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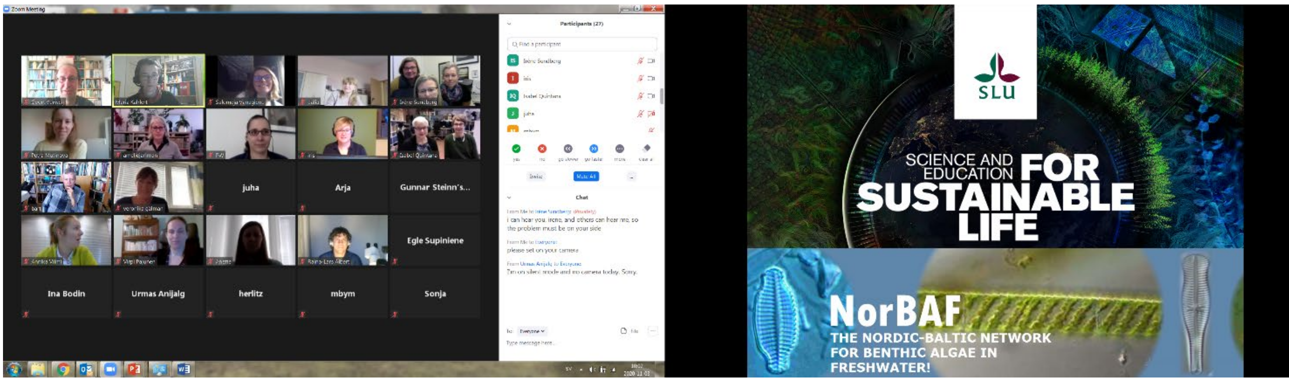

6th Nordic-Baltic diatom intercalibration/harmonization exercise 2020

Diatom exercise in times of pandemics

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Innehåll

Summary

This report summarizes the results of the 6th Nordic-Baltic diatom intercalibration/harmonization exercise. This exercise is organized by NorBAF (Nordic Network - Benthic Algae in Freshwater, www.norbaf.net) and the Department of Aquatic Sciences and Assessment, SLU (Swedish University of Agricultural Sciences). The intercalibration included the counting of three Swedish diatom samples, all of them to be prepared by the participants. Identification and enumeration of the diatoms followed the Swedish Standard method using diatoms for environmental monitoring (Jarlman et al., 2016). This method is based on the European standard (CEN, 2014). The counts were evaluated according to Kelly (2001), and the participants agreed to accept Kelly's suggestion to use a similarity level of >60% (Bray-Curtis similarity) as threshold for approval. The results were compared and discussed with the auditors Amelie Jarlman, Jarlman Konsult AB Lund and Prof. Dr. Bart Van de Vijver, Botanic Garden Meise, Belgium. Recent taxonomic literature was presented and discussed. To improve the harmonization of the identification of problematic groups, taxa tables with identification characteristics were established or updated from former exercises, and are here published together with pictures kindly shared by participants to enable others to use and discuss our agreed identification help for freshwater benthic diatoms. Maria Kahlert, Associate Professor, Dept. of Aquatic Sciences and Assessment, SLU, was the overall organizer and calculated the results. SWEDAC (Swedish Board for Accreditation and Conformity Assessment), The Swedish Agency for Marine and Water Management (SwAM/HaV) and Finnish Environment Institute (SYKE) are supporting the intercalibration.

1 Introduction

This report summarizes the results of the 6th Nordic-Baltic diatom intercalibration/harmonization exercise, organized by NorBAF (Nordic Network - Benthic Algae in Freshwater, Kahlert and Albert, 2005) and the Department of Aquatic Sciences and Assessment, SLU (Swedish University of Agricultural Sciences). NorBAF is an informal network, a cooperation of people working with freshwater benthic algae in the Nordic countries including Fennoscandia, Iceland, and the countries around the Baltic Sea. Our objective is to develop contacts between educational institutions, research institutions, non-governmental organisations and private companies in the field of education and lifelong learning. The network is open to anyone who shares our interest, we are also cooperating with other algal groups in Europe. The network was started in 2005 with financial help of Nordplus Neighbour and the Erken Laboratory, University of Uppsala, Sweden. Nordplus Neighbour is one of the Nordic Council of Ministers' five mobility and network programmes. Now, NorBAF is funded by the cooperation of participants.

Information about the previous exercises in 2007, 2009, 2011, 2013 and 2016 can be found on the NorBAF webpage (www.norbaf.net, Kahlert and Albert, 2005), and in a few scientific publications (Kahlert et al., 2009, Kahlert et al., 2012, Kahlert et al., 2016).

It is important to harmonize the diatom identification among laboratories and analysts in order to improve comparisons between different diatom studies, especially as diatom monitoring has increased because of the Water Framework Directive. Based on the experience from the activities in former years, the NorBAF participants agreed to continue with diatom intercalibrations every ~ 3rd to 4th year. SWEDAC (Swedish Board for Accreditation and Conformity Assessment) and SYKE (Finnish Environment Institute) are informed about our activities and the participation of Swedish and Finnish laboratories and consultants. The NorBAF participants have also agreed to issue certificates of participation, including a measure about their final individual results reflecting the harmonization with the agreed NorBAF recommendations on diatom identification and counting.

With our actions, we NorBAF participants hope to help others in diatom identification, to make people aware of identification problems, to share knowledge and experience, and also to spread the fun of identifying diatoms! NorBAF exercises include often slide preparation as well to ensure harmonization of the entire method from preparation to identification and counting. We are by no means perfect, and our work and agreements, taxa tables and results of diatom names, should be seen in the light of improving the harmonization of diatom identification of the Nordic countries with the focus on environmental assessment. This is no taxonomic compilation, and we are open for constructive criticism and discussion, to be able to improve our work in the next NorBAF exercise!

2 Methods

The diatom intercalibration 2020 was performed as follows. All participants received three diatom samples preserved in 70% ethanol, all untreated. The participants prepared their own slides. Preparation, identification and enumeration of the diatoms followed the Swedish Standard method using diatoms for environmental monitoring (Jarlman et al., 2016). A short English description can be found in 'Status, potential and quality requirements for lakes, watercourses, coastal and transitional waters. Handbook 2007:4' (Swedish Environmental Protection Agency, 2010). English instructions about slide preparation were also available: 'Diatom preparation according to Amelie Jarlman, January 2007' (Amelie Jarlman and Kahlert, 2007). Participants were reminded to follow the instructions, and agreements of earlier exercises, found on the NORBAF homepage (Kahlert and Albert, 2005). The Swedish Standard taxa list (Kahlert et al., 2018, only the "accepted" taxa must be used when reporting results) and the standard format (Swedish University of Agricultural Sciences - Department of Aquatic Sciences and Assessment, 2018) had to be used when reporting results. Only accepted taxa had to be reported, no older synonyms, or taxa not found in the list (for example newly described species). The participants had to report the taxon-ID and name of the identified taxa, the total count of valves of this taxon, and additionally the number of valves counted as "cf." if identification was uncertain, and the number of deformed valves of this taxon including deformation categories (see more below). For the *Achnanthidium minutissimum* complex, participants also had to report the average valve width of 10-20 valves. The Swedish method uses routinely three size groups of the *Achnanthidium minutissimum* complex instead of species names, and the average width is used to classify all counted valves of this complex into one size group only for the respective sample (Jarlman et al., 2016). Last, participants were encouraged to also list taxa that were seen in an overview of the sample, but not counted after the required count number of 400 valves was reached. It was also possible to leave comments to each taxon, and to the entire sample.

The counts were evaluated according to Kelly (2001). The results of each participant were compared with the results of two auditors, familiar with the Swedish Standard method and the Nordic flora (Amelie Jarlman, Jarlman Konsult AB, and Bart Van de Vijver, National Botanic Garden of Belgium), and the participants had agreed to accept Kelly's (2001) suggestion to use a similarity level of >60% (Bray-Curtis similarity) as threshold for approval of the results. The analysis and evaluation of deformed diatom valves has recently been included in the Swedish standard method using diatoms in environmental assessment (Havs- och vattenmyndigheten, 2018). The 6th NorBAF exercise was the second time where results were compared to evaluate the uncertainty of this method. Deformations had to be sorted into the categories 'slightly deformed outline", 'strongly deformed outline', 'slightly deformed structure' and 'strongly deformed structure' for each taxon. For examples and pictures of deformed valves, see Kahlert (2012).

The exercise was performed anonymously. Samples were sent to the participants in April-May 2020 and results had to be sent back no later than 31st of July 2020.

The results were discussed during an online workshop on 2-5 November 2020. Previous workshops had been held at the Norr Malma field station at Lake Erken in Sweden, but this was not possible during the COVID-19 pandemic. All participants were invited to participate and discuss the results, and also discuss solutions to problematic taxa groups. We also discussed new literature and new insights gained by the ongoing taxonomical collection done by Amelie Jarlman and Bart van de Vijver. Everybody was welcome to show pictures from their own samples for discussion. New for 2020 was that the first day of the workshop was planned to focus on basic questions of diatom counting & identification only, whereas 3-5/11 were focused on advanced identification challenges, one sample per day was discussed. In this way, we wanted to ensure that experienced analysts could choose to not participate the first day, and all of us could focus on the advanced challenges later on. Also new was that a workshop homepage was established in an education platform, where all results and discussions of the intercalibration were published for an easier and faster access of the participants. Furthermore, we performed an evaluation to ask the participants about how to continue with the NorBAF exercises (Attachment 1: Evaluation). We finally agreed to publish the results as report to share knowledge and experience with a broader public.

3 Results

The 6th NorBAF exercise had 27 participants from 8 countries (Estonia, Finland, Germany, Iceland, Lithuania, Sweden, The Netherlands, United Kingdom) representing 18 different institutions, companies, universities or agencies. All results were presented during the workshop, and the general presentations of the first day are here published as attachments (Attachment 2: General issues and Overview results). Then, we discussed on days 2-4 how to separate species in difficult taxa complexes, and how to update our NorBAF tables where we are listing mainly Nordic species with morphological characters, and suggestions on how to separate them. All participants were encouraged to contribute to the tables with discussions, own images, questions and disagreements, to improve those tables for the use of everyone later on to ensure a harmonized identification of those difficult species, and more harmonized taxa lists in the future.

The results are presented here in the attachments (Attachment 2: compilations of the different diatom taxa). Please note that those tables are by no means meant to be complete or free from errors. You can help us by contributing with constructive criticism. The images are mainly taken by the participants, and unfortunately, some lack a scale bar. To be noted, that all this work is voluntary, and we did what was possible in the given time. In addition, we prefer to publish the results for everybody's use despite the few shortcomings. All participants of the 6th NorBAF exercise were encouraged to contribute to the report.

The published taxa tables include the following genera:

- *Gomphonema*
- small Naviculoides
- medium *Navicula*
- *Nitzschia*
- *Fragilaria*

Finally, the evaluation showed that our NorBAF exercises are very much appreciated. 81% of the participants replied that they rated the exercise as very good or excellent (attachment 1), and many suggestions were proposed which we will consider to improve the next NorBAF exercise.

Acknowledgements

Many thanks to Amelie Jarlman and Bart Van de Vijver for their support as auditors. Many thanks also to Adrienne Mertens for many diatom pictures and for valuable inputs on the identification of the discussed taxa. Thanks also to Irene Sundberg for valuable input. Many thanks to everybody making the NorBAF exercises possible and constructive.

Attachments

Attachment 1: Evaluation

Attachment 2: General issues, Overview results, compilations of the different diatom taxa (*Gomphonema,* small Naviculoides, medium *Navicula, Nitzschia, Fragilaria)*

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NorBAF
THE NORDIC-BALTIC NETWORK FOR BENTHIC ALGAE IN FRESHWATER!

SLU NorBAF

6th Nordic-Baltic diatom intercalibration/harmonization exercise 2020

Maria Kahlert, SLU

Day 1 – General issues

1. Instructions
   a) Accepted codes
   b) Spelling errors
   c) New taxa
   d) Achnanthidium minutissimum width
2. Calibration!
3. Do not count girdle bands – (TFLO and others)
4. Overlooking small taxa/optics?
5. Rare taxa, singletons, force fitting
6. Check always a second time your dominant taxa identification – those are making the difference
7. Harmonization

Instructions – to follow or not to follow

From the invitation letter:

"The Swedish Standard taxa list and the standard format **must** be used when reporting results.

1. The taxa list is found here (please only use the "accepted" taxa when reporting results): http://miljodata.slu.se/mvm/DataContents/Omnidia
2. The standard format to add the found taxa is found at https://www.slu.se/globalassets/ew/org/inst/vom/datavardskap/dataleveranser/kiselalger_mall_20180405.xlsx"

Detailed instructions were also included in the letter.

Why should you follow the instructions and the standard list?

Because it is one step of the harmonization – diatom taxa lists, counts and index values are only comparable if a standard method and list is used.

Instructions – to follow or not to follow

NorBAF 2020 problems:

- Quite a few participants did not filter the standard taxa list for ”accepted” taxa, but used codes for synonyms. Problems:
  - in a similarity analysis, those taxa will count as different
  - worse: a synonym is often not the same as the new name, which in many cases is described with a more narrow approach, or even as several new species, which then makes a comparsion impossible
    (e.g. NorBAF2020 use of FRHO Frustulia rhomboides (Ehrenb.) De Toni, which is split into new taxa, of which 5 are represented in the SE taxalist.)

Because it is one step of the harmonization – diatom taxa lists, counts and index values are only comparable if a standard method and list is used.

Instructions – to follow or not to follow

NorBAF 2020 problems:

- Spelling errors, probably because of manual input instead of copying code and name. Using codes not included in the SE taxalist. Problems:
  - Practical: In reality, the automated system will return your input and ask for correction to codes/names that are included in the list. More work for you.
  - Worse: misspelling a code to a different one which actually is in the list will result in the wrong species name and index value!
  - Again, comparison of species lists is not possible.

  Examples:
  - *"AAN" instead of "NAAN"*
  - *"NBDF" – not existing wrong code for Neidium binodeforme NBNF*
  - *"AOBL" – existing (!) wrong code for Achnanthes oblongella AOBG, "AOBL" actually is the code for Achnanthes obliqua* (Gregory) Hustedt

Because it is one step of the harmonization – diatom taxa lists, counts and index values are only comparable if a standard method and list is used.

Instructions – to follow or not to follow

NorBAF 2020 problems:

- Special on codes: What to do with “new” taxa to the SE taxalist, i.e. taxa you think are not included in the list:
  - First, check carefully if the name you are using is found in the list, either in the accepted names, or in the others. If the latter is the case, go to column “L” to see what the new code is. Check also if that one is accepted, and if not, continue until you have the accepted code. Use it, do not use a synonym code/name.
  - If you still have a reason to use a synonym, please add this reason in the field of comments (column BG) when submitting.
    (E.g. because the code might be used in a time series to enable the comparison with older counts.)
  - New taxa to the list: the **SE diatom expert group** will discuss if any new taxon shall be added to our standard list.
    For this, we need a) you are sure about your new taxon, b) good pictures, c) size, d) a comment about the new taxon in the comment field “BG”
    Reporting (https://miljodata.slu.se/):
  - send the pictures & the size to the data host by email
  - report the taxon with the genus code & name, write the new name (and code if you know it) in the comment field, also add there that you sent in pictures & size to the data host

Because it is one step of the harmonization – diatom taxa lists, counts and index values are only comparable if a standard method and list is used.

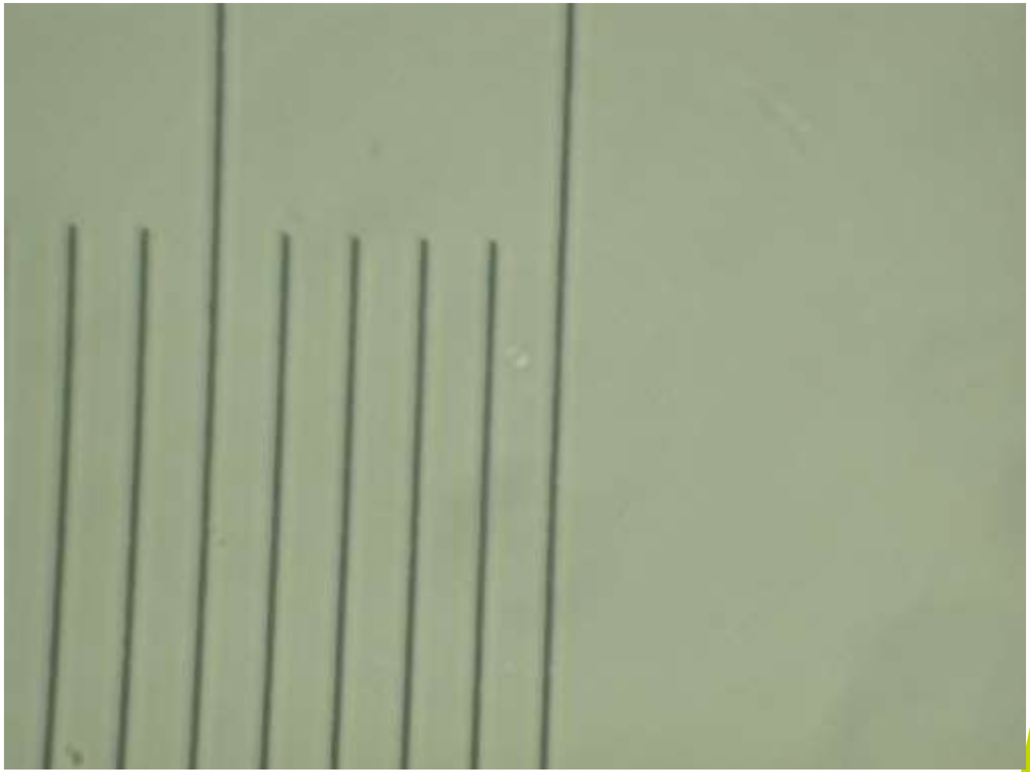
Instructions – to follow or not to follow

NorBAF 2020 problems:

- *Achnanthidium minutissimum* width:
  - Count all valves (valve and girdle views) of the “A. minutissima” group sensu Tafel 32-34 in Süsswasserflora von Mitteleuropa Band 2/4, Krammer & Lange-Bertalot, 1991 as one taxon only, with the exception of *A. gracillimum* Lange-Bertalot and *A. caledonicum* which are counted separately.
  - Measure the width of 10-20 valves laying flat and preferably as single valve. Take randomly the 10-20 suitable valves coming up in turn in your field of view.
  - Calculate the average of your measurements.
  - This average value determines the group number of your entire “A. minutissima” group: average width < 2,2 µm: ADM1, 2,2-2,8 µm: ADM2, > 2,8 µm: ADM3
  - Reporting: Note the correct code (ADM1, ADM2, or ADM3) in column AN (code column), write the total number of your counted “A. minutissima” group (valve & girdle views together) in column AU, and (!) note the average width in column BB

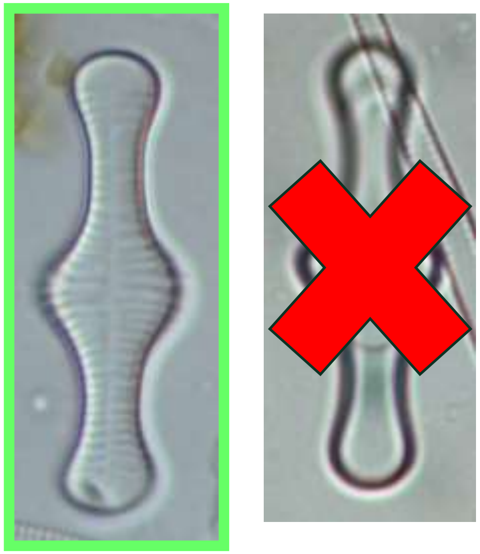
Calibration

Check your calibration on a routine basis – a well calibrated microscope is the basis for all your measurements, the ground for any identification

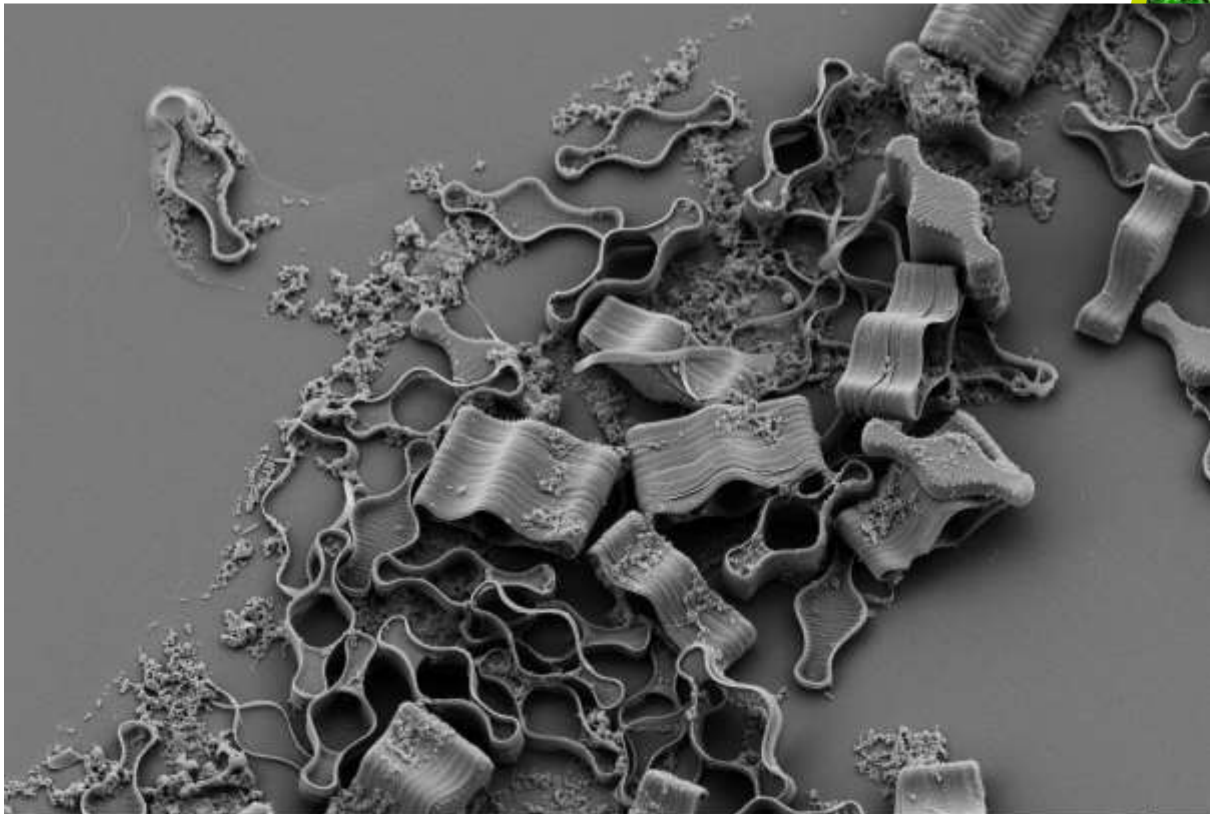


But other taxa have girdle bands as well!

