC) as continuous variables:

Jak jsme interkalibrovali

Intercalibration activities

• the aim is to ensure that national class boundaries of individual Member States are established consistent with the normative definitions in WFD and are comparable between Member States

• CZ belongs to two intercalibration groups – Central Baltic and Eastern Continental.

1st phytobenthos intercalibration exercise (2004-2006)

12 MS in the Central Baltic group

"MSs that submit intercalibration data or finalise their national boundary values subsequent to the publication of the results of the first intercalibration exercise **must ensure that their national boundary values (expressed as ICM) fall within the acceptable band for high/good and good/moderate status boundaries."**

2nd phase of the intercalibration 2008-2011

a. Ringtest 2009 and workshop, Luxembourgh 26.-27.11.2009

b. X-GIG phytobenthos group reference conditions workshop, Erken Laboratory, Sweden, 14-16 April 2010 workshop Erken

Problematic issues involved:

- **Typology**

„Preliminary studies showed, that the intercalibration typology **used in the 1st phase <u>was not helpful for separating diatom assemblages</u>** (Kelly et al., 2007) and this typology was not used for subsequent analyses“

- **Taxonomical problems**

„To what extent are we trying to determine the "right" name, and to what extent are we working out the consequences of splitting versus lumping?“

Ringtest 2009 and workshop, Luxembourgh 26.-27.11.2009

Organized by: Maria Kahlert

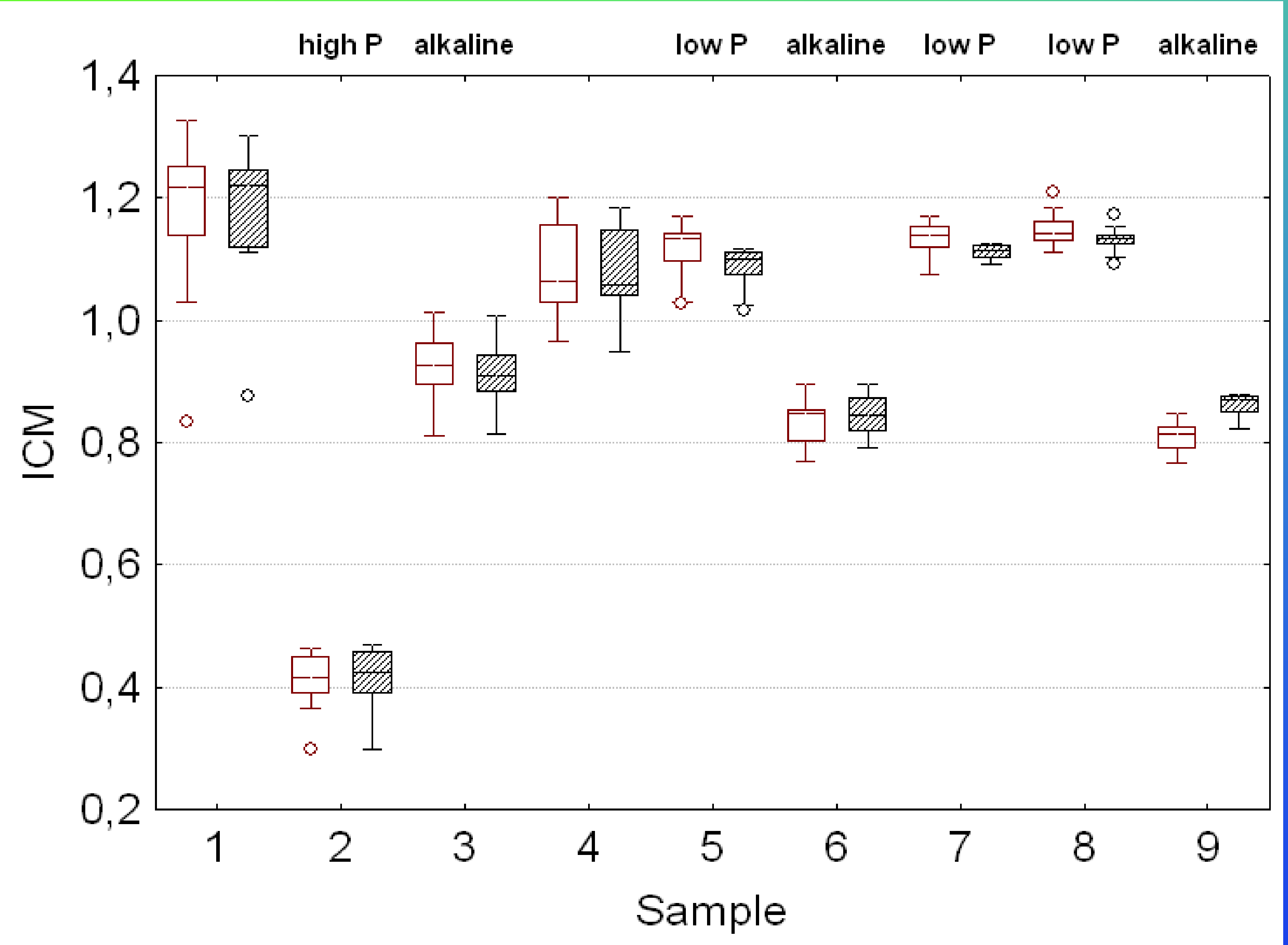
9 samples, 22 member states (from CZ: Tomáš Bešta, Petr Marvan, Markéta Fránková)