Do not count girdle bands!

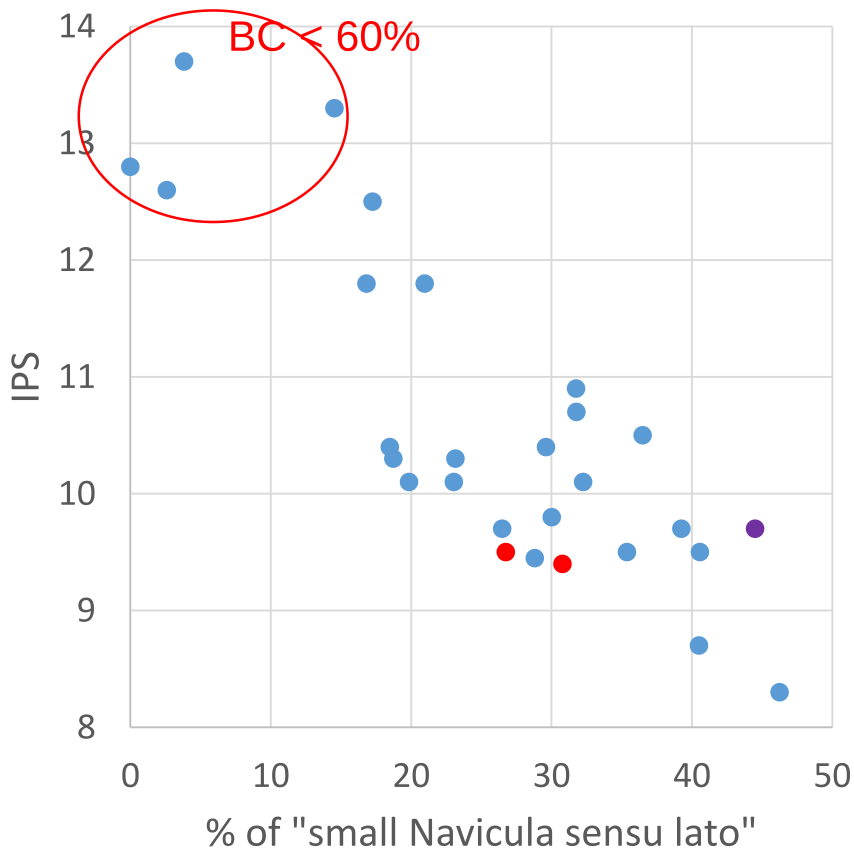


Tabellaria flocculosa



	Sample 2	%
SSEM	Sellaphora seminulum	14,0
MAPE	Mayamaea atomus var. permitis	8,7
EOMI	Eolimna minima	3,4
FSAP	Fistulifera saprophila	2,2

Overlooking of small taxa

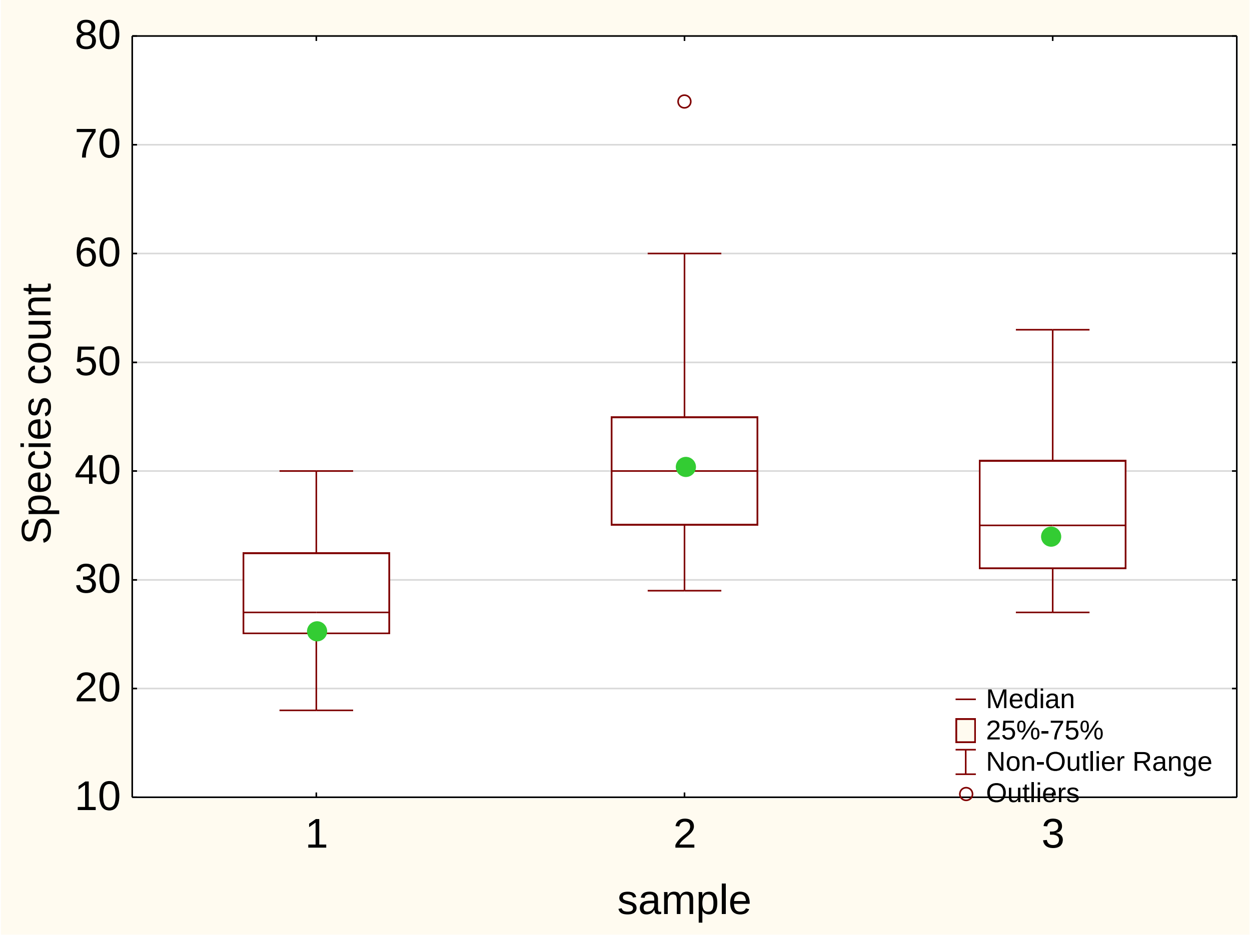


Underestimation of ”small *Navicula* sensu lato”, many of them having low IPS scores indicating pollution & eutrophication -> overestimation of IPS

Do you have sufficient optics (or patience?) to resolve *Fistulifera saprophila* and others?

10 µm FSAP MAPE EOMI SSEM

Rare taxa, singletons, force fitting



In routine analysis for biomonitoring, one should focus on the frequent taxa.

Those make the difference in index value, and also the differences in similarity.

- Auditors:
  1: 27
  2: 41
  3: 33

Rare taxa, singletons, force fitting

- Problems with trying to ”identify them all”:
  - It is very expensive to try to get “all taxa”. You need to count 3000-8000 valves to come close to the real taxa number present at a site (Patrick et al. 1954).
  - Even when trying to identify all valves in 400 counts you need a very good expertise plus much effort (time, literature, and often SEM), and this still is expensive and does usually not change the index value a lot
  - There is a high risk that singletons are not correct identified because not all characters of the valve are visible (not laying flat, not in focus, untypical form, deformed etc.). For most taxa, identification is much easier if the analyst has seen a variety of valves in the slide.

There are indices and studies using the presence of taxa, in these cases more effort might be spent on the identification of rare taxa, but be aware that rare taxa identification is a challenge.

Rather set singletons as genus-level, or if you are quite, but not fully sure, use “cf.”. You can always note your idea on the taxa name in the field of comments.
Maybe the year after, the same taxon might be frequent, then the name can be changed backwards.
PS: And certain valves cannot be identified at all: Certain girdle views etc.

Rare taxa, singletons, force fitting

- Do not do “Force fitting”!
- **Always** check your identification/final taxon name (size, characters etc.) (Never trust yourself ☺)
- Force fitting often happens when a standard list of taxa is used.
  Be aware, you could indeed have a taxon which is not listed.
- Make use of “cf.” (“you are quite sure of the identification”) in case of doubt (e.g. when certain characters do not match, or you are not sure)
- In case of more doubt, us genus-level or leave the taxon “unidentified”, and make a note in the field of comments, where you also can leave your idea on the possible taxon name.
- I personally do not trust taxa lists without any “cf.”, “unidentified taxon” or “genus-level”.

Frequent taxa - problematic identification

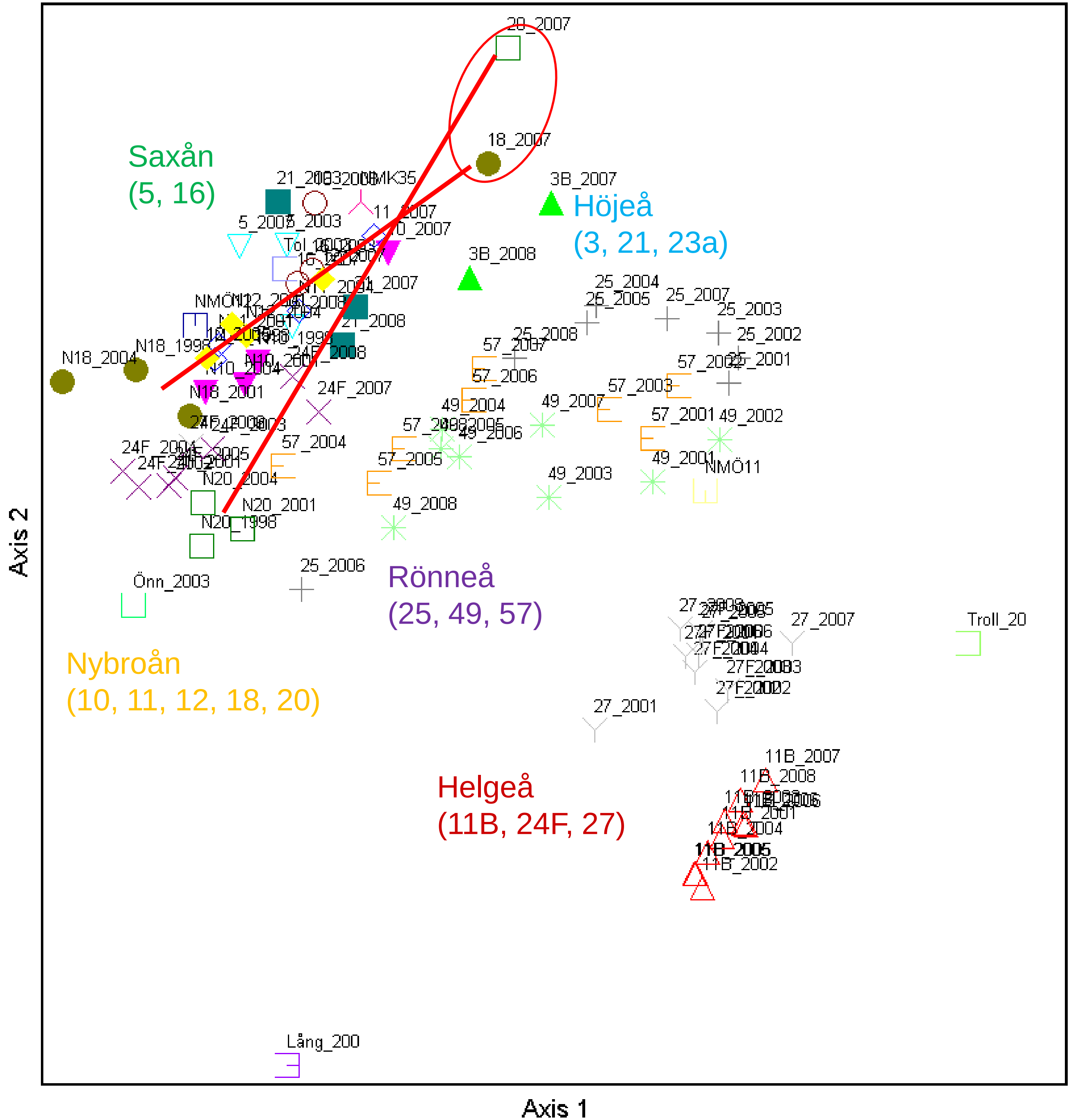
- However, try to go to the most detailed level possible for the frequent taxa, even if in girdle view. E.g. count *Eunotia* girdles as “*Eunotia* sp.”, not as “unidentified. Frequent taxa make the difference in index value and similarity!
- There are some tricks to get *Eunotia* in valve view when preparing a slide. Ask Amelie Jarlman and other experts!
- At SLU, we count girdles as a genus-group (or several, depending on size and e.g. stria density) and then set aside 1 hour extra to continue counting just valve views of this genus, to give at least some of the girdles a name. (Part of) the girdle counts are then replaced by the taxa name. This especially for *Eunotia,* also other taxa, if frequent.

Frequent taxa importance

- Check always a second time your identification of the frequent taxa – those are making the difference
- NorBAF2020: The main differences in similarity and index values of the participants was due to differences in the most frequent taxa of a sample – rare taxa were not important really
- The IPS (Indice de Polluo-sensibilité Spécifique, Cemagref 1982, indicating eutrophication & organic pollution) is heavily dependent on the relative abundance of a taxon:
  $IPS = \Sigma A_j S_j V_j / \Sigma A_j V_j$
  - Aj relative abundance in % of taxon j
  - Sj sensitivity of taxon j (1-5, tolerant to sensitive)
  - Vj weight (1-3)
- It also is usually an important question to identify the most frequent species correctly

Harmonization

Species lists include usually the relative abundance, and are not comparable if different names for the frequent taxa are used by different analysts



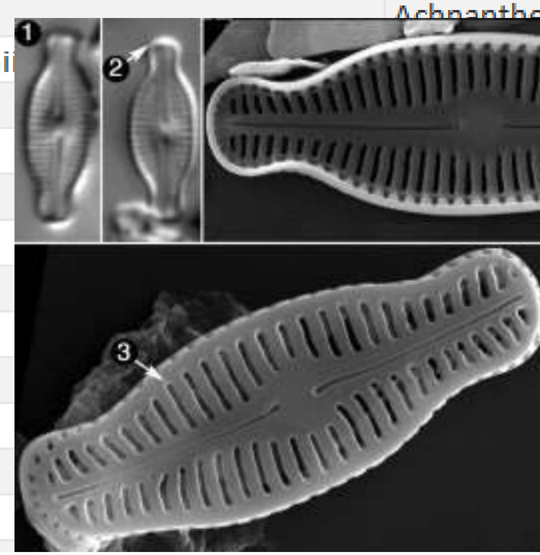
Final taxon: Achnanthes acares/ricula/carissima

Circumpolar diatom database

NOMENCLATURE_DIATOMS

Class	TaxonName	TaxonNameFinal		
Bacillariophyce	Achnanthes cf. carissima	Achnanthes cf. carissima		
Bacillariophyce	Achnanthes cf. ricula	Achnanthes cf. ricula		
Bacillariophyce	Achnanthes ricula	Achnanthes ricula	Achnanthes	ricula
Bacillariophyce	Diadesmis sp. 1 (Achnanthes cariss	Achnanthes cf. carissima	Achnanthes	cf. cari
Bacillariophyce	Diadesmis sp. aff. contenta (Navicı	Navicula cf. schmassmannii		cf. schı
Bacillariophyce	Karayevia carissima	Achnanthes carissima		carissi
Bacillariophyce	Navicula cf. schmassmanii	Navicula cf. schmassmanii		schma
Bacillariophyce	Navicula schassmanni	Navicula schmassmannii		schma
Bacillariophyce	Navicula schassmannii	Navicula schmassmannii		schma
Bacillariophyce	Navicula schmasmannii	Navicula schmassmannii		schma
Bacillariophyce	Navicula schmassanni	Navicula schmassmannii		schma
Bacillariophyce	Navicula schmassannii	Navicula schmassmannii		schma
Bacillariophyce	Navicula schmassmanii	Navicula schmassmannii		schma
Bacillariophyce	Navicula schmassmannii	Navicula schmassmannii		schma
Bacillariophyce	Navicula schmassmannii Hustedt	Navicula schmassmannii		schma
Bacillariophyce	Navicula schmassmannii Hustedt 1	Navicula schmassmann		schma
Bacillariophyce	Navicula schmassmanniii	Navicula schmassmann		schma
Bacillariophyce	Navicula schumassmannii	Navicula schmassmann		schma
Bacillariophyce	Naviculadicta schmassmannii	Navicula schmassmann		schma
Bacillariophyce	Achnanthes brevipes	Achnanthes brevipes		brevip
Bacillariophyce	Achnanthes brevipes v. intermedi	Achnanthes brevipes va		brevip
Bacillariophyce	Achnanthes cf. coarctica	Achnanthes coarctata		coarcta

Record: 1 of 6148 No Filter Search



Humidophila schmassmanni
Length: < 9 µm
https://diatoms.org/

algaeBASE

Harmonization is improving comparability

J Appl Phycol
DOI 10.1007/s10811-008-9394-5

Harmonization is more important than experience—results of the first Nordic–Baltic diatom intercalibration exercise 2007 (stream monitoring)

Maria Kahlert · Raino-Lars Albert ·
Eeva-Leena Anttila · Roland Bengtsson ·
Christian Bigler · Tiina Eskola · Veronika Gälman ·
Steffi Gottschalk · Eva Herlitz · Amelie Jarlman ·
Jurate Kasperoviciene · Mikołaj Kokociński ·
Helen Luup · Juha Miettinen · Ieva Paunksnyte ·
Kai Piirsoo · Isabel Quintana · Janne Raunio ·
Bernt Sandell · Heikki Simola · Irene Sundberg ·
Sirje Vilbaste · Jan Weckström

Table 4 Effect of diatomist variables on the variance of the intercalibration results (pCCA, Monte Carlo permutation test (999 unrestricted permutations)

Source of variance	Explained variance	(%)	Significance p
Total inertia	10.1		
Teaching group a diatomist was involved in	0.863	8.6	0.001
Time of experience with diatom analyses	0.082	0.8	0.006
Availability of differential interference contrast (DIC)	0.079	0.8	0.035
A person's participation in the test intercalibration 2006	0.081	0.8	0.022
Number of diatom samples counted per year	0.094	0.9	0.003
Counted samples mainly recent	0.116	1.1	0.002
Non-significant factors			
Availability of phase contrast (PHA) optics			>0.05
Number of diatom courses done			>0.05

So, even if you are expert, it is necessary to harmonize taxa identification if the results will be used together with the results of other analysts.

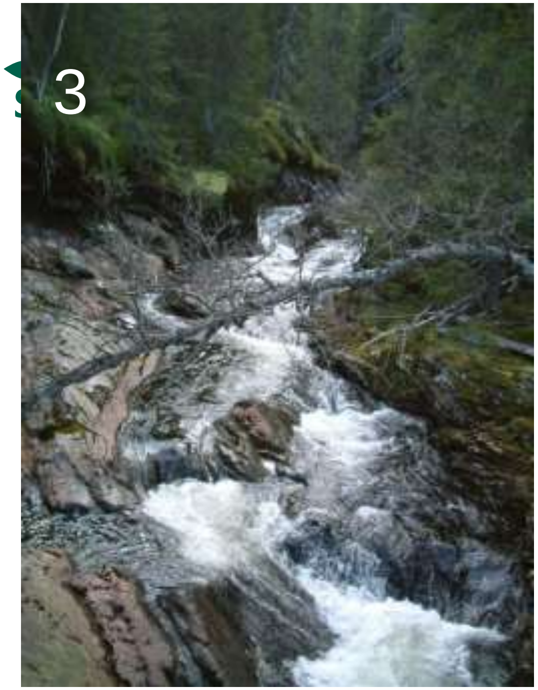
SCIENCE AND EDUCATION FOR SUSTAINABLE LIFE

Overview of the results

1. Site description
2. Taxa ≥ 10% of total counts in one sample
3. Taxa pooled before similarity analysis
4. Similarity to auditors
5. Deviation (in IPS units) vs. similarity with auditors (Bray-Curtis). All samples, all participants.
6. IPS vs. Tot-P
7. ACID vs. pH
8. Deformations

Site descriptions

3



2

		(km2)**
Gnyltån	5	33,1 (25,4)
Morån	5	27,0 (21,8)
Hörlingeån, Rökeå	6	63,3(51,7)
Lillån/Bosgårdsån	5	32,5(25,2)
Ejgstån	5	49,9 (48,6)
Laxbäcken	4	9,6
Stråfulan	2	36,3 (35,5)
Härån	4	79,9 (21,3)
Sörjabäcken	4	23,0 (21,1)
Hornsjöbäcken	1	40,2
Bastuån	1	47,7 (41,6)
Lillån (E4)	3	26,5 (14,1)

1

**Avrinningsomr.	provtagningspunkten (

I vattendragen följs nu det kemiska olika undersökningsmoment med p och schema B i sjöar och schema C metodik som används inom IKEU- med principer enligt Naturvårdsver

Site descriptions, nutrients, pH

- Sample 1: **Sörjabäcken** 2019 (IKEU) – Tot-P: 7µg/l; pH 6,1 (min: 5,3)
- Sample 2: **Skavebäck** 2019 (municipality) - downstream a horticulture, modeled Tot-P: 121 µg/l *(no water chemistry available)*
- Sample 3: **Bastuån** 2019 (IKEU) - Tot-P: 4µg/l; pH 6,5 (min: 5,8)

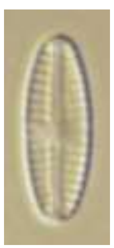
Taxa ≥ 10% of total counts in one sample

Sample 1:

TFLO 43,9% *Tabellaria flocculosa*

FGRA 10,8% *Fragilaria gracilis*

BNEO 10,1% *Brachysira neoexilis*



Sample 2:

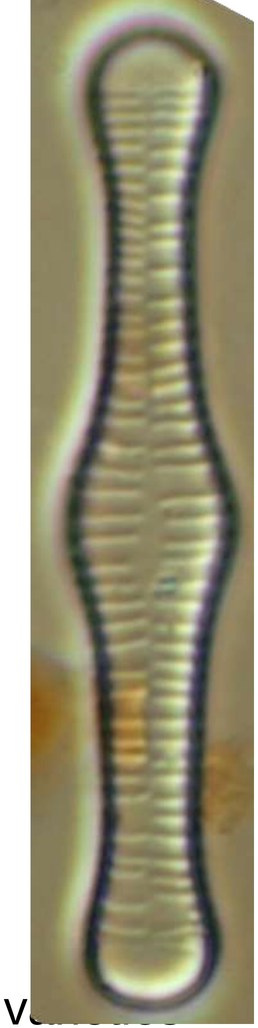
CPLA 28,7% *Cocconeis placentula* incl. v

SSEM 14,0% *Sellaphora seminulum*

Sample 3:

FGRA 29,1% *Fragilaria gracilis*

TFLO 22,9% *Tabellaria flocculosa*



Taxa pooled before similarity analysis

- Sample 3:
  - *Achnanthidium minutissimum* close to threshold between 2 groups -> groups ADM1 & ADM2 pooled
  - *Gomphonema clavatum* complex taxa merged:
    Gomphonema clavatum, G. montanum, G. clavatum s.lat., *G. subclavatum**
  - *Gomphonema exilissimum* complex taxa merged:
    *Gomphonema exilissimum, G. exilissimum s.lat., G. varioreduncum**
- All samples:
  - *Eunotia bilunaris* s. lat. (EBIL) and *E. bilunaris* s. str. (EBLU) merged to EBIL* *(all samples)*
  - *Brachysira brebissonii* (BBRE) and *B. intermedia* (BINT) merged to BBRE** *(sample 1, few in 3)*
- In general:
  - all non "accepted" codes (Swedish Standard taxa list) were transformed to the accepted codes *(including the codes with spelling errors)****
  - all taxa without code (not included in Swedish Standard taxa list) were transformed to genus level
- *Sample 2: Nitzschia palea var. minuta (NPAM)* was merged into *N. palea (NPAL)*

SLU

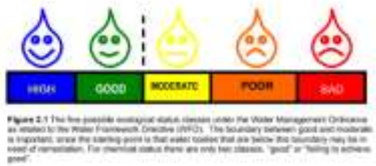
Similarity to auditors

Kelly 2001: The results can be seen as replicates of the auditors if the Bray-Curtis similarity (BC) is at least 60 %.

	1	2	3
Hills N2	*4,5*	*8,3*	*6,5*
1	49	47	32
4	87	71	77
6	78	74	65
7	65	47	70
8	88	77	76
10	70	69	74
11	81	77	77
15	75	73	74
16	76	67	82
18	78	55	77
20	82	63	74
22	84	68	70
23	74	76	75
25	70	71	76
26	83	76	77
29	79	71	50
30	88	84	85
33	81	80	68
34	73	64	77
36	90	74	80
38	89	89	88
40	82	72	73
41	77	75	75
42	43	72	66
44	63	53	71
46	59,6	55	58
47	76	70	76
49	79	69	64

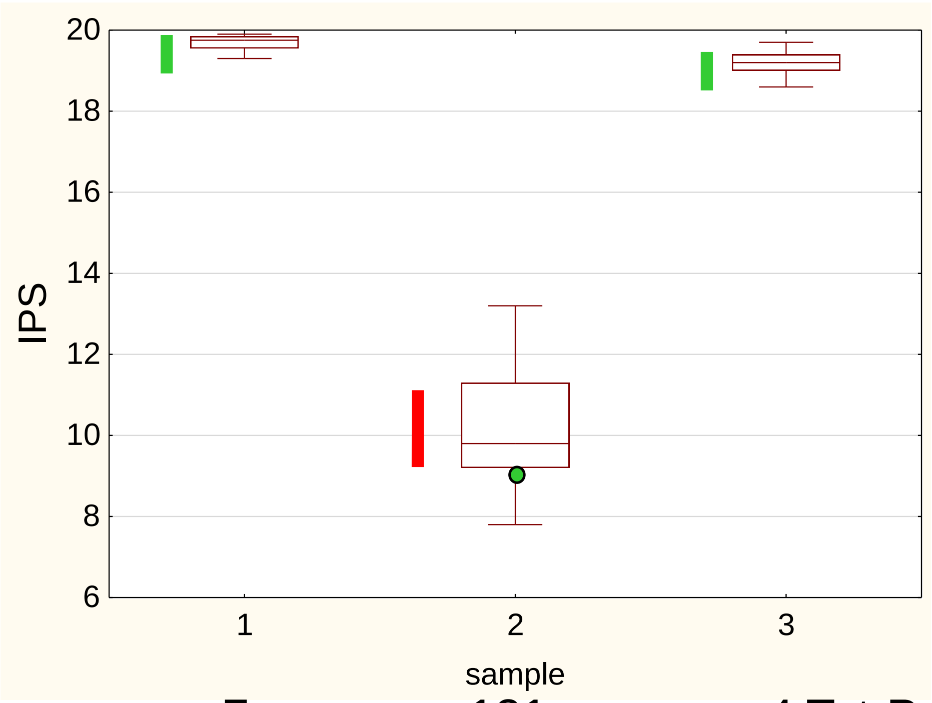
Tabell 2. Klassindelning för IPS-index och EK-värden (ekologiska kvalitetskvoter).

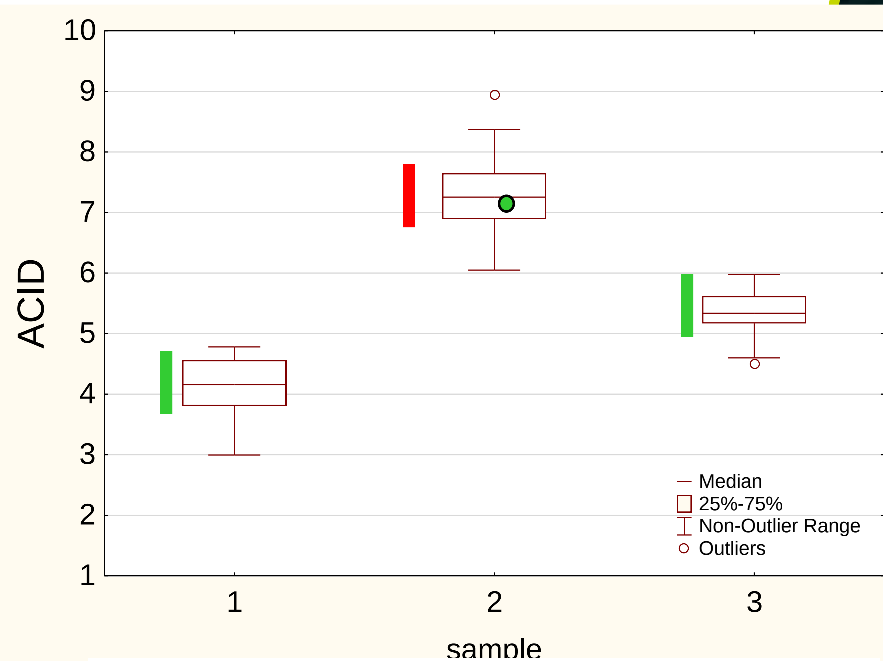
klass	status	Beskrivning i bedömningsgrunderna 1999	IPS-värde	EK-värde
1	hög	Mycket näringsfattigt till näringsfattigt tillstånd och ingen eller obetydlig förorening	≥ 17,5	> 0,89
2	god	Näringsfattigt till näringsrikt tillstånd och/eller svag förorening	14,5-17,5	
3	måttlig	Näringsrikt till mycket näringsrikt tillstånd och/eller tydlig förorening	11-14,5	
4	otillfreds-ställande	Stark förorening	8-11	
5	dålig	Mycket stark förorening	< 8	< 0,41



Acidity classes	ACID	pH mean12	pH minimum12
Alkaline	≥ 7,5	≥ 7,3	-
Near neutral	5,8-7,5	6,5-7,3	-
Moderately acid	4,2-5,8	5,9-6,5	< 6,4
Acid	2,2-4,2	5,5-5,9	< 5,6
Very acid	< 2,2	< 5,5	< 4,8

Indices and allowed error margins





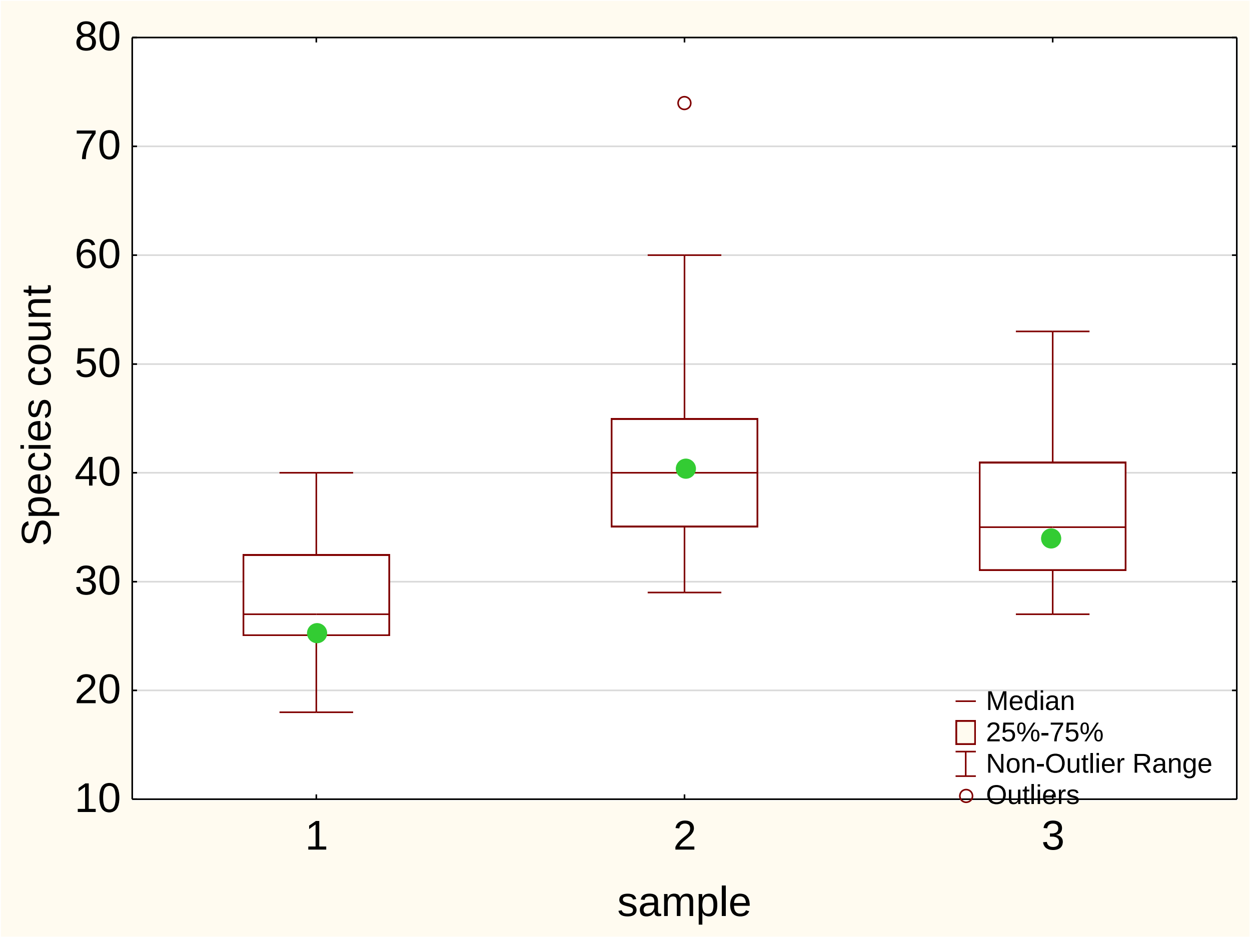
7 121 4 Tot-P µg/l

pH Ø 6,1 *neutral* 6,5

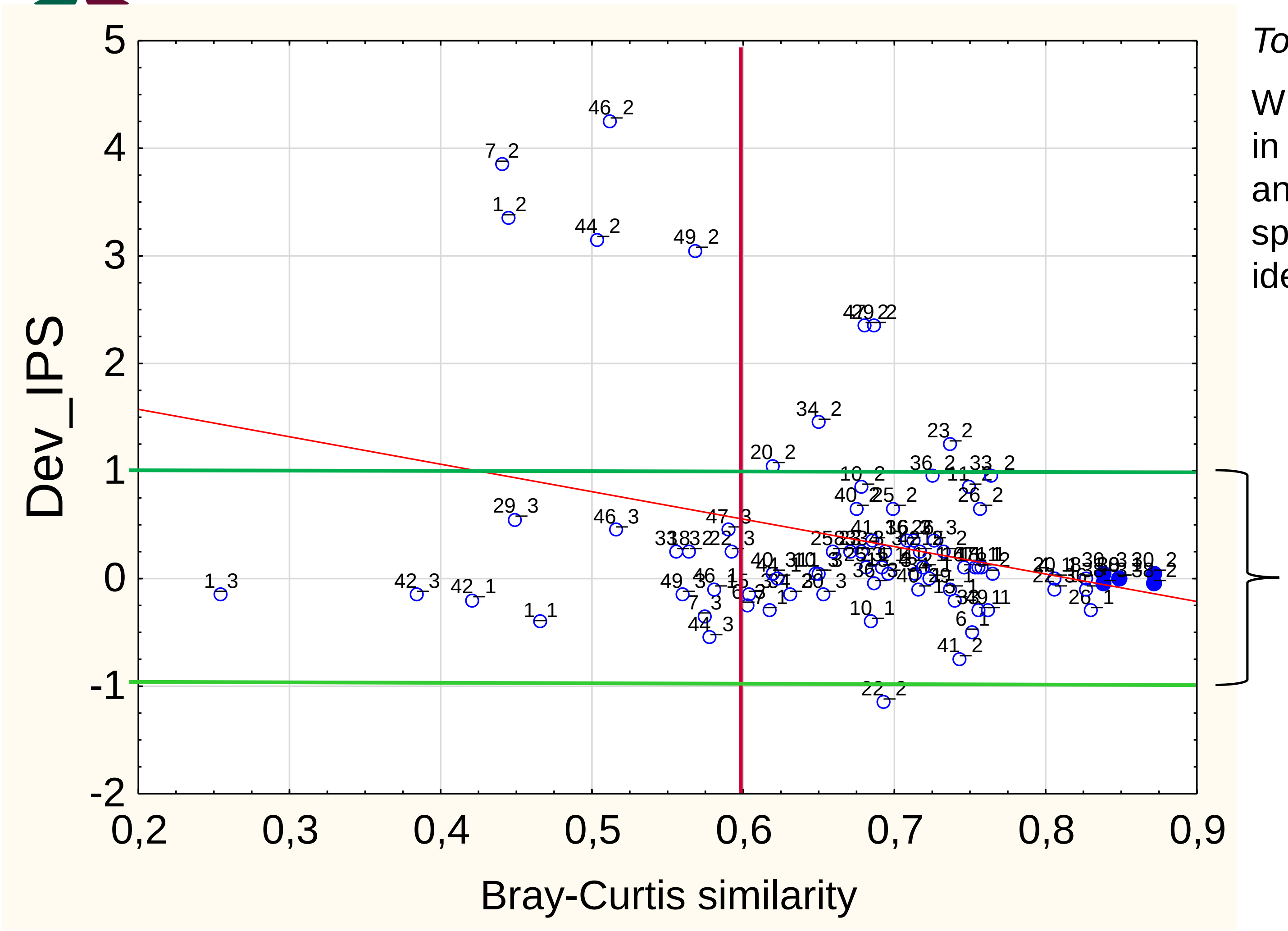
min: 5,3 5,8

- Auditor mean

Number of counted species



Auditors:
27
41
33

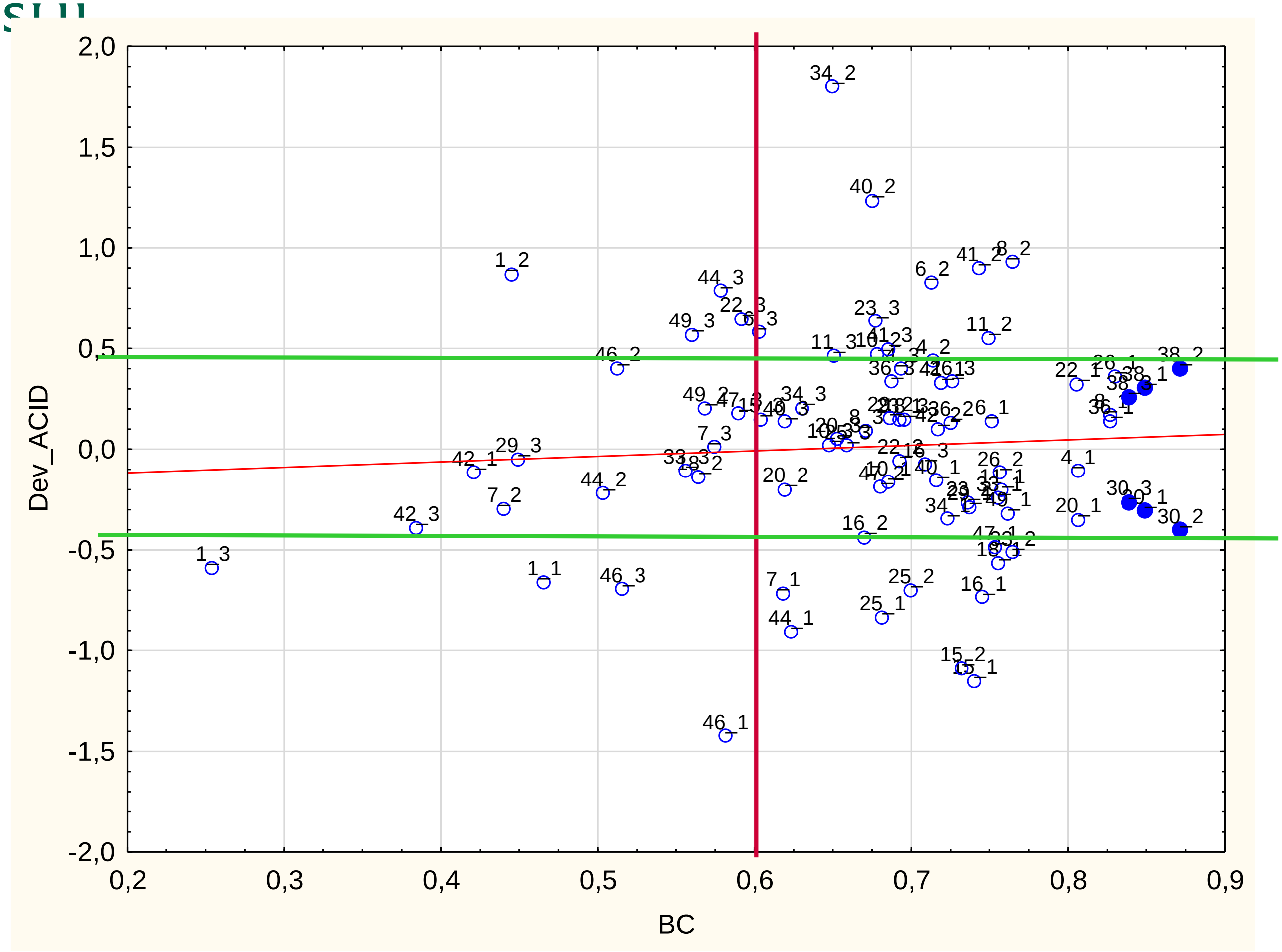


To be discussed:

Which taxa cause trouble in IPS/ACID calculations and should therefore get special attention when identifying?

Allowed deviation for IPS 1-13 (less for 13-20)

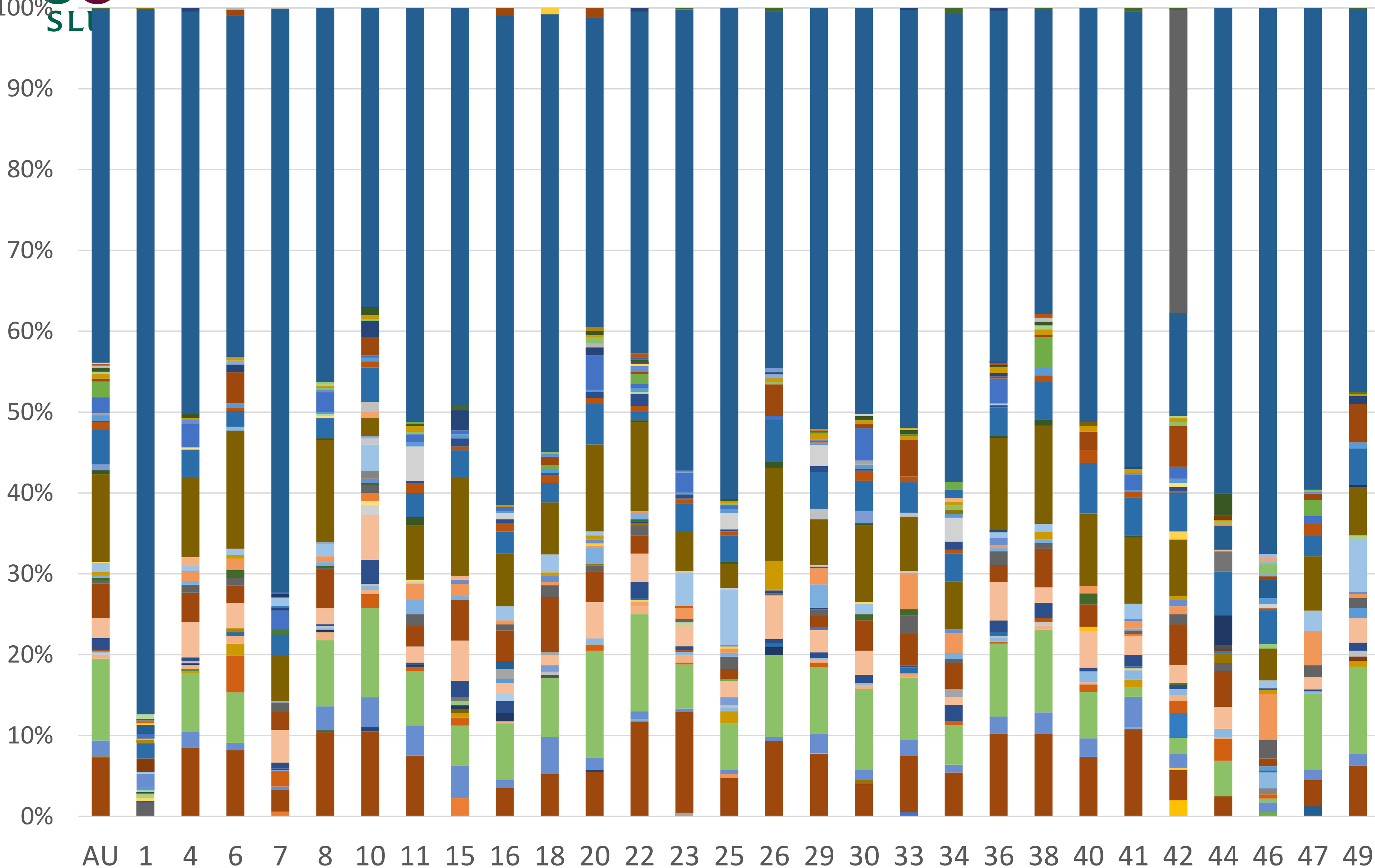
Deviation (in IPS units) vs. similarity with auditors (Bray-Curtis).
All samples, all participants.
Result: If deviating, usually in more than one sample.
Threshold of 60% removes results with highest deviations.