The main focus here is taxonomic revision and implications for the intercalibration process.

We´ll need to look at critical taxa during the meeting, to agree the "right" names and/or a pragmatic solution”

- Proposals of „merged“ taxa
- Exclusion of taxa with low freqency from evaluation

Maria Kahlert et al. (submitted): Identification versus counting protocols as sources of uncertainty in diatom-based ecological status assessments (submitted).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Sample

Table 5 List of changes to taxa lists recommended by workshop participants for phase II diatom intercalibration.
Indicator values (V) for the merged taxa for the IPS are all set to "1"
Indicator values for the merged taxa for the TI are unchanged

Taxa	Action	Revised IPS sensitivity	Revised TI sensitivity
All taxa identified only to genus	Omit		
Achnanthidium minutissimum sensu lato (including *A. catenatum*)	Merge	4.6	1.2
Amphora inariensis, A. pediculus	Merge	4.0	2.8
Asterionella spp.	Omit		
Cocconeis placentula	Merge varieties	3.9	2.1
Cyclostephanos spp.	Omit		
Encyonema ventricosum complex (*E. lange-bertalotii, E. minutum, E. silesiacum, E. ventricosum*, etc)	Merge	4.9	2.0
Fragilaria capucina complex excluding *F. vaucheriae* (see below)	Merge	4.2	1.3
Fragilaria crotonensis	Omit		
Fragilaria vaucheriae sensu lato (*F. capitellata, F. vaucheriae*)	Merge	3.4	1.8
"Gomphonema intricatum" complex (*G. angustum, G. minutum, G. pumilum* including varieties)	Merge	5.0	1.4
Mayamaea / Fistulifera	Merge	2.2	3.0
Nitzschia palea	Merge varieties	1.0	3.0
Pseudostaurosira / Staurosira	Merge both genera	3.8	2.8
Stephanodiscus spp.	Omit		
Thalassiosira spp.	Omit		

Ringtest 2009, sample EU 01,16 repeated analyzes

χ^2 crit. (q = 95 %) = 24.993, χ^2 crit. (q = 99 %) = 30.578

χ^2 calculated N	N/2	
312.020	145.499	*Achnanthidium pyrenaicum* s.l.
1564.329	784,025	*Achnanthidium catenatum* s.l. (*caledonicum*, *microcephalum*)
1472.442	736.506	*Achnanthidium minutissimum* s.l.
25.325	8.994	*Cocconeis placentula* s.l.
30.557	14.793	*Fragilaria* spp.
27.859	15.752	*Gomphonema parvulum* s.l. (incl. *exilissimum*)
39.590	20.196	*Encyonema* spp.(*minutum* s.l., *lange-bertalotii*, *schimanskii*)
48.553	25.567	*Gomphonema pumilum* s.l. (incl. *minutum*)
193.780	96.397	*Ulnaria ulna* et *biceps*
41.837	20.532	*Navicula leptostriata* et *heimansoides* et *notha* (et *cryptocephala*)
23.048	11.732	*Reimeria sinuata*