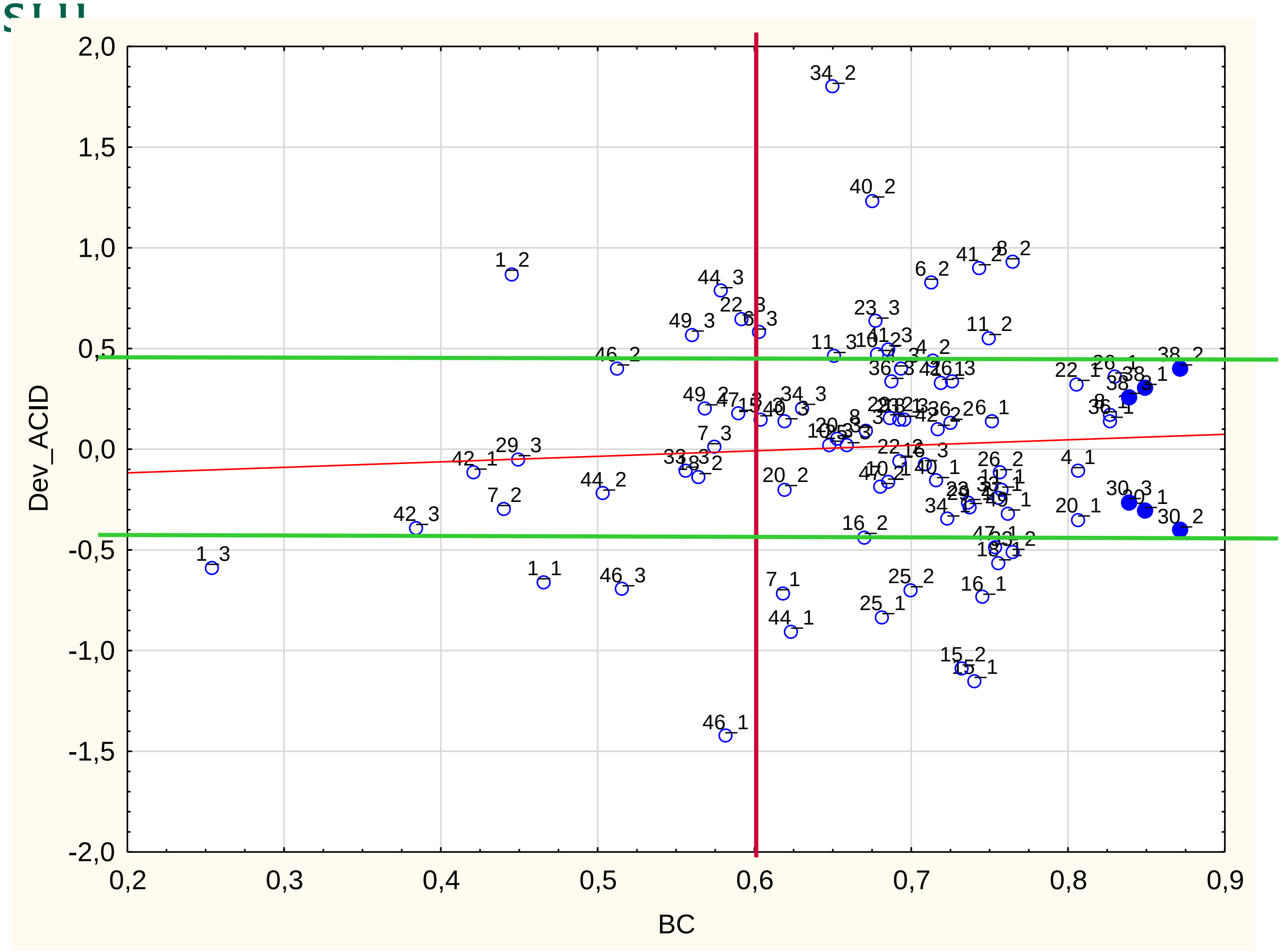
Allowed deviation for ACID: 10%

Deviation (in ACID units) vs. similarity with auditors (Bray-Curtis).
All samples, all participants.
Result: If deviating, usually in more than one sample.
Threshold of 60% does remove the worst result, but not the other deviations.

Sample 1 Sörjabäcken 2019 (IKEU)



Sample 1



Taxa causing trouble in ACID calculations:

Reasons of deviation:

> 1 units *negative* deviation:

46_1. No ADMI & very low non-acidic other taxa, and additionally no indifferent taxa -> ACID calculation extremely low

15_1: same, but having indifferent taxa

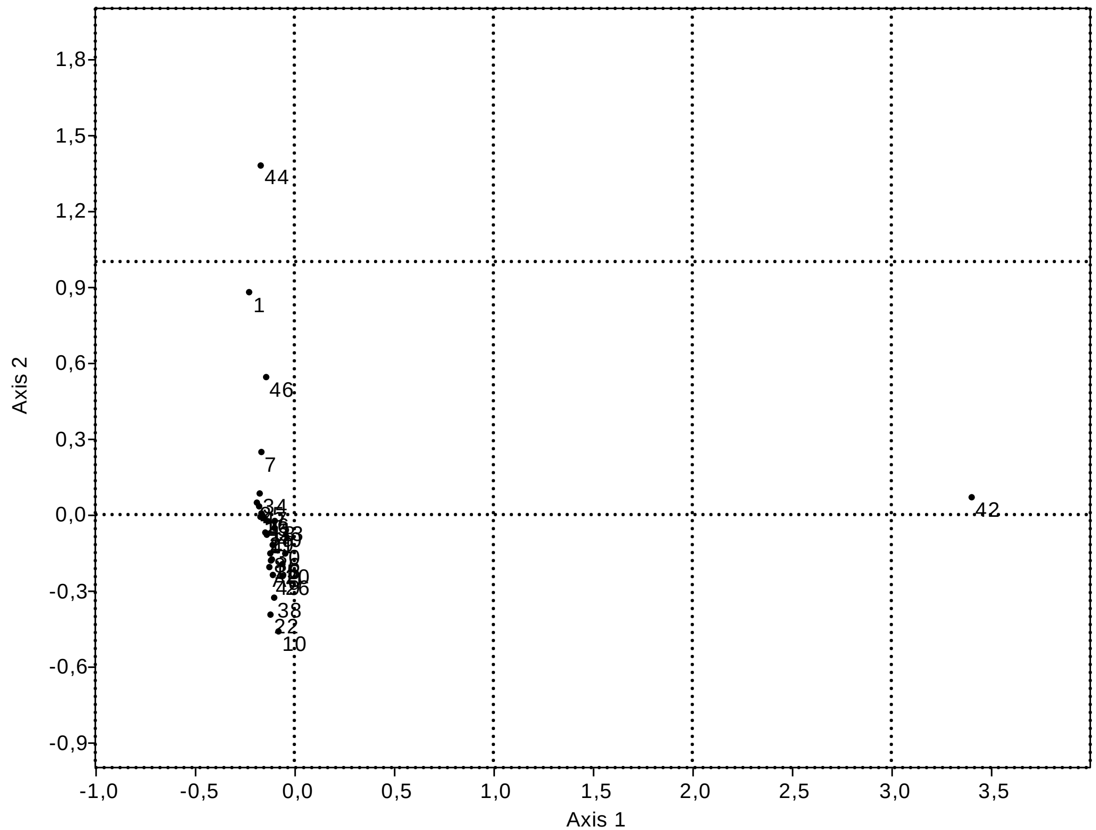
15_2: highest EUNS

> 1 units *positive* deviation:

34_2, 40_2: low EUNS, but not zero (when 0, ACID calculation better, e.g. 11_2)

Deviation (in ACID units) vs. similarity with auditors (Bray-Curtis).
All samples, all participants.
Result: If deviating, usually in more than one sample.
Threshold of 60% does remove the worst result, but not the other deviations.

Sample 1



Correspondence analysis (CA) of all participants and taxa (harmonized/merged codes).

SIMPER (Similarity Percentage, using Bray-Curtis similarity measure) analysis

shows that the following taxa are responsible for the deviation of

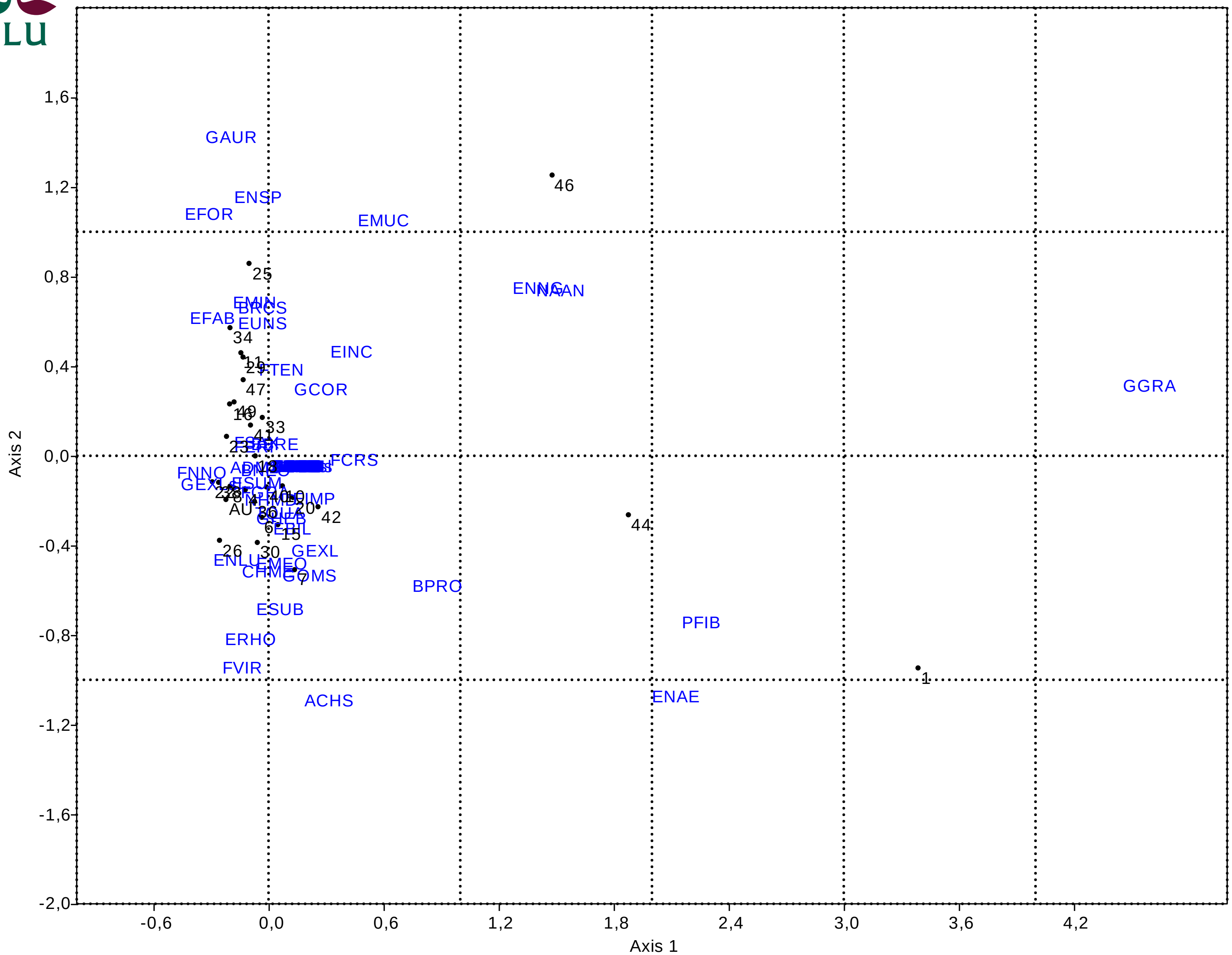
44, 1, 46, 7:
>> *T. flocculosa* (Ø 70%) than others (Ø 50%), additionally low or very low amounts of BNEO, FGRA and ADM2

42: *Tabellaria sp*. instead of *T. flocculosa*

-> The dominant taxa make the difference in similarity.
1. Always check those very carefully.
2. Never ever count TFLO girdle bands…
3. Taxa lists are only comparable/harmonized if the accepted names of the standard list are used.

In case of doubt: use ”cf./aff.” and make a note in the comment field when submitting. In case you think it is a new species: Use the genus name&code, describe the taxon and why you did not use an accepted name in the comment field, and send in pictures and size to the data host.

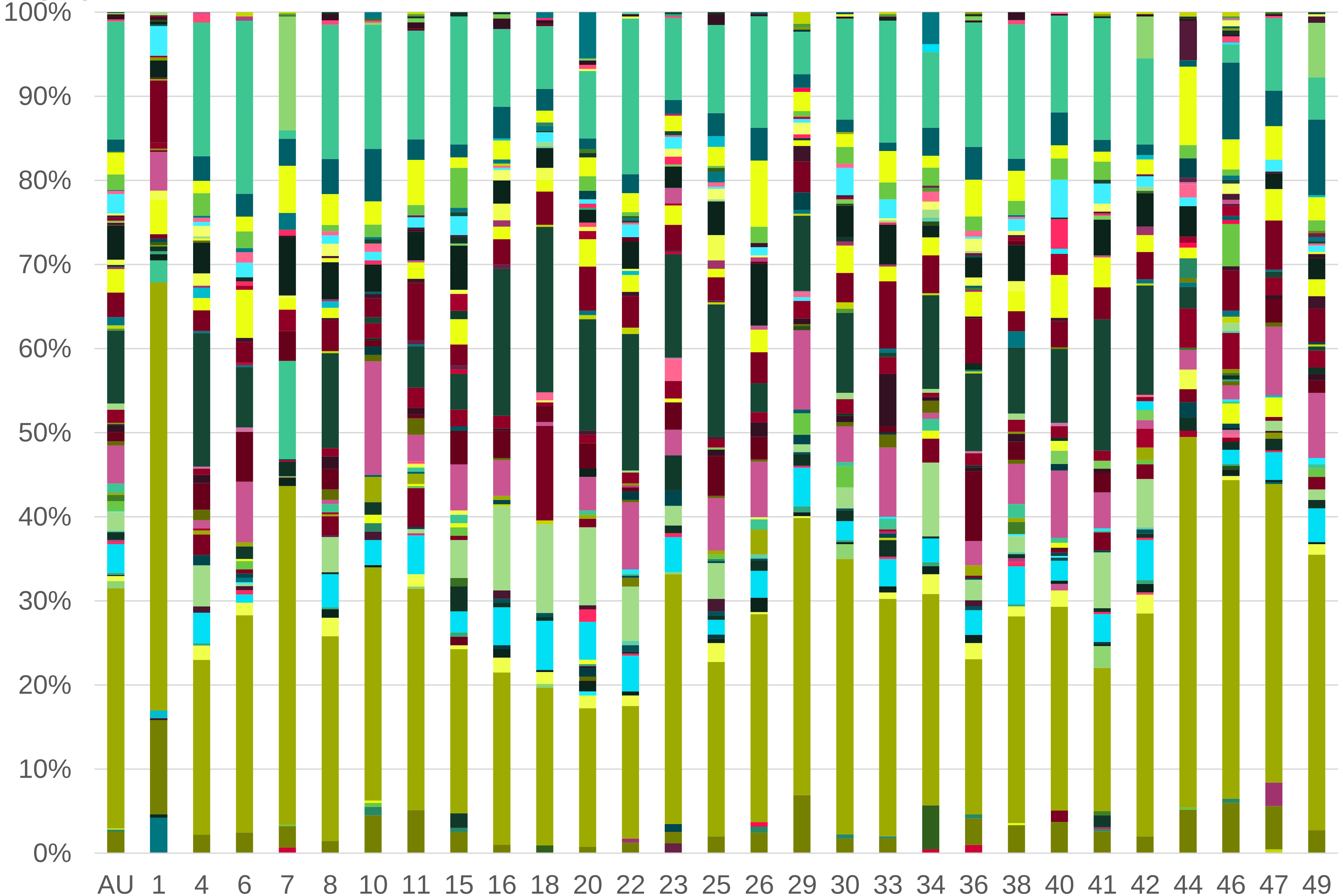
Sample 1



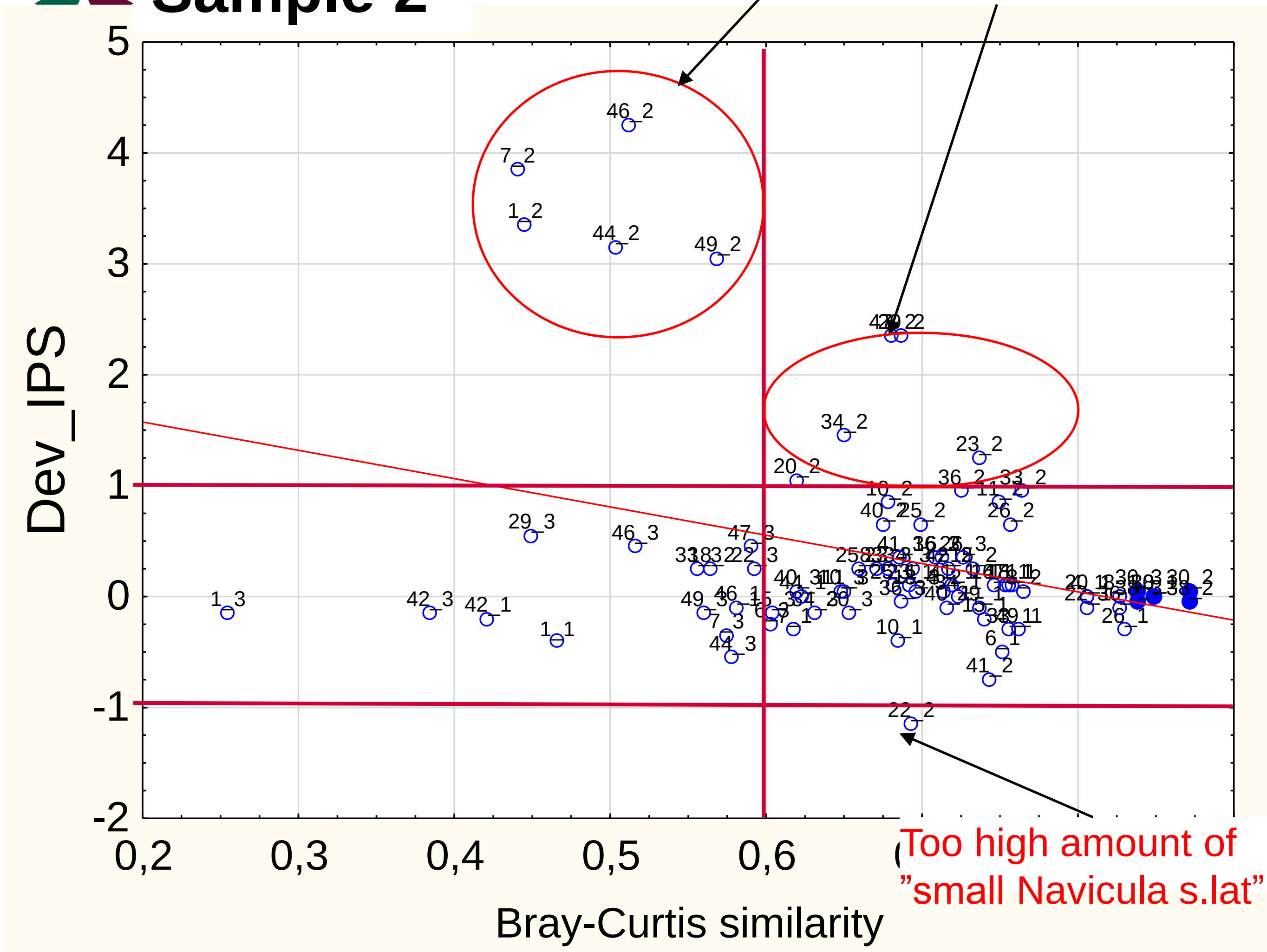
SIMPER for
1, 44, 46:
Too much FGRA, ADM2, BNEO plus differences in several other taxa, including GGRA presence, GHEB absence, and too much PFIB/ENAE

Correspondence analysis (CA) of all participants (harmonized/merged codes). Detailed analysis, removed (uninformative) taxa: singletons, TFLO/TABS, UNID.

Sample 2 Skavebäck 2019 (municipality)



Sample 2



Taxa causing trouble in IPS calculations:

Other problems with BC> 60%:
29, 34, 23

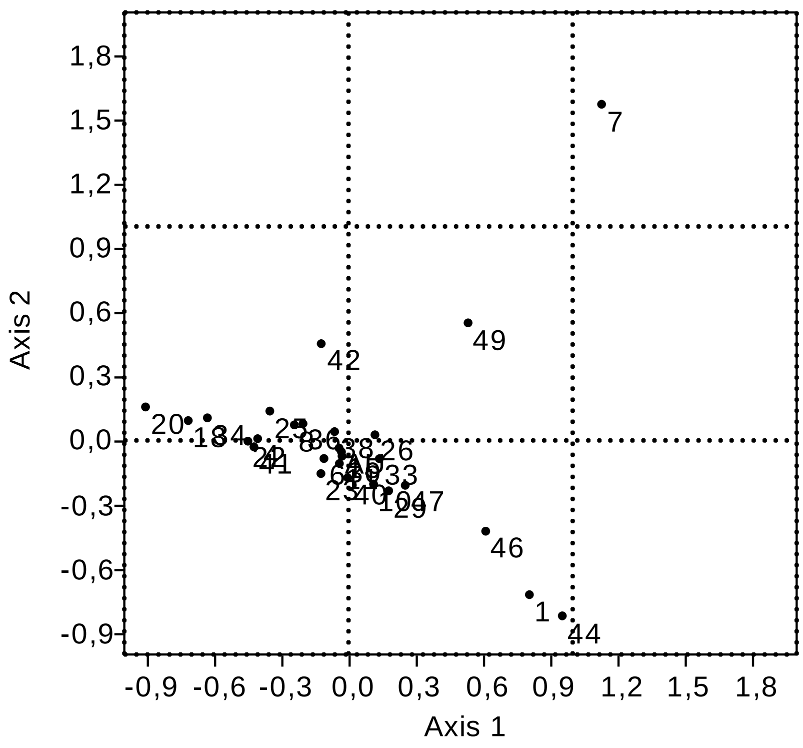
29: 4% more of ADM3 and CPLA each, both with IPS 4-> if recalculated with 2,6% and 28,9%, IPS gets 10,9, which still is too high. Low amount of SSEM (with IPS of 1.5), only 5%. Plus other differences of a combination of taxa.

34: ADM2 instead of ADM3, other *Gomphonema* than the dominating GPAR (GPAR IPS=2, others 3 and higher)

23: GEXL and MAAL (higher IPS scores) instead of GPAR and MAPE

Deviation (in IPS units) vs. similarity with auditors (Bray-Curtis).
All samples, all participants.
Result: If deviating, usually in more than one sample.
Threshold of 60% removes results with highest deviations.

Sample 2



Correspondence analysis (CA) of all participants and taxa (harmonized/merged codes).

SIMPER (Similarity Percentage, using Bray-Curtis similarity measure) analysis

shows that the following taxa are responsible for the deviation of

Both outlier groups:

- Lower % of SSEM, MAPE, FSAP (part of “small Navicula s.lat.”)
- Lower % of GPAR

7, 49, 42:

- Use of code SELS
- Higher amount of RABB

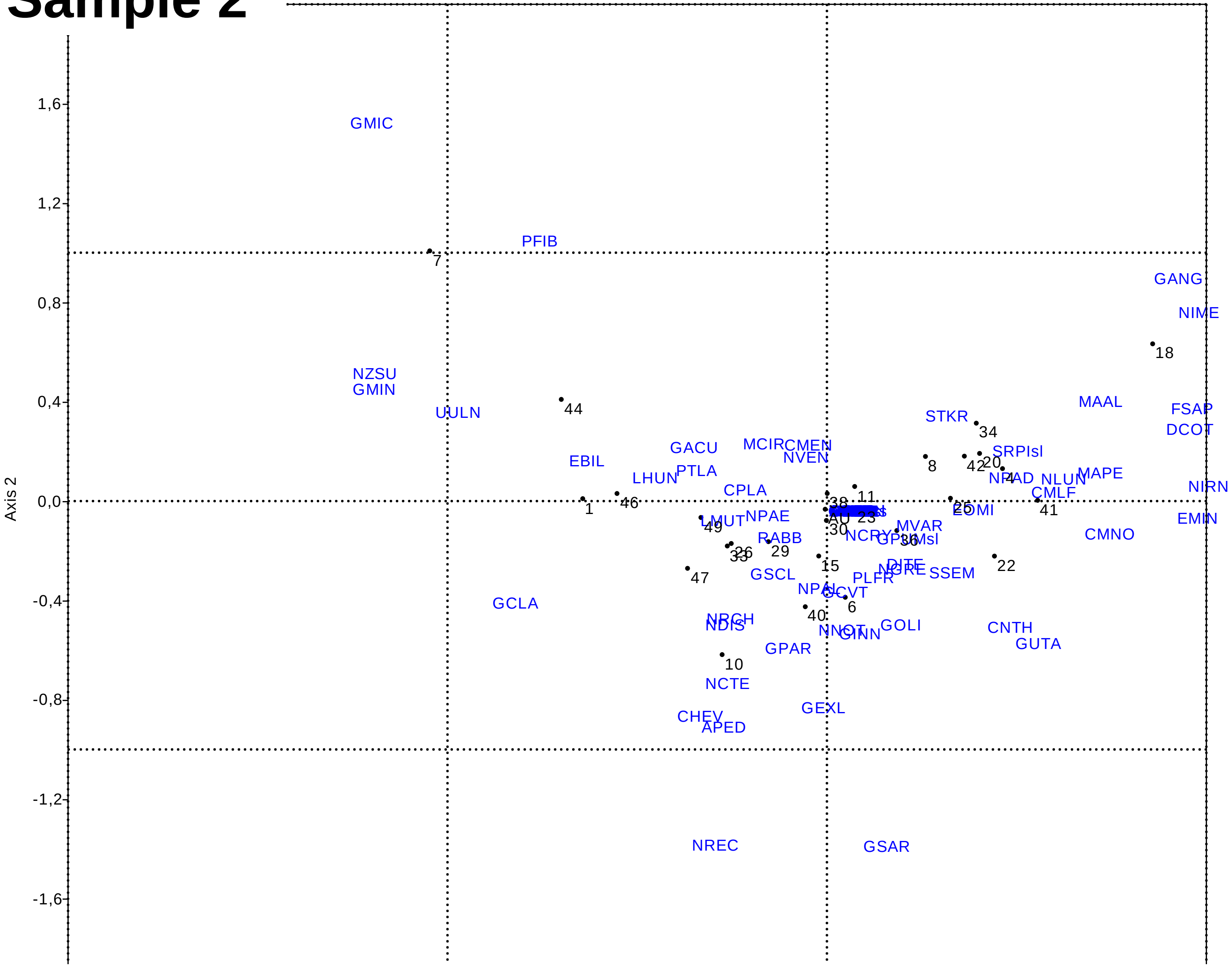
44, 1, 46:

- Higher % of CPLA
- Higher % of ADM3 (probably instead of “small Navicula s.lat.”)
- No FSAP

-> The dominant taxa make the difference in similarity.

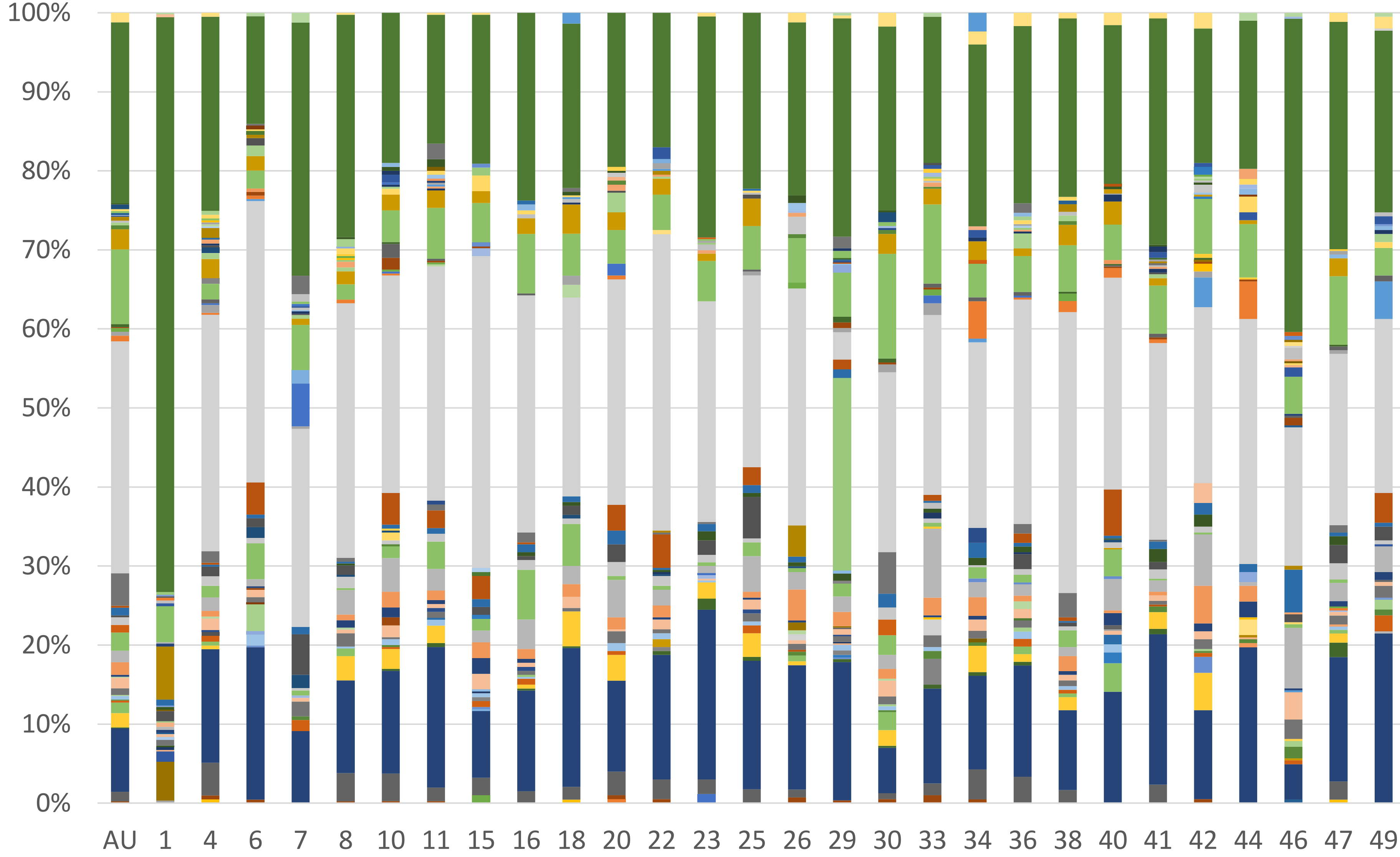
1. Always check those very carefully.
2. Good optics are needed to not overlook the small taxa, and not all of them are *Achnanthidium*…If small taxa are overlooked, larger taxa get relative higher %

Sample 2

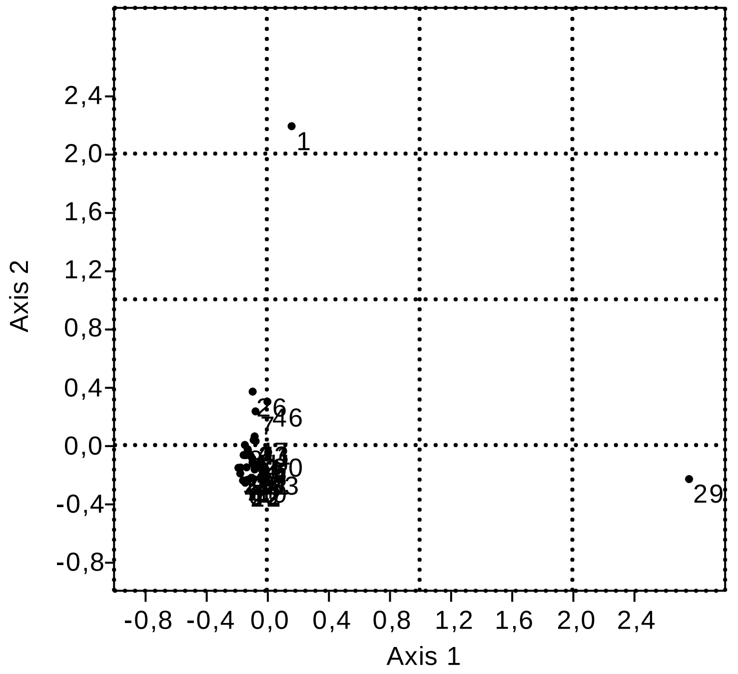


Correspondence analysis (CA) of all participants (harmonized/merged codes). Detailed analysis, removed (uninformative) taxa: singletons, UNID, genus level, ADM2/ADM3 (driving one part of ordination, but no taxonomical problem).

Sample 3 Bastuån 2019 (IKEU)



Sample 3



Correspondence analysis (CA) of all participants and taxa (harmonized/merged codes).

SIMPER (Similarity Percentage, using Bray-Curtis similarity measure) analysis

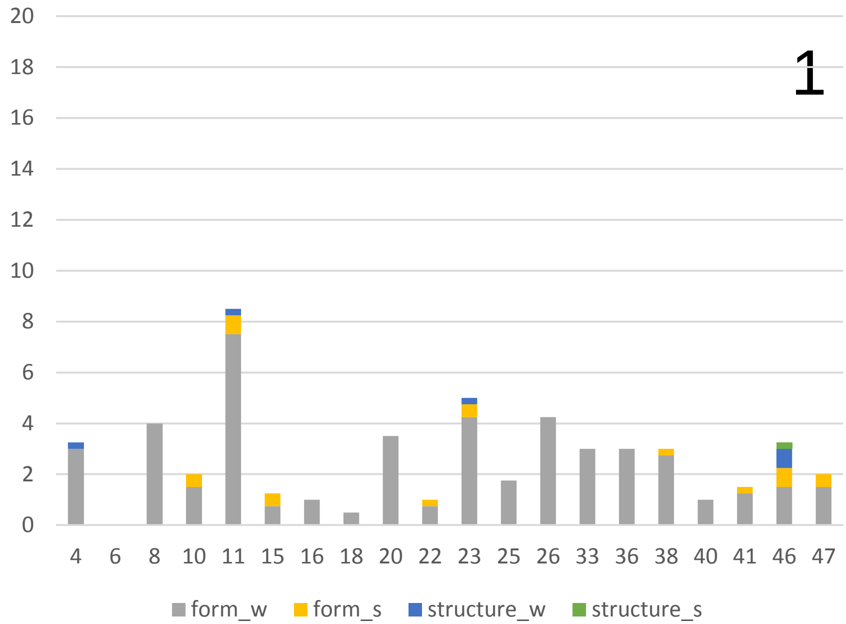
shows that the following taxa are responsible for the deviation of

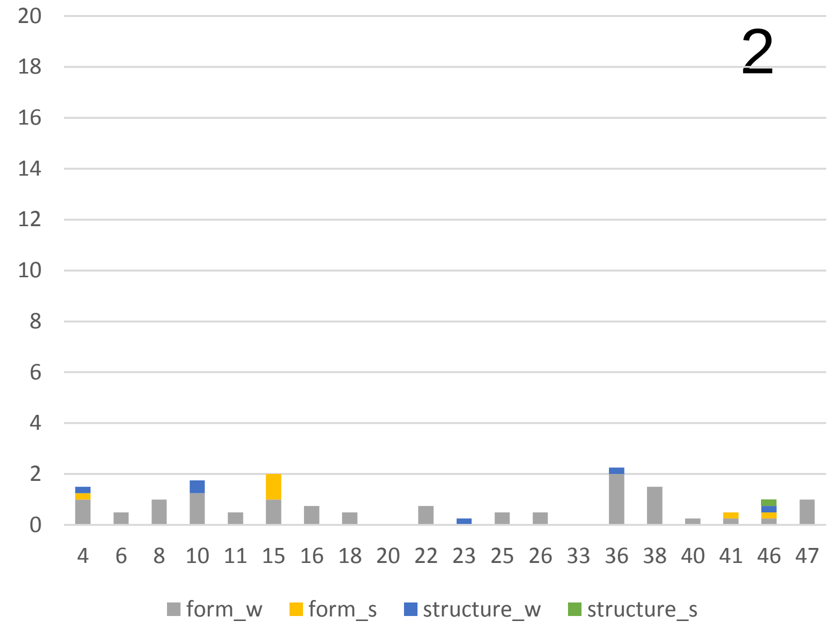
1: 3xTFLO, no FGRA (instead high % of FCAP), ADM3 instead of ADM12 & many other taxa different

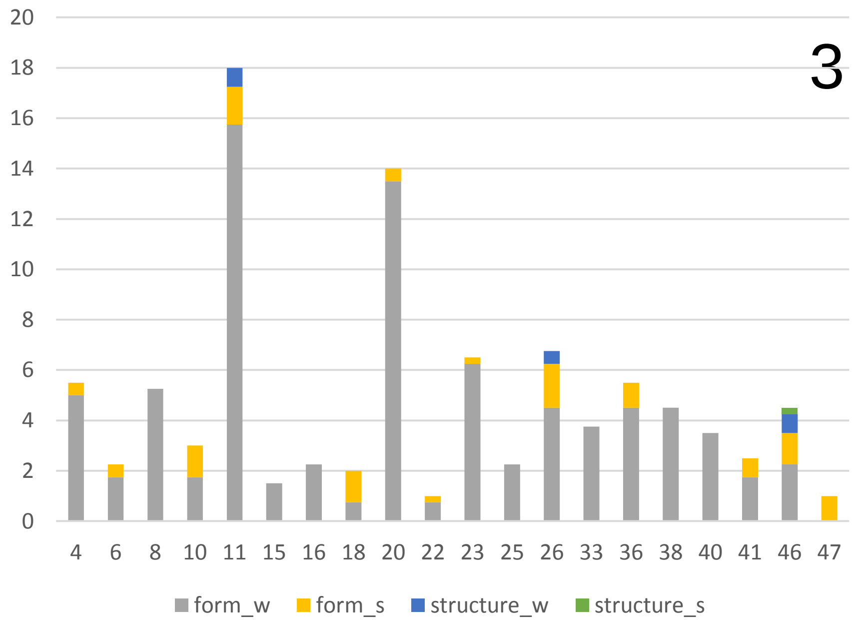
29: FACD instead of FGRA

-> The dominant taxa make the difference in similarity. Always check those very carefully.

Deformations



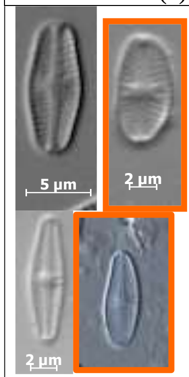
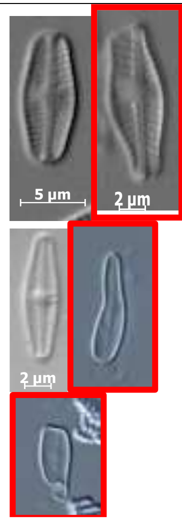


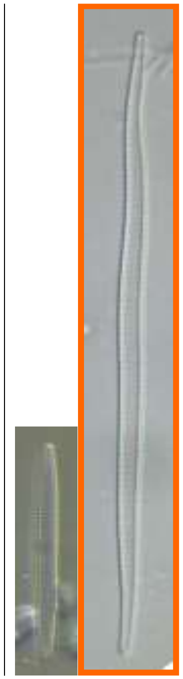
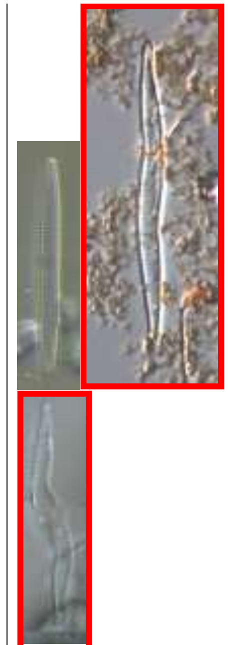


Agreement, that sample 3 has most deformed valves, and sample 2 has least.

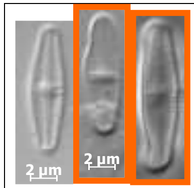
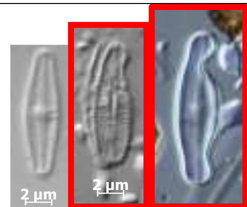
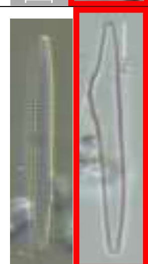
But quite some variation…

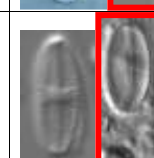
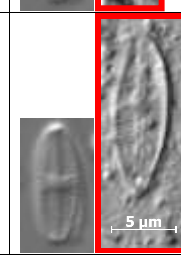
* 25 had only total deformations,
16 also in samples 1 and 3

Onormal form (1)			
	1As Svag asymmetrisk Exempel: Släkte *Sellaphora,* *A. minutissimum*		1At Tydlig Asymmetrisk Exempel: Släkte *Sellaphora,* *A. minutissimum*

	1Bs Svag böjd Exempel: Släkte *Fragilaria., A. minutissimum*		1Bt Tydlig böjd Exempel: Släkte *Fragilaria*.,

	1Cs Svag inbuktad Exempel: Släkte Eunotia		1Ct tydlig inbuktad Exempel: Släkte Eunotia

	1Cs Svag inbuktad Exempel: Släkte Achnanthidium		1Ct tydlig inbuktad Exempel: Släkte Achnanthidium
			1Ds tydlig utbuktad Exempel: Släkte *Fragilaria*.,
			1Et tydlig övrig

Onormalt mönster (2)			
			2At Tydlig avvikande striering Exempel: Släkte *Fragilaria*.,sl
			2Bt tydlig avvikande raf Exempel: Släkte *Eolimnia*
			2Ct Tydlig övrig (exempel: mönster rätt, men asymmetriskt) Exempel: Släkte *Eolimnia*

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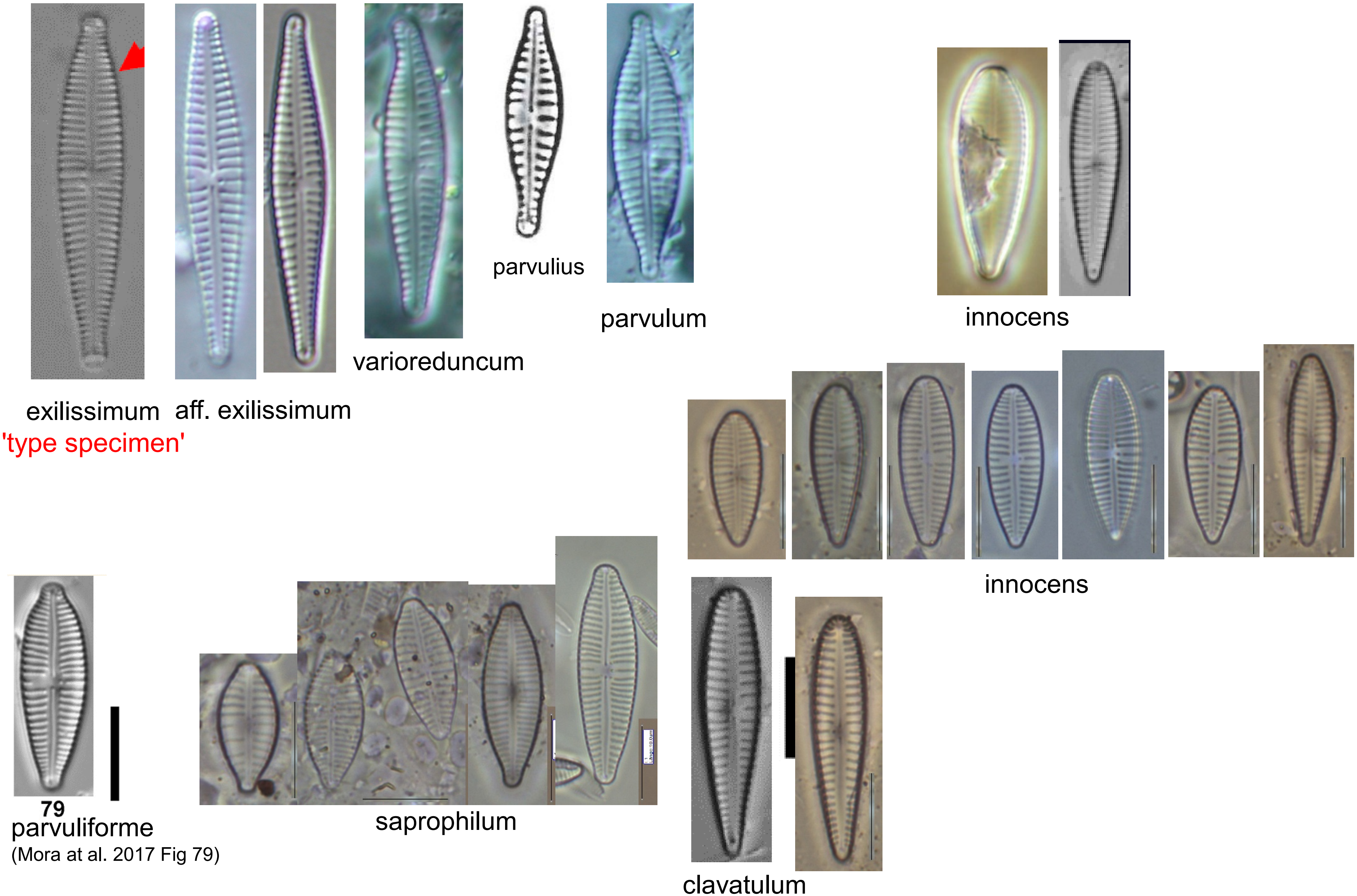
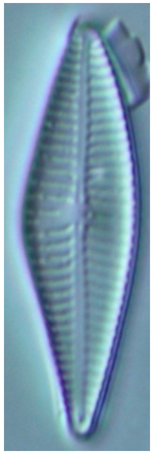
Gomphonema