424.681	211.994	Achnanthidium minutissimum incl. jackii, saprophilum, eutrophilum
55.879	26.094	Amphora pediculus et inariensis
48.658	24.651	Amphora libyca, copulata, aequalis
37.616	18.621	Caloneis bacillum (bacillaris, lancettula)
97.753	48.633	Cocconeis pediculus
19.728	9.674	Cocconeis placentula s.l.
34.812	17.220	Cymbella affinis incl. v.procera, excisa, excisiformis
28.752	13.920	Diploneis, omnes species
25.197	12.823	Encyonema minutum s.l. incl. lange-bertalotii
43.938	22.454	Fallacia lenzii
30.373	16.933	Fallacia subhamulata
64.176	31.274	Melosira varians
31.605	16.445	Meridion circulare var. circulare
53.569	26.377	Fragilaria spp. (omnes species)
31.852	14.909	Gomphonema olivaceum (incl. varr.)
36.129	18.046	Gomphonema minutum et pumilum
30.897	13.513	Gomphonema parvulum var.parvulum (incl. f.saprophilum
31.047	12.711	Navicula cryptotenella et cryptotenelloides
85.132	43.085	Navicula gregaria
37.891	17.758	Navicula tripunctata
22.921	9,829	Navicula reichardtiana var. reichardtiana
24.027	12,125	Navicula radiosa
51.200	22.454	Nitzschia dissipata Incl. v. media
35.547	16,985	Nitzschia linearis (incl. subtilis, tenuis)
20.410	9,974	Fragilaria ulna var.acus
75.130	39,410	Fragilaria ulna (t var. ulna et biceps, non acus

X-GIG phytobenthos group reference conditions workshop, Erken Laboratory, Sweden, 14-16 April 2010 workshop Erken

Aim:

"The principal objective is to review the results produced during phase 1, in order to demonstrate whether or not these were robust. A key concern across the entire intercalibration exercise is the validity of reference concepts; a second concern specifically for the phytobenthos exercise is whether the intercalibration typology is valid."

Participation: L. Opatřilová (P. Marvan – only in post-conference discussion)

Main output:

- list of diatom taxa with higher frequency of occurrence in national datasets from suggested reference localities

Main problems:

- still persisting problems with diatom taxa delimitation / identification
- still persisting problems with assigning different reference values to different water types (as concerns altitude, water basin area, altitude etc.)

Kelly, M. et al. (to be submitted to Freshwater Biology) :Establishing expectations for pan-European diatom based ecological status assessments

		TI			IPS		
		r	mean	P	r	mean	p
Alkalinity n=290	valve counts	0.1431	1.6003	0.06010	-0.1252	4.6056	0.03308
	transformed	**0.2051**	1.7607	0.00044	**-0.2545**	4.3917	0.00028
	presence	**0.2240**	1.8093	0.00036	**-0.2849**	4.3284	0.00022
Conductivity n=306	valve counts	0.1004	1.6853	0.07944	-0.1347	4.5640	0.01840
	transformed	**0.1577**	1.8629	0.00569	**-0.2182**	4.3273	0.00037
	presence	**0.1884**	1.9234	0.00093	**-0.2514**	4.2475	0.00029
Latitude n=370	valve counts	-0.4126	1.6666	0.00010	0.2876	4.5651	0.00023
	transformed	-0.4957	1.8410	0.00008	**0.4775**	4.3477	0.00007
	presence	-0.5178	1.8972	0.00006	**0.5164**	4.2764	0.00006
Altitude n=345	valve counts	-0.0653	1.6887	0.22657	0.0684	4.5581	0.20506
	transformed	-0.0807	1.8694	0.13453	0.0861	4.3322	0.11023
	presence	-0.0792	1.9256	0.14233	0.0875	4.2572	0.10454
River width n=118	valve counts	-0.2318	1.8957	0.01156	0.1165	4.4234	0.20892
	transformed	**-0.3596**	2.0680	0.00013	**0.2634**	4.2320	0.00396
	presence	**-0.4012**	2.1145	0.00011	**0.6022**	4.1623	0.00088
River depth n=121	valve counts	-0.1072	1.9155	0.24208	0.0731	4.4444	0.42541
	transformed	-0.0998	2.1100	0.27593	0.1752	4.2202	0.05461
	presence	**-0.1633**	2.1656	0.07350	**-0.2385**	4.1380	0.00842
Phosphorus n=255	valve counts	0.5262	1.6649	0.00005	-0.3919	4.5541	0.00012
	transformed	0.5215	1.8122	0.00006	-0.4182	4.3621	0.00010
	presence	0.5113	1.8549	0.00007	-0.4105	4.2999	0.00010

Taxon	All-Max	Const	CB-max	Const
Achnanthidium minutissimum sensu lato	95.5	**69.0**	95.5	**90.7**
Achnanthidium pyrenaicum (Hustedt) Kobayasi	95.7	21.5	92.5	20.2
Achnanthes oblongella Oestrup	51.4	18.0	51.4	31.8
Amphora pediculus (Kützing) Grunow	60.5	21.9	22.3	33.6
Brachysira vitrea (Grunow) Ross in Hartley	31.5	14.4	8.6	14.0
Cocconeis placentula sensu lato	79.5	41.3	78.9	**63.6**
Eunotia bilunaris sensu lato	32.7	16.0	32.7	17.8
Eunotia implicata Nörpel. Lange-Bertalot & Alles	36.9	15.5	10.4	15.0
Eunotia minor (Kützing) Grunow in Van Heurck	15.8	14.6	15.8	16.2
Encyonema neogracile Krammer	14.4	15.8	14.4	17.4
Encyonema ventricosum sensu lato	89.2	41.7	36.2	56.1
Eolimna minima (Grunow) Lange-Bertalot	61.6	17.6	18.6	29.3
Fragilaria capucina Desmazieres sensu lato	62.5	48.6	58.8	**70.1**
Fragilaria vaucheriae sensu lato	25.0	35.6	23.4	**51.4**
Gomphonema olivaceum sensu lato	27.0	14.9	19.3	19.3
Gomphonema parvulum sensu lato	61.4	27.5	61.4	41.4
Gomphonema pumilum sensu lato	86.0	33.3	80.6	39.9
Hannaea arcus (Ehr.) Patrick	76.3	23.4	76.3	30.8
Meridion circulare (Greville) C.A.Agardh	22.6	15.5	5.4	21.8
Navicula cryptocephala Kützing	7.5	13.7	5.2	19.9
Navicula cryptotenella Lange-Bertalot	25.4	21.2	17.8	27.1
Nitzschia dissipata (Kützing) Grunow	15.0	22.6	11.4	36.1
Navicula gregaria Donkin	39.7	19.4	39.7	38.0
Navicula lanceolata (Agardh) Ehrenberg	64.3	17.2	59.0	34.0
Nitzschia palea sensu lato	59.5	16.5	17.9	29.0
Navicula tripunctata (O.F.Müller) Bory	40.8	14.1	18.0	20.9
Planothidium lanceolatum sensu lato	42.3	16.6	9.4	21.5
Reimeria sinuata (Gregory) Kociolek & Stoermer	28.0	28.8	26.1	43.3
Synedra ulna (Nitzsch) Ehr.	70.7	25.8	30.9	35.8
Tabellaria flocculosa (Roth) Kützing	88.2	31.2	88.2	36.1

Different ecological quality criteria for different water types

- Results of hitherto intercalibration activities do not allow to set different reference values for different water types.

One possible reason: unsuitable taxa quantification by valve counts (ascribing too great importance to small-celled diatoms such as *Achnanthidium* species)

Equal reference criteria (regardless altitude, size of catchment area etc.) → Ecological status = Water quality → Return to pre-WFD era

Gracias vobis omnibus

pro patientia