Thanks so much to Adrienne Mertens for many diatom pictures and for valuable inputs on the identification of this genus.
Thanks also to Irene Sundberg for valuable input.


exilissimum
'type specimen'
aff. exilissimum
varioreduncum
parvulius
parvulum
innocens
innocens
79
parvuliforme
(Mora at al. 2017 Fig 79)
saprophilum
clavatulum

Gomphonema	author	Figures	Length/width	width	Str/10µm	notes
exilissimum	Lange-Bertalot & Reichardt	SWF4 76/14-20; ICO2/62 22	Pictures: 4,5-5,7. SE Suggestion: > 4	Pictures: 4,7-6 SE Suggestion: ≤ 6	Pictures: 13-18	Clearly rostrate headpole Convex upper margins
aff. exilissimum (new species ”nordicum”)		ICO2/62 23-27	Pictures: 5,5-7,2 SE Suggestion: > 4	Pictures: 4,7-5,3 SE Suggestion: ≤ 6	Pictures: 14-15	Acute, not protracted headpole Slender ”neck & legs”, almost concave upper margins
varioreduncum	Jüttner, Ector, E. Reichardt, Van de Vijver & E.J. Cox	Jüttner et al. 2013, Diatom Research, DOI:10.1080/0269249X.2013.797924	Jüttner: 3.3–5.5, Length: 13.5–28.4µm	Jüttner: 4.1–5.2	Jüttner: 14-18	Asymmetrical valves with head pole and/or foot pole deflected to various degrees.
parvulius	Lange-Bertalot & Reichardt	Hofmann 2011, 99:21-24, ICO2 64:9-12 (same as in Hofmann) , SWF 2/4 76:22-29	Text Hofmann Length: 10-22µm	Text Hofmann: 3-4,5, Jüttner: 3.5–4.5	Hofmann: 13-16 Jüttner: 12–14	prefers acid water, rel small taxon Hofmann: no heads (only rostrate) ???
parvulum	(Kützing) Kützing	SWF4 76/1-7, Hofmann 2011 99:1-5 (f. parvulum)	Pictures: 2,8-6 SE Suggestion: ≤ 4 (Amelie 2017. Not 4.5 as written earlier)	Pictures: 5,3-6,6 (Amelie 2017: not necessarily ≥6 as stated earlier). Barts advice: ≤6µm (of the population), otherwise saprophilum	Pictures: 15-17	Small heads placed on small shoulders, [earlier 2 forms: parvulum and saprophilum; the latter thicker (Hofmann 2011: 6-8µm, f.parvulm 5-6.5 µm)]
saprophilum	(Lange-Bertalot & E.Reichardt) Abarca et al.	Lange-Bertalot et al. 2017, p. 316, plate 101, figs 6-10; same as in Hofmann 2011 99:6-10 (f. saprophilum)		Barts advice: >6µm (of the population), otherwise parvulum		Fat, no capitate headpoles, more squat, pressed. Probably are the fat ones with capitate poles and higher striae density G. parvuliforme (Diat of Eur 8, also fig 79 in Mora et al. 2017

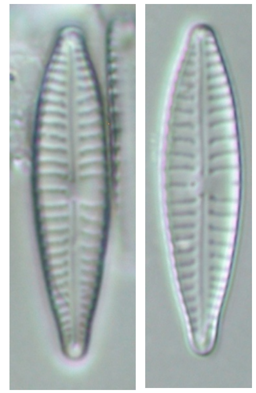


graciledictum

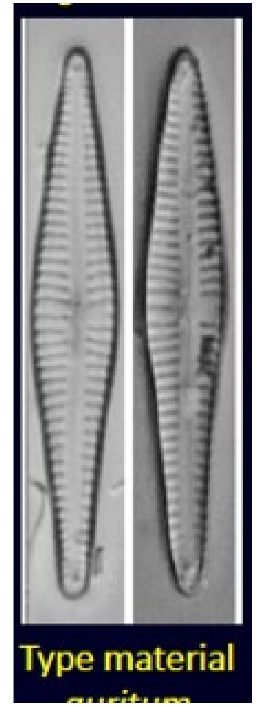
hebridense

cf. angustatum ? (Bart)

angustatum



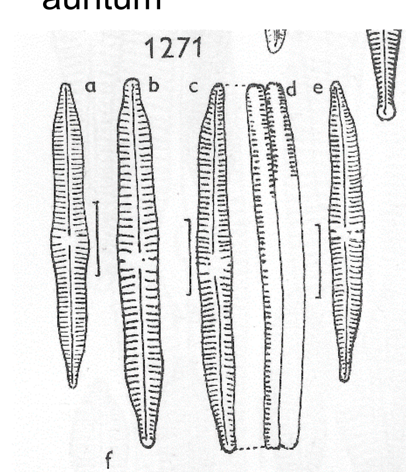
cf. angustatum (Bart)
sp. (Amelie)

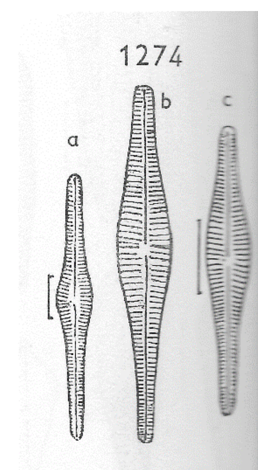


auritum

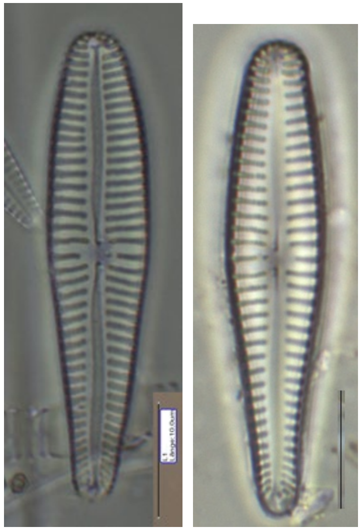
No pictures for *G. lagerheimii*
not clear what this taxon is really

1271 and 1274 are the scanned images of Cleve-Euler:
1271: G. *lagerheimii*
1274: G. hebridense
According to those, and the stria density, G. "lagerheimii" of ICO8 should instead be G. hebridense.

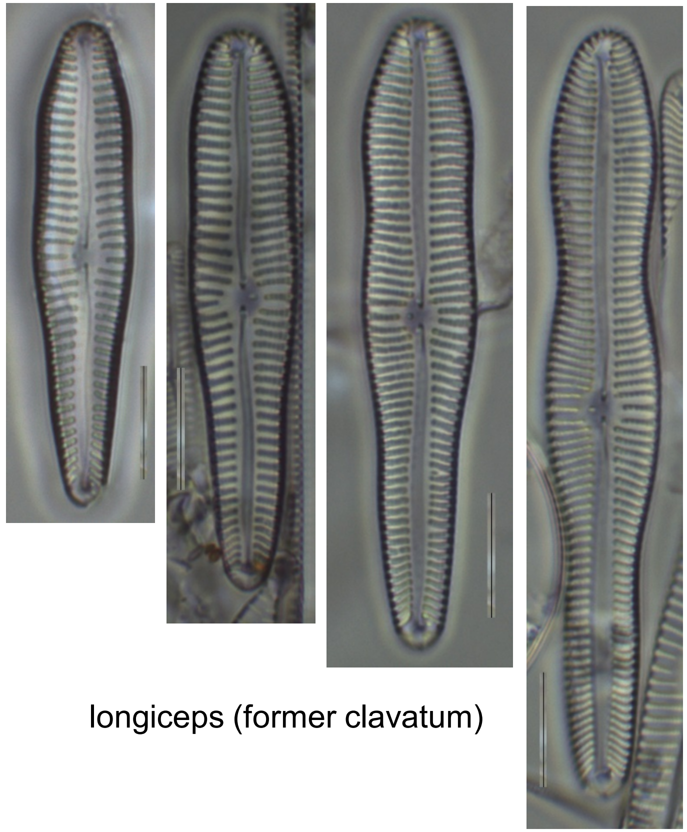




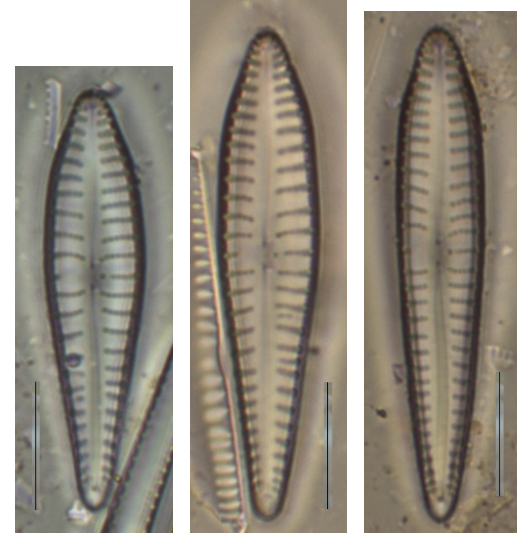
Gomphonema	author	Figures	Questionable figs.	Length/width	width	Str/10µm	notes
graciledictum *(=formerly gracile)*	E.Reichardt	ICO2/62 20-21; SWF4 79 1-7, Reichardt 2018	ICO2/98 4;		Pictures: 6,7-8	Pictures: 11-15 very parallel and punctated	strictly rhombic, quite fat
auritum	A. Braun & Kützing	ICO2/98 2-3, 5- 6; SWF4 79 10-12, Van de Vijver et al. 2020	ICO2/98 4; 7-8; 64/26-27; SWF4 79 8-9	Pictures: 5,8-6,3	Type material: 4-6; Pictures: 5,3-6	Type material: 13-15 Pictures: 12-13(14)	Acute ends, no"shoulders" Never convex margins ± rhombic (i.e. largest width near center)
angustatum	L-B et al. 2017, p299, pl99:41-45	Hofmann 2011, ICO 8 T23, 24, 26, Reichardt 2018		Length: 16 – 48 Width: 5,3 – 6,7	Width: 5,3 – 6,7	10 - 14	Symmetry: Thickest part above center
hebridense	Gregory	ICO2/64 18-25; SWF1 156 12-14; SWF4 79 13-17, Reichardt 2018	ICO2/98 1		SWF: 4-8	Pictures: 13-14(15) (SWF: 10-14)-18	"shoulders", outline ± rhombic, always more or less bent
lagerheimii nr. 1	A. Cleve	ICO2/64 5-8; SWF1 155 22-24			SWF: 4-8	Pictures: 9-11 (SWF: 8-12)	"shoulders", outline 3-waves and ± linear, quite acute pointy head
lagerheimii nr. 2	A. Cleve	ICO8/41 18-29		Length: 40-54	5-6,4	12,5-16	All characters like hebridense, but that one not even mentioned in ICO 8 – no solution yet, is probably an error (and is instead G.hebridense?)



subclavatum

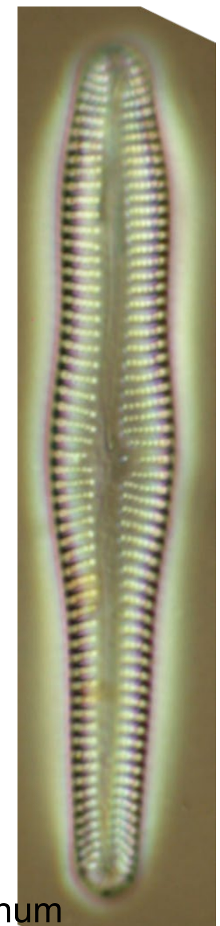


longiceps (former clavatum)

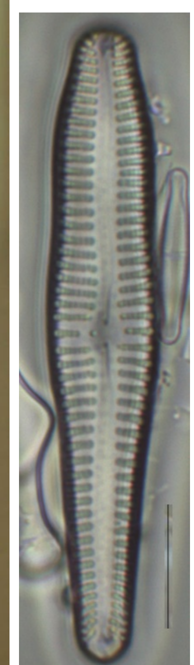


insigniforme

subclavatum



montanum



montanum

insignifor

Gomphonema	author	Figures	Questionable figs.	Length/width	width	Str/10µm	notes
longiceps (former clavatum)	Ehrenberg	Reichardt 2015 Diat Res 30(1-2): 141-149; Reichardt 2018, Hofmann 2011 T94:1-5			7-10, Reichardt 2015: 8-11	9-11, Reichardt 2015: 9-13 (mostly 10-11). Areolae 28 (25-31)/10µm	Swollen center, triundulate margins, clavate outline (Hofmann 2011), more straight first and then cuneate (in opposite to G. subclavatum)
montanum	Schumann	SWF 2/4 T 83, 16-18, SWF 2/1 F163/6	Hofmann T94: 6-7 (A.Mertens), and 8-10 (M.Kahlert)		6,5-9,5	9-11, areolae clearly visible: 20/10µm (Hofmann)	”other form” (Hofmann 2011) Heads somewhat more extracted than in longiceps, looks like ”pinched” from rest of the valve, and somehow rectangular (rel. flat pole) (Maria)
subclavatum	(Grunow) Grunow	Reichardt 2018, Hofmann 2011 T95:25-30		L: 35-55 (type) 25-70 (Hofmann 2011) < 25 as ”cf.” by Reichardt 2018	6.5-8 (type) 8-10 (Hofmann 2011)	9-12 (type) 8-10 (Hofmann 2011)	Center only a little bit swollen”, lanceolate-clavate outline (Hofmann 2011), narrowing from the middle to the end
insigniforme	E.Reichardt & L-B	Reichardt 2018, ICO8 T3					Cuneate headpole, undulate valve outline, curved striae, areolae clearly visible

Small *Navicula* s.lat.

Thanks so much to Adrienne Mertens for many diatom pictures and for valuable inputs on the identification of this genus.

Code SE taxalist vs. xx (today)	Suggestion for change/new names	Authors	Length (µm) (Hofmann et al. 2011) (LB 2001 DoE)*	Width (µm) (Hofmann et al. 2011) (LB 2001 DoE)*	Striae (/10µm) (Hofmann et al. 2011) (LB 2001 DoE)*	Notes	Index value OMNIDIA vs. xx (newest) & suggestion to implement in updated SE taxalist
FSAP	Fistulifera brake very easily so count even if you can see it´s broken – Swedish methods text needs to be updated to include this information	(H. Lange-Bertalot et K. Bonik) H. Lange-Bertalot 1997	(3,8)4,5-7,6	2-4	*48-81*	often only sternum visible, with "2 nodes"	IPS 2/5, TDI 5/1, &PT 1, pH (vand Dam) 3
MAPE	Update to Mayamaea permitis MPMI	(Hustedt) Bruder & Medlin	6-9 (DoE images 7.3-10)	3-4	30-36	raphe with "3 nodes", acute ends	IPS 2,3/1, TDI 5/1, %PT 1, pH 4; MPMI same values
MAAL*	Update to Mayamaea alcimonica MALC	(E. Reichardt) C.E. Wetzel, Barragán & Ector	*As MAPE** but DoE images larger: 9.3-11.3	*As MAPE**	24-26	raphe with "3 nodes", acute ends, less striae and "valve size is larger in average" (than MAPE)* - Reichardt gives no measurements either	IPS 3,5/1, TDI 5/1, %PT 1, pH 4** (SE taxalist has added value, OMNIDIA has 0), MLAC same values
SSEM as used in SE taxalist until Dec 20	Update to Sellaphora saugeresii SSGE; Wrong use of name in SE taxalist. "SSEM" is acctually a synonym of what we until now (Dec 2020) have identified as "S. joubaudii).	*Not sure how to deal with this formally, need to check with ArtDatabanken*	3-21	3-5	18-22	Rounded ends	The the correct SSEM is really the same as Sellaphora seminulum (Grunow) D.G. Mann*
EOMI	Update to ? Now 2 taxa: SEAT & SNIG	*need to check with ArtDatabanken*	5-18	2-4,5	25-30	Rounded ends	IPS 2,2/1, TDI 5/1, %PT 1, pH 4
ESBM	Update to Craticula subminuscula CSNU	(Manguin) C.E. Wetzel & Ector in Wetzel et al.	7-12,5	3,5-6	15-26	raphe weakly bent	IPS 2/1, TDI 5/1, %PT 1, pH 4; CSNU same values
SSGE to replace SSEM	Sellaphora saugeresii	(Desm.) Wetzel & Ector	6.5–11.0	3.3–3.8	21–22 (type), symmetrical central area	*Has in OMNIDIA a description of 18-22 str/10µm; rounded ends*	*Same as SSEM*
SCRA new taxon	Sellaphora crassulexigua	(Reichardt) Wetzel & Ector	5.5-14	2.7–4.4	17–23, always an asymmetrical central area	*New taxon (probably identified as SSEM earlier)*	*Rare and restricted to springs; IPS 2,5/1, no TDI, no Van Dam pH value*
SNIG	Sellaphora nigri	(De Not.) Wetzel & Ector	3.7–13.0	2.7–4.8	25–32	*Valve width larger than for SEAT*	*No values yet*
SEAT	Sellaphora atomoides	(Grunow) C.E. Wetzel et Van de Vijver	3.4-16.3	2.6-3.7	30-36	*Valve width smaller than for SNIG. Central area small, 2 (3) shortened striae.*	*No IPS value, TDI 4/1 %PT 0, pH 0*
SLAB	Sellaphora labernardierei	Beauger, C.E.Wetzel & Ector	6.1-11	2.2-3.4	20-28	*Larger valves with soemwhat swollen center. central area widened, rectangular, more*	*From springs, has no index values yet*

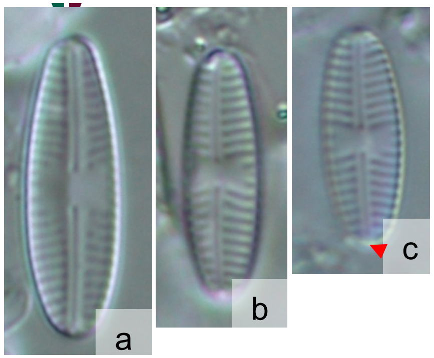
Comments

* SSEM: The correct SSEM is really the same as Sellaphora seminulum (Grunow) D.G. Mann. Info A.Mertens: See Wetzel et al 2015.
Basionym: Navicula seminulum Grunow 1860, Verh. zool.–bot. Ges. Wien, vol. 10, p. 552, pl. 2, fig. 3a–d (non 2a–d), nec Navicula seminulum Ehrenb. 1842, Ber. Bekanntm. Verh. Königl. Preuss. Akad. Wiss. Berlin, 1842, p. 265, nomen nudum.
Synonyms: = Navicula seminulum var. radiosa Hust. 1954, Arch. Hydrobiol., vol. 48, p. 473, figs 36, 37; = Navicula joubaudii H. Germ. 1982, Cryptog. Algol., vol. 3, p. 36, pl. 2, figs 12–24; = Sellaphora radiosa (Hust.) H. Kobayasi in Mayama et al. 2002, Diatom, vol. 18, p. 90; = Sellaphora joubaudii (H. Germ.) Aboal in Aboal et al. 2003, Diatom Monographs, vol. 4, p. 433.

Maria: The only clear difference I can see between S. saugeresii and S. labernardierei is the valve width, which is thinner in oligotrophic springs obviously. Threshold: 3.4/3.4 µm

Small taxa of *Navicula* s.l.

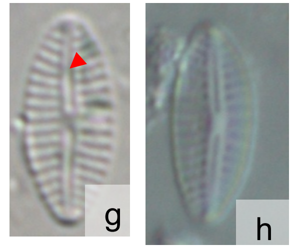
NORBAF intercalibration 2007 -> Update 2020



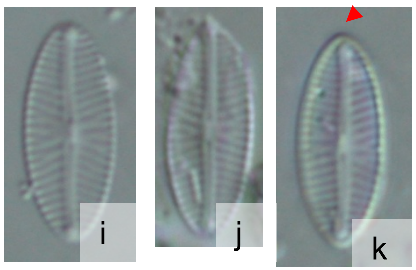
[*N. seminulum* Grunow (a.c)]
Sellaphora saugerresii,

[*N. minima* Grunow (d-f)]
Sellaphora nigri (d, e)
Sellaphora atomoides (f)

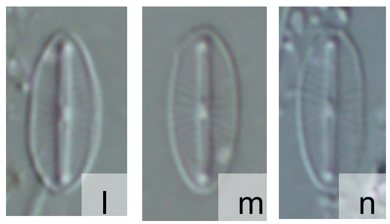
10 µm



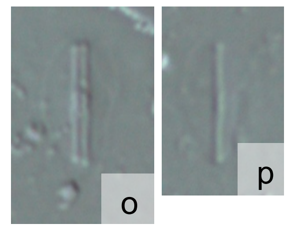
[*N. subminuscula* Manguin (g,h)]
-> Craticula subminuscula



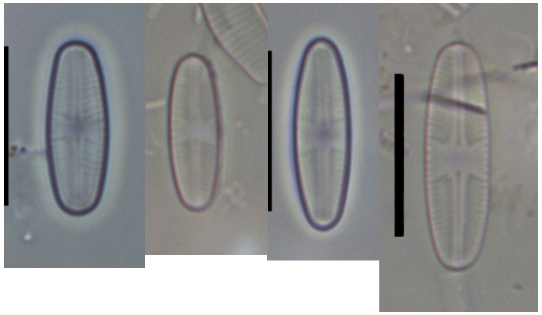
[*N. atomus* var. *alcimonica* Reichardt (i-k)]
Mayamaea alcimonica



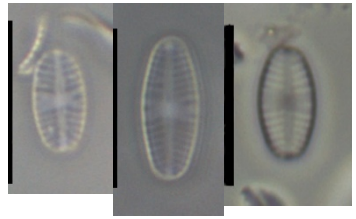
[*N. atomus* var. *permitis* (Hustedt) Lange-Bertalot (l-n)]
Mayamaea permitis



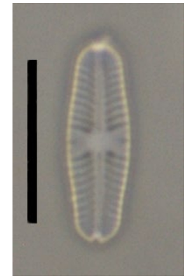
[*N. saprophila* Lange-Bertalot & Bonik (o, p)]
-> Fistulifera saprophila



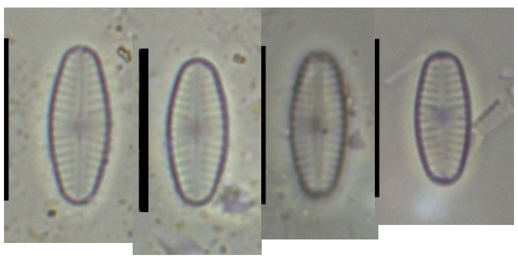
Sellaphora atomoides



Sellaphora crassulexigua



Sellaphora seminulum



Sellaphora labernardierei

Sellaphora saugerresii

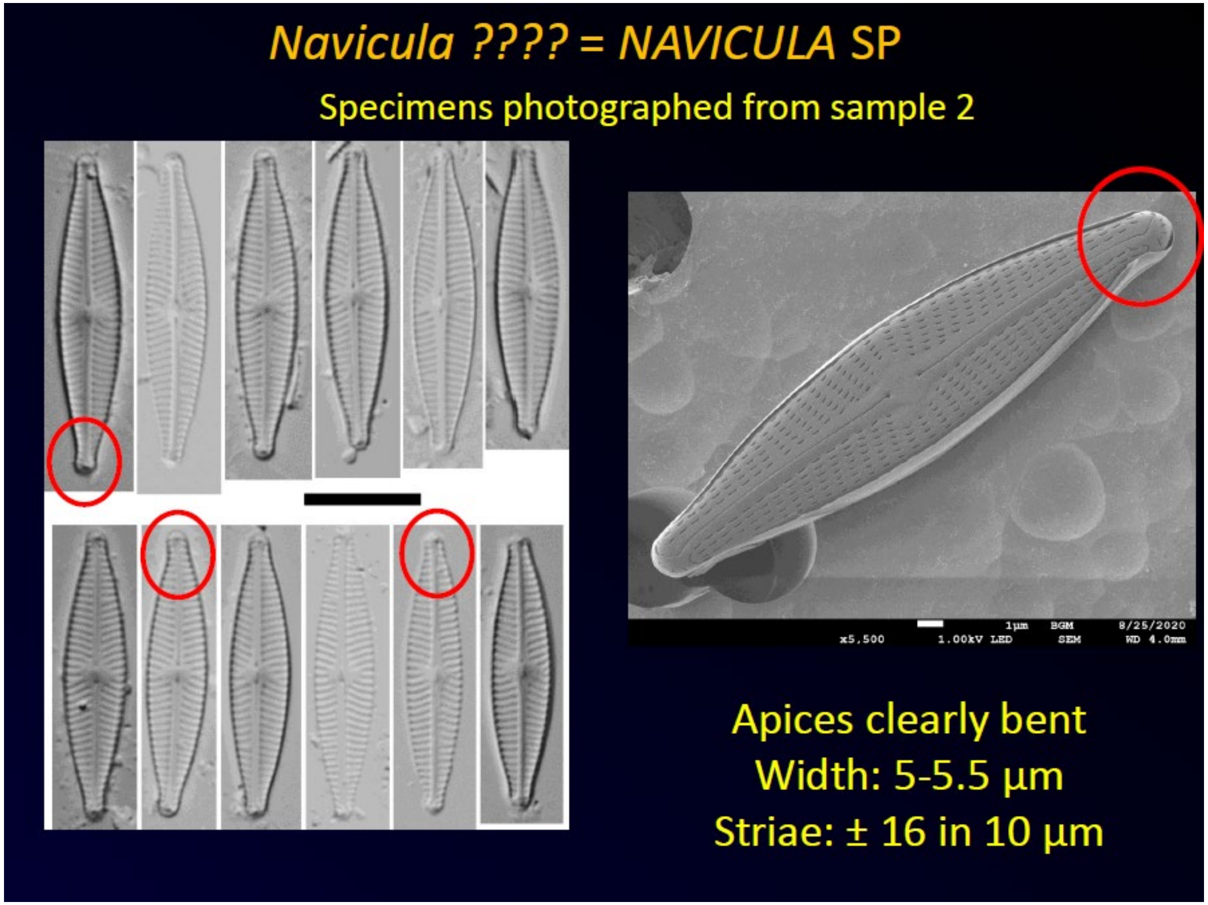
medium Naviculacea

See also Bart Van de Vijvers International Diatom Workshop Chapter I (*Navicula cryptocephala* etc.)

Navicula

Species	Author	Length [µm]	Width [µm]	Stria / 10µm	Special / typical characters
cryptocephala	Kützing	20-40	5-7	14-18	protracted apices
veneta	Kützing	13-30	4,4-6	13,5-15	Rectangular central area
gregaria	Donkin	13-30	5-7,5	13-20	Striae only weakly radiate, lineolae distinct
cryptotenella	Lange-Bertalot	12-40	5-7	14-16	no protracted apices, straight striae, ± rhombic impression, quite strongly silicified
antonii	Lange-Bertalot in Rumrich et al.	11-30	6-7,5	10,5-15	
antonioides	Van de Vijver, Jarlman & Lange-Bertalot	12-19	4,9-5,8	14-15	similar to antonii, but thinner
reichardtiana	Lange-Bertalot	12-22	5-6	14-16	too short N. cryptocephala (“<20µm), elliptic outline, central area striae short-long-short
ireneae	Van de Vijver, Jarlman & Lange-Bertalot	20-26	4.5-5	15-17	Apices shortly protracted (more than in cryptotenella), subrostrate, straight; smaller than cryptocephala and different central area (asymmetric)
exilis	Kützing	20-45	6-8	13-15	Very large central area
lundii	Reichardt	13-35	4-6.3	14-15	The separation from other taxa (is a ±mix of cryptocephala & exilis) is not clear. See DoE 2, Pl22:17-24
germainii	Wallace	26-40	5-8	13-15	Striae convergent at the ends; DoE 2 Pl.35:7-13

Unknown Navicula from sample 2, Norbaf 2020



- Too thin for N. ireneae, that one also with straight apices
- N. cryptotenella has no protracted apices
- Probably new species

Navicula

Species	Author	Length [µm]	Width [µm]	Stria / 10µm	Special / typical characters
trivialis	Lange-Bertalot	25-65	8,5-12,5	11-13	larger than oligotraphenta
oligotraphenta	Lange-Bertalot & G.Hofmann	28-38	8-9,5	10-12	
phyllepta	Kützing	25-46	6,6-8,5	17-20	trivialis is wider and has less striae
radiosa	Kützing	40-120	8-12	10-12	
lanceolata	(C.Agardh) Ehrenberg	28-70	8-12	10-13	
rhychocephala	Kützing	40-60	8,5-10	10-12	
salinarum	Grunow in Cleve & Grunow	18-50	6,5-12	12,5-17	
gottlandica	Grunow in Van Heurck	35-60	8-12	16-18	As synonym to N. supergregaria in DoE 2, but must be another species as N. supergregaria has a round central area, whereas N. gottlandica has a narrow lanceolate one, besides also different size & striae density; both a bit similar to, but larger than N. gregaria
tripunctata	(O.F.Müller) Bory	30-70	6-10	9-12	check lanceolate (which is more lanceolate with a more roundish central area)
capitoradiata	Germain	24-45	7-10	11-14	check subalpina
subalpina	Reichardt	20-52	5-7	14-17	Ecology: alkaline, oligo- to mesotrophic lakes in alpine areas; N. capitoradiata is wider & has less striae;

Navicula

Species	Author	Length [µm]	Width [µm]	Stria /10µm	Special / typical characters
caterva	Hohn & Hellermann	10,4-17	4,2-5,5	(16)18-21	Similar to reichardtiana, but thinner & denser striae which are more regular radiate
vilaplanii	(Lange-Bertalot & Sabater) Lange-Bertalot & Sabater	12-17	2,5-3,3	19-22	check tenelloides, longicephala and ultratenelloides
perminuta	Grunow in Van Heurck	5,5-20	2-4	14-20	brackish water; central area almost a stauros due to the much shortened middle striae
Navigiolum canoris	(Hohn & Hellerman) Lange-Bertalot	13-15	3.8–4.8	20-22 strongly radial	several striae alternately shorter and longer; ecology: in rock pools and other ephemeral waters
cryptotenelloides	Lange-Bertalot	9-18	3,7-4,2	16-18	similar to, but thinner & smaller than cryptotenella
notha	Wallace	19-32	4.5-5	15-17	Proximal raphe ends with central pores turned to the primary side of the valve (without the Voigt fault), central pores distinctly offset from the median to the primary side
heimansioides	Lange-Bertalot	30-50	5-6	14-16	Proximal raphe ends with central pores turned to the primary side of the valve (without the Voigt fault), central pores inconspicuous somewhat distant
leptostriata	Jorgensen	25-35	4,5-5,5	16-18	Proximal raphe ends with central pores turned to the primary side of the valve (without the Voigt fault); central pores very close

Navigiolum canoris (Hohn et Hellerman) Lange-Bertalot in Lange-Bertalot, Cavacini, Tagliaventi and Alfinito comb. nov. 2003 1668

Lange-Bertalot, H., P. Cavacini, N. Tagliaventi and S. Alfinito. 2003. Diatoms of Sardinia. Rare and 76 new species in rock pools and other ephemeral waters. Iconographia Diatomologica 12: 1-438. pl. 26, figs. 1-3

Basionym: Navicula canoris Hohn et Hellerman

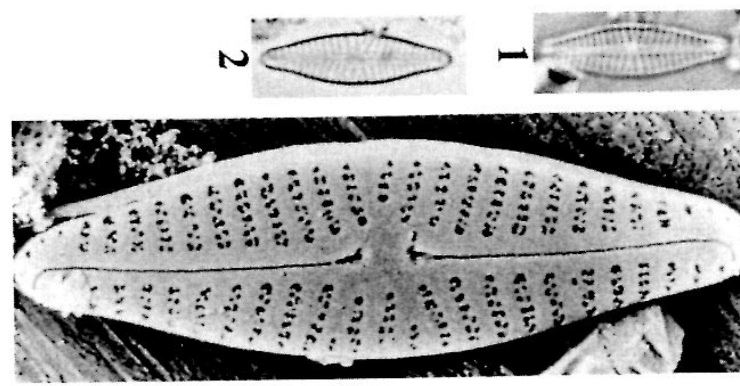
Hohn, M.H. and J. Hellermann, 1963, Transactions of the American Microscope Society 82(3): 250-329 p. 293, fig. 3: 32

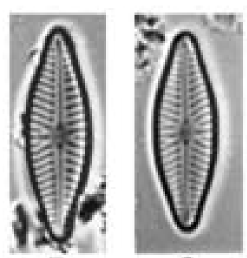
Valid.

Navigiolum canoris (Hohn & Hellerman) Lange-Bertalot nov. comb. [Figs 26: 1-3]

Basyonym: *Navicula canoris* Hohn & Hellerman 1963, Trans. Amer. Micr. Soc. 80, p. 293, fig. 3: 32

Lange-Bertalot in Krammer & Lange-Bertalot 1991b shows a microphotograph (fig. 68: 26) of the holotype and further micrographs (figs 68: 27-30) from other slides containing *Navicula canons* in the collection Hohn & Hellerman. No SEM-studies of *Navicula canons* were possible at this moment, therefore it is not evident but only very likely that it belongs to *Navigiolum* as is confirmed in the case of the presumed synonymous species *N. exiliformis* Reichardt 1988 (see below).



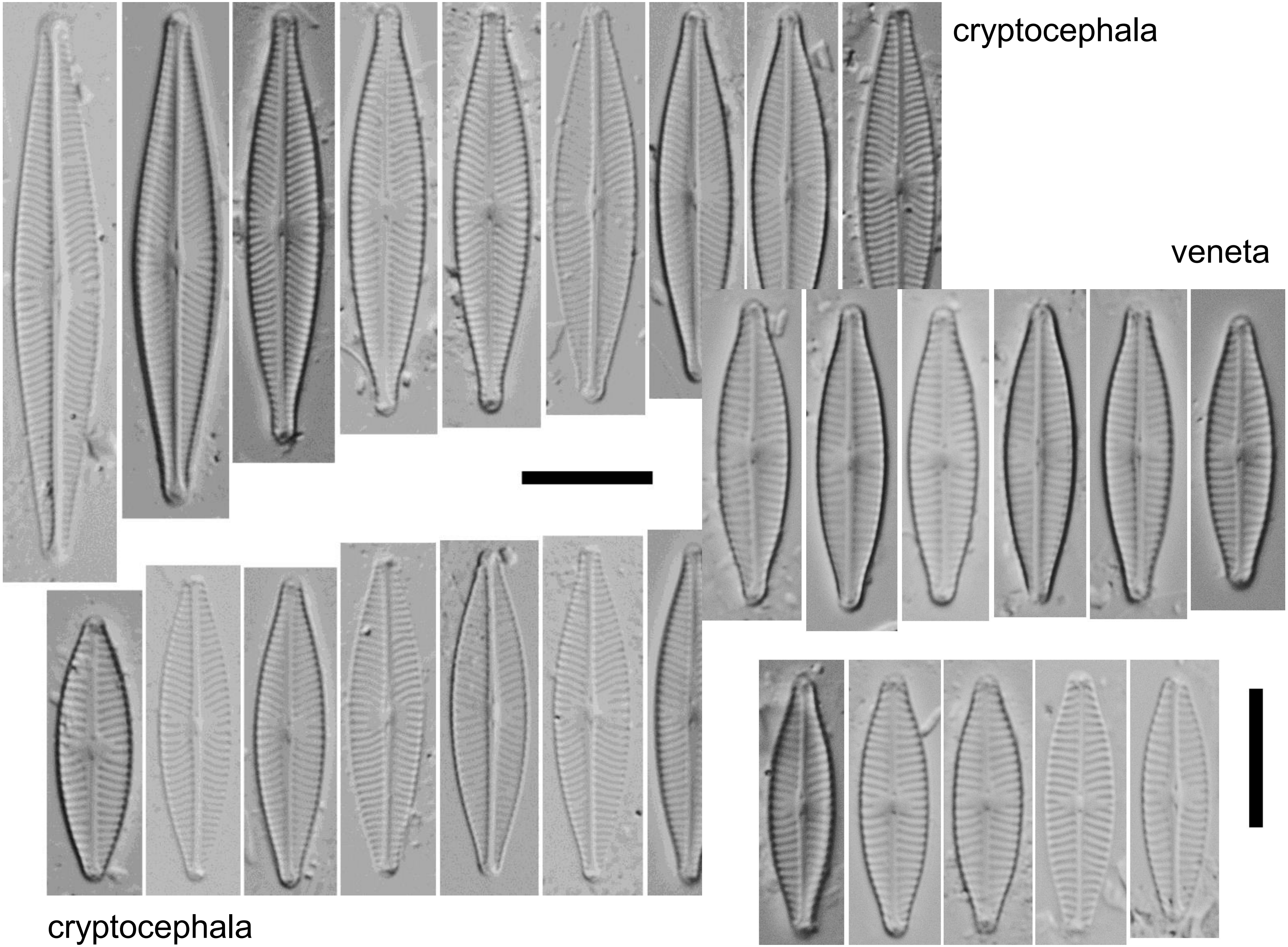


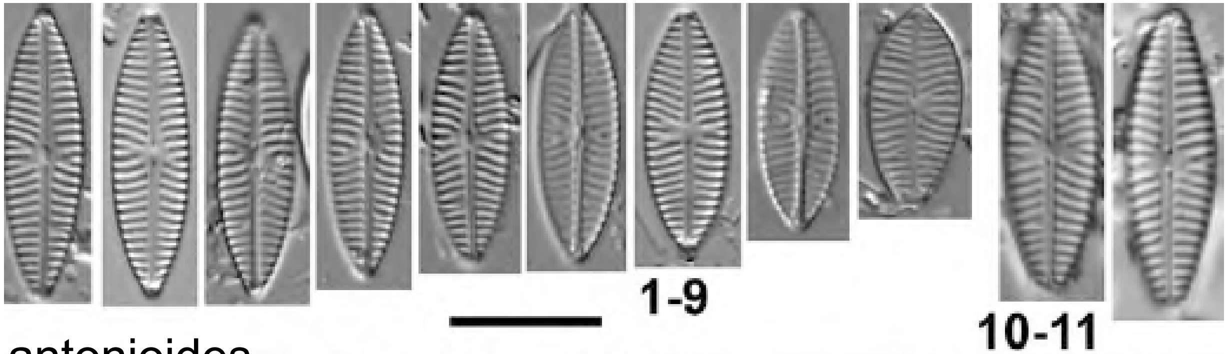
7 8

See Diatom Research 3(2): 237-244

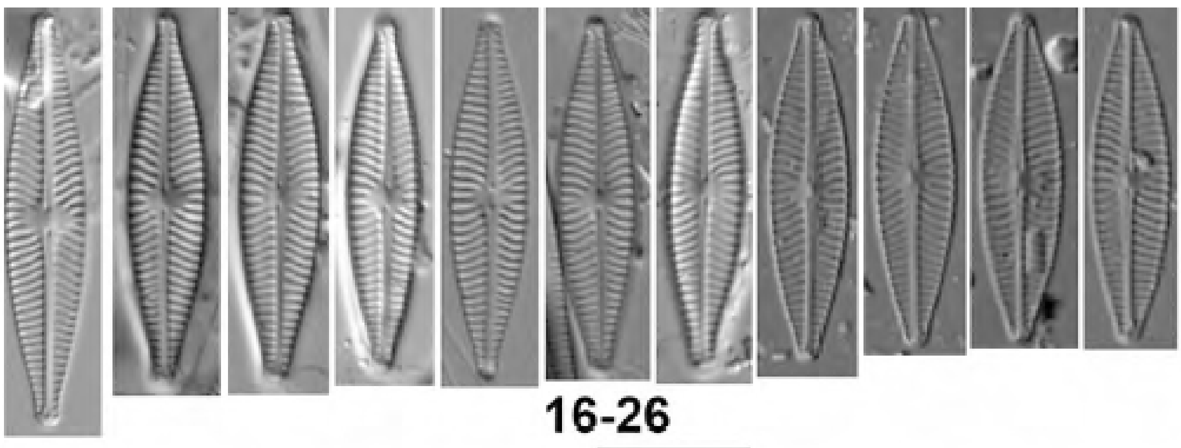
ANSP Diatom New Taxon File
http://symbiont.ansp.org/dntf/gallery.php?g=Navigiolum

The following pictures on the next 2 slides have been copied from:
Bart Van de Vijver International Diatom Workshop Chapter I
(Navicula cryptocephala etc.)
and
Van de Vijver, B., et al. (2010). "Four new Navicula (Bacillariophyta) species from Swedish rivers." Cryptogamie Algologie 31(3): 355-367.


cryptocephala
veneta
cryptocephala



antonioides



ireneae

Modified from the NorBAF2013 working sheet

N.cryptocephala
27x5,7 15str
2654_2

N.cryptocephala
23x5 17str
2750_2

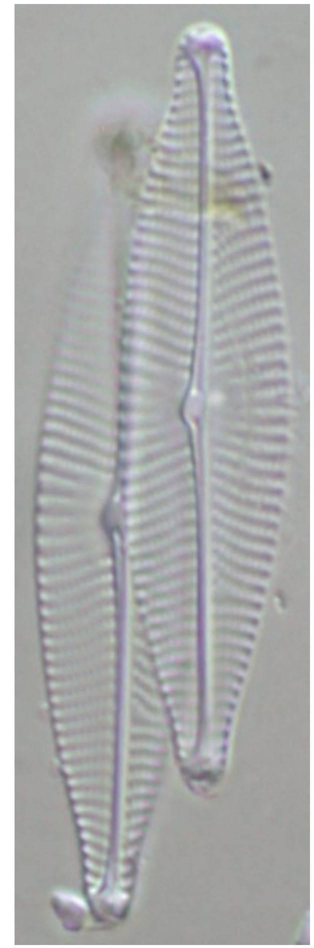
Norbaf intercalibration
2007, sample 3

N. cf. *cryptocephala*

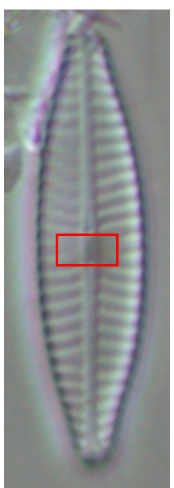
N. reichardtiana

N. cf. *reichardtiana*
(too many striae) 9363

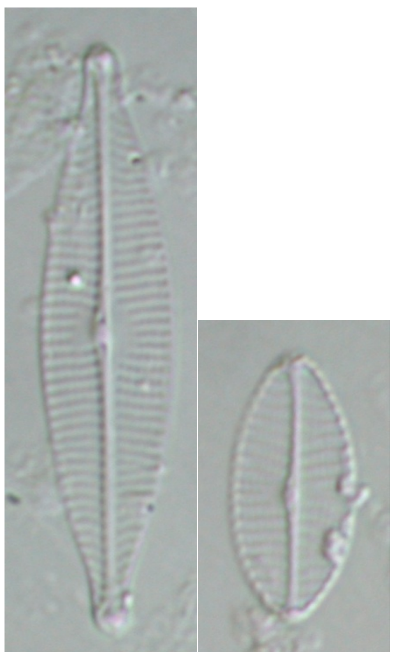
N. ireneae?
24,1x4,7 18str
8985



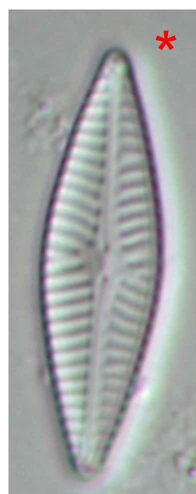
N. germainii
35x,7
7103



N. veneta



N. gregaria

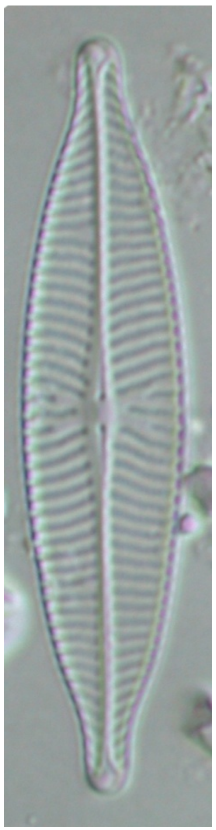


* See next slide

9478 - Navicula cryptotenella
19,2x5,2x16str

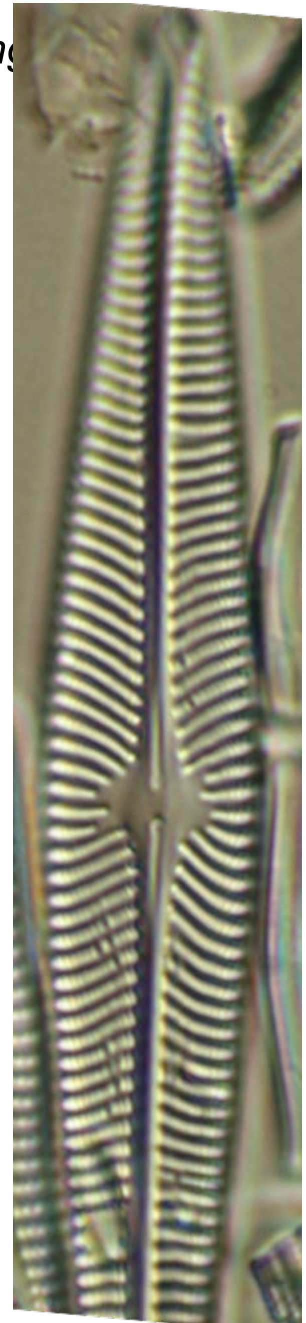
N. antonii

Modified from the NorBAF2013 working

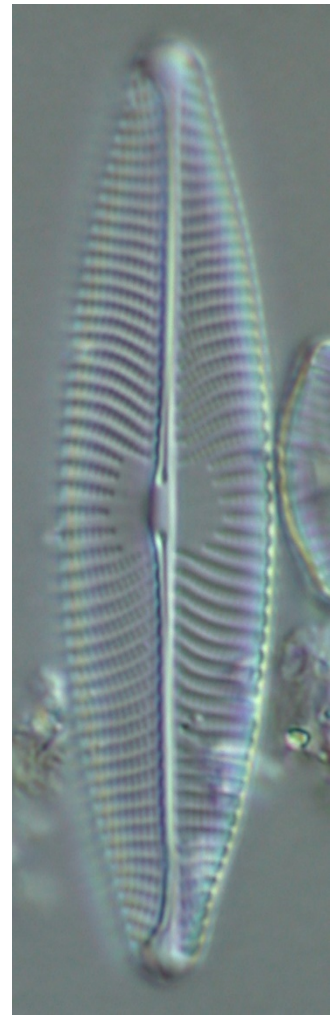


N. capitatoradiata

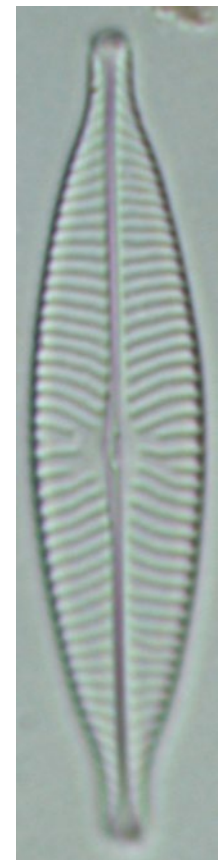
N. trivialis
39,7x9,1 14str
32 pkt. 9358



N. radiosa
70,4x10 12str
4830



N.lanceolata 42x9 3087

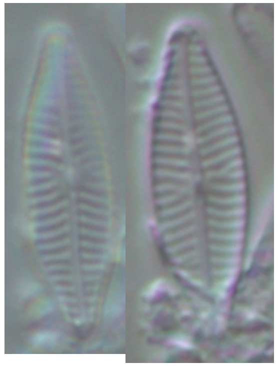


N. capitoradiata
35,9x7,5 14str
1530

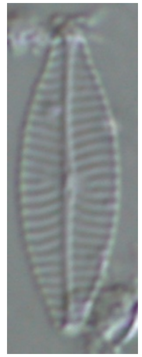
N. subalpina
32,5x6 17str
6122

SLU

caterva
vilaplanii
perminuta
Navigiolum canoris
cryptotenelloides
notha
heimansioides
leptostriata



N. cf caterva
13,6x3,8 21str
3030_32_2



N. cf caterva
13,7x4,4 21str
3063_2

N.vilaplanii
16x3x18str

N. cryptotenella
?x4,1 20str
6138

Nitzschia

Thanks so much to Adrienne Mertens for many diatom pictures and for valuable inputs on the identification of this genus.
Thanks also to Irene Sundberg for valuable input.

Larger Nitzschia

Nitzschia	Author	Figures	Length [µm]	Width [µm]	Length / Width ratio (from published images)	Fibulae / 10µm	Striae / 10µm	Special / typical characters	Ecology
dissipata	(Kützing) Grunow	109:8-13[1]	12.5-85	3.5-5	3.3-7.1	5-11	39-50	"Kiel" in middle of valve	Preferring nutrient rich conditions[1]
media (syn.: dissipata var media (Hantzsch) Grunow)	Hantzsch	109:14-18[1]	No difference given to *N. dissipata*[1]	4-5[1]	8.8-17[3]	No difference given to *N. dissipata*[1]		"Kiel" at the edge of valve, not in the middle.	In contrast to *N. dissipata* also in oligo to mesotrophic conditions[1]
recta	Hantzsch in Rabehorst	110:1-5[1]	35- >100	5-7	13-18	5-8	40-50	Larger than *N. dissipata*	Not fully understood, but up to β-mesosaprobic conditions[1]
bavarica	Hustedt	69:1-4[2]	64-80[2]	3.3-4[2]	17.4-20.9[2]	7.5-10[2]		"no morphological difference to media" [2]	Oligo-dystrophic [2]
oligotraphenta	(Lange-B) Lange-B	109:3-7[1]	30-45[1]	3-3.5[1]		8.5-11.5[1]	46-48[1]	Capitate, linear valves	In calciumrich, oligo to moderate eutrophic lakes; rare in streams but noted from alpine regions
rectiformis	Hustedt	69:5-9[2]	40-58[2]	4-4[2]	10-14.5[2]	6.5-8[2]		Wider than N. bavarica, usually concave valve, less fibulae	Electrolyt-poor conditions

1 Hofmann et al. 2011
2 ICO2 1996
3 SWF 2/21997,1999

Larger Nitzschia

Figures: M. Kahlert

5712

N. recta ?

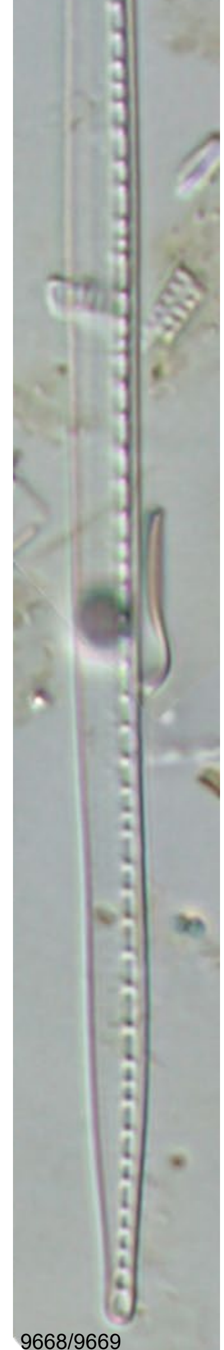
M.Kahlerts pictures from Norbaf2020, sample 2

5791 L54xL4,6 x6 Fib

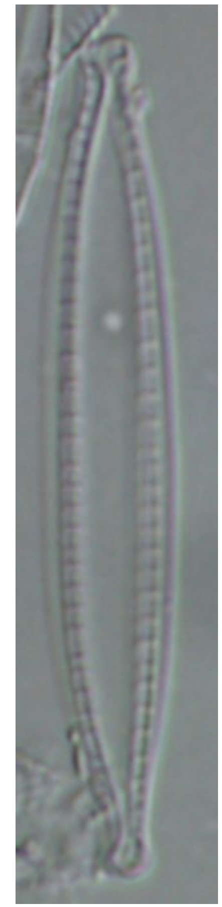
7494 recta L54,6xW6,1 8 fib

9741 media L57xW4x8 fib

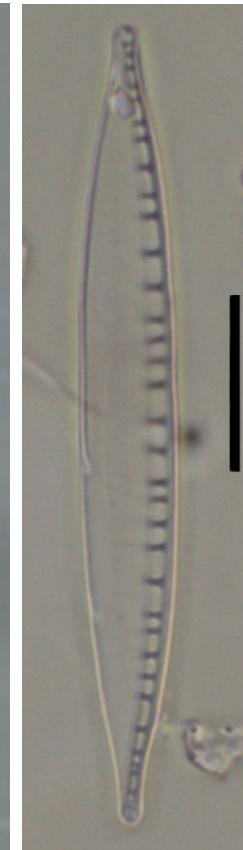
2918 NDIS L35



9668/9669 N.bavarica? I think this is N. media



9782 oligotraphenta L37,2xW4,8x11 fib



N. rectiformis Figure: A.Mertens

Smaller Nitzschia

Nitzschia	**Author**	**Figures**	**Width [µm]**	**Length [µm]**	**Fibulae / 10µm**	**Str / 10 µm**	**Length / width ratio**	**notes**
paleacea	(Grunow) Grunow in Van Heurck	111:21-29 (1)	1.5-4	8-55	14-19	44-55		ZK* (”Zentralknoten”= space between the central fibulae)
archibaldii	L-B	111:30-34 (1)	2-3	15-40	14-19	46-55		IPS 3,8/2 No ZK!
palea var. debilis	(Kützing) Grunow		3* < 3,5**	25-100* (SWF: 15-70)	14-17[f]	≥ 37[f]	≤ 15* (7-14[f])	IPS 3/1, no ZK, wide range from elektrolyt/nutrient-poor streams to electrolytrich/eutrophic lakes[1]
palea var. palea	W.Smith		≥ 3,5	15-70	9-14	28-40[t]	≤ 10[f]	IPS 1/3, no ZK, a-mesosaprobic to polysaprobic waters[1]
gracilis	Hantzsch		2,5-4	30-110[t] if > 70*: = N.gracilis ≠ N. palea	12-18[t]		> 15f*	IPS 3/2, no ZK, oligo- to b-mesosaprobic[3]; valve outline with parallell sides
palea var. tenuirostris	sensu L-B		Habitus overlap of N. palea var. debilis and N. gracilis, therefore unclear separation, therefore not included in the Swedish taxa list					IPS 1/3. Unclear ecology, according to (1) in nutrient rich lakes and large streams

1 Hofmann et al. 2011
2 ICO2 1996
3 SWF 2/21997,1999

Updated from NorBAF2016 working sheet

Smaller Nitzschia

Nitzschia	Author	Figures	Width [µm]	Length [µm]	Fibulae / 10µm	Str / 10 µm	Length / width ratio	IPS / notes
acidoclinata	Lange-B		2,5-3	8-45	10-16	26-32(36)		ZK! As perminuta; oligotrophic, fine
perminuta	(Grunow) M.Peragallo		2,5-3	8-45	10-16	26-32(36)		No ZK! Linear-lanceolate; weakly subcapitate, somewhat concave middle. Oligotrophic
frustulum	(Kützing) Grunow		3-4	5-60	10-16	19-30		ZK, wide / big lanceolate, very thick, heavy, thick striae, always convex??
liebethruthii	Rabenhorst	108:39-45 (1)	2.8-3.2	14-32	12-14	23-25		No ZK (compare N. fonticola), narrowly lanceolate, you can see always areola (points), more coarse than supralittorea, brackish
soratensis (abbreviata in 1)	E.Morales & Vis		2.6–3.2	6.8–13.7	7.9–13.8	27.1–28.7		Linear–lanceolate, very slightly protracted, broad, strictly freshwater
inconspicua (frustulum var. Inconspicua in 1)	Grunow		2.3–3.1	4.1–15.3	8.9–17.0	23.7–30.4		Linear–lanceolate, very slightly protracted, narrow, brackish–marine / euryhaline
supralittorea	Lange-B		2,5-4	10-25	14-18(20)	25-34, visible in LM		No ZK, Linear-lanceolate, Bart: parallel; eutrophic, finer than lieberthrutii and very regular
agnita	Hustedt		2,9-4,6	18-40	13-20	>35		No ZK, lanceolate, you don't see striae, the valves are very tightly together, fibulae on both valves, very convex, high elecrolyte
aequorea	Hustedt		2,9-4,6	18-40	13-20	32-35		No ZK, lanceolate, striae visible, very convex, brackish
lacuum	Lange-B		2-3	10-20	13-18	35-40		No ZK. oligotrophic
fonticola	Grunow in Cleve & Möller	108:9-15 (1)	2.5-5.5	7-46	9-14	24-33	mL/mW 4.35[3]	ZK! Compare N. liebethruthii and N. costei Tudesque, Rimet & Ector 2008 Diat. Res. 23; clear lanceolate valve shape[3]
costei	L.Tudesque, F.Rimet & L.Ector		2.5-4.5[3]	8-45[3]	(7)9-12(13) [3]	23-27[3]	mL/mW 5.38[3]	ZK! linear-lanceolate shape[3]

1 Hofmann et al. 2011
2 ICO2 1996
3 Tudesqueetal2008DiatomResearch23483-501

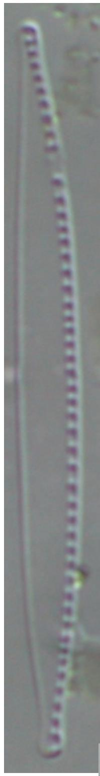
Updated from NorBAF2016 working sheet

SLU

Figures: M. Kahlert

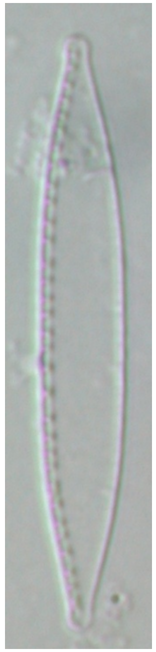
Comment Irene:
Maybe *N.fonticola*?
Reply Maria: NFON should have ZK, what do others think?

2010 archibaldii 21.5x2.3x 16fib no ZK



debilis

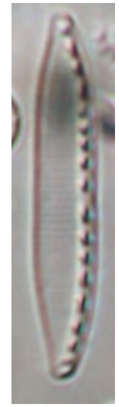
2016 palea var. debilis 22.6x3.4x 14fib no ZK



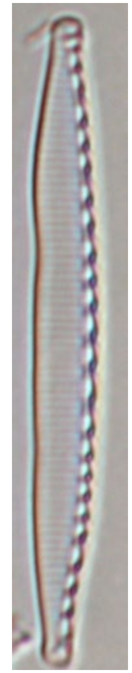
9410 palea 26,4x3,7x13 fib

9413 palea 32,5x4,7x 12 fib

5571 gracilis

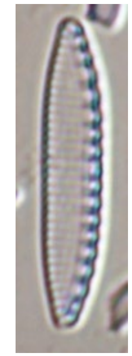


3106 acidoclinata 16,4x2,5x32x10 fib

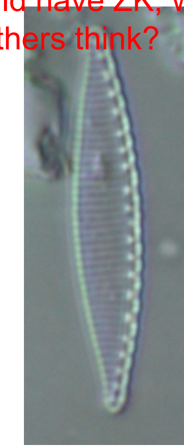


3148 perminuta 29,1x2,9x27

3129 perminuta 17,8x3x28x14 fib



2861 frustulum 13,9x2,7x26x12 fib

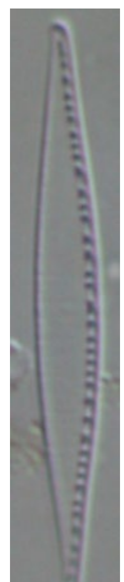


3131 N.cf liebetruthii 16,8x2,8 12 fib, 30str, no ZK?

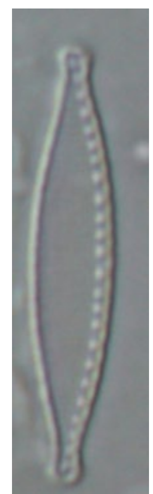
9427 archibaldi

9471 N. supralittorea 15,1x3,3 16 fib, 28str

9442 N. supralittorea 14,8x3,8 14 fib, 30str



2893 N. cf. agnita 26x3



9821 N. agnita-aequorrum complex ("fat lacuum") 19,6x3,7 12 fib

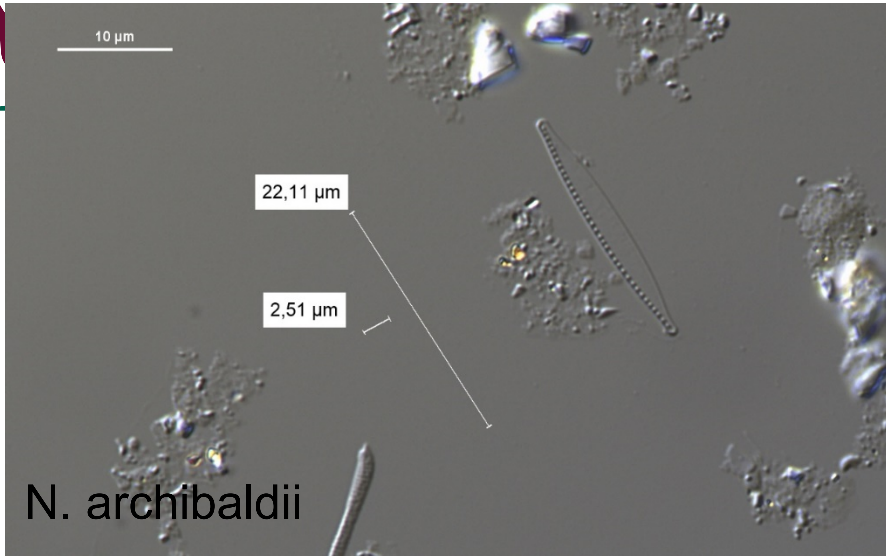
4313 N. lacuum 16,2x2,4 17 fib

2870 N. inconspicua 10x2,6 11 fib, 24str

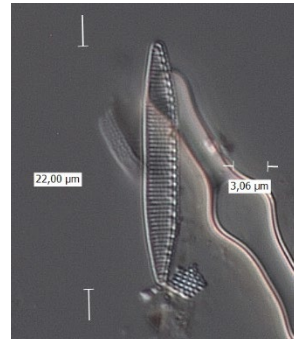
3119 N.soratensis 9,1x2,5 12 fib, 30str

9844 N.fonticola 20,3x3,1x14 fibx30 str ZK

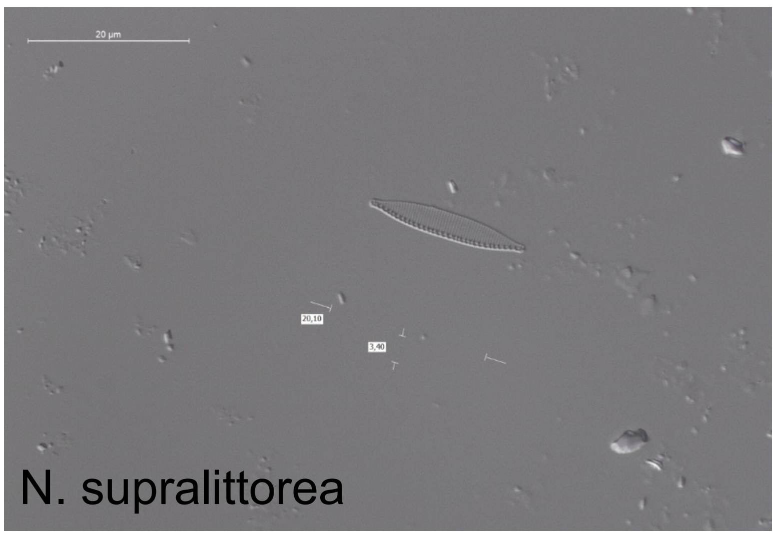
Figures: I.Sundberg



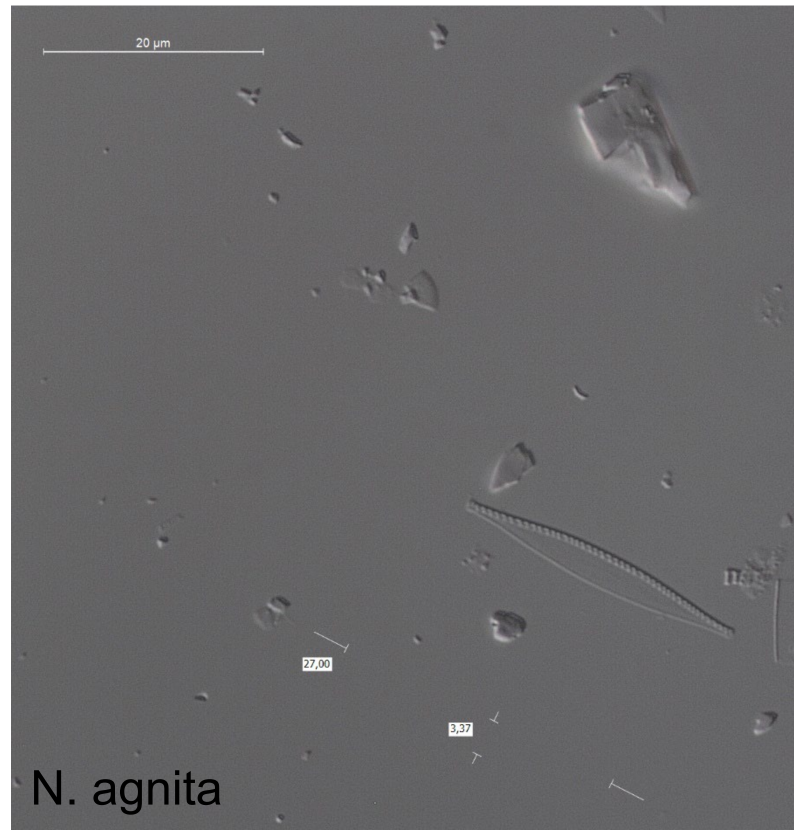
N. archibaldii



N. liebetruthii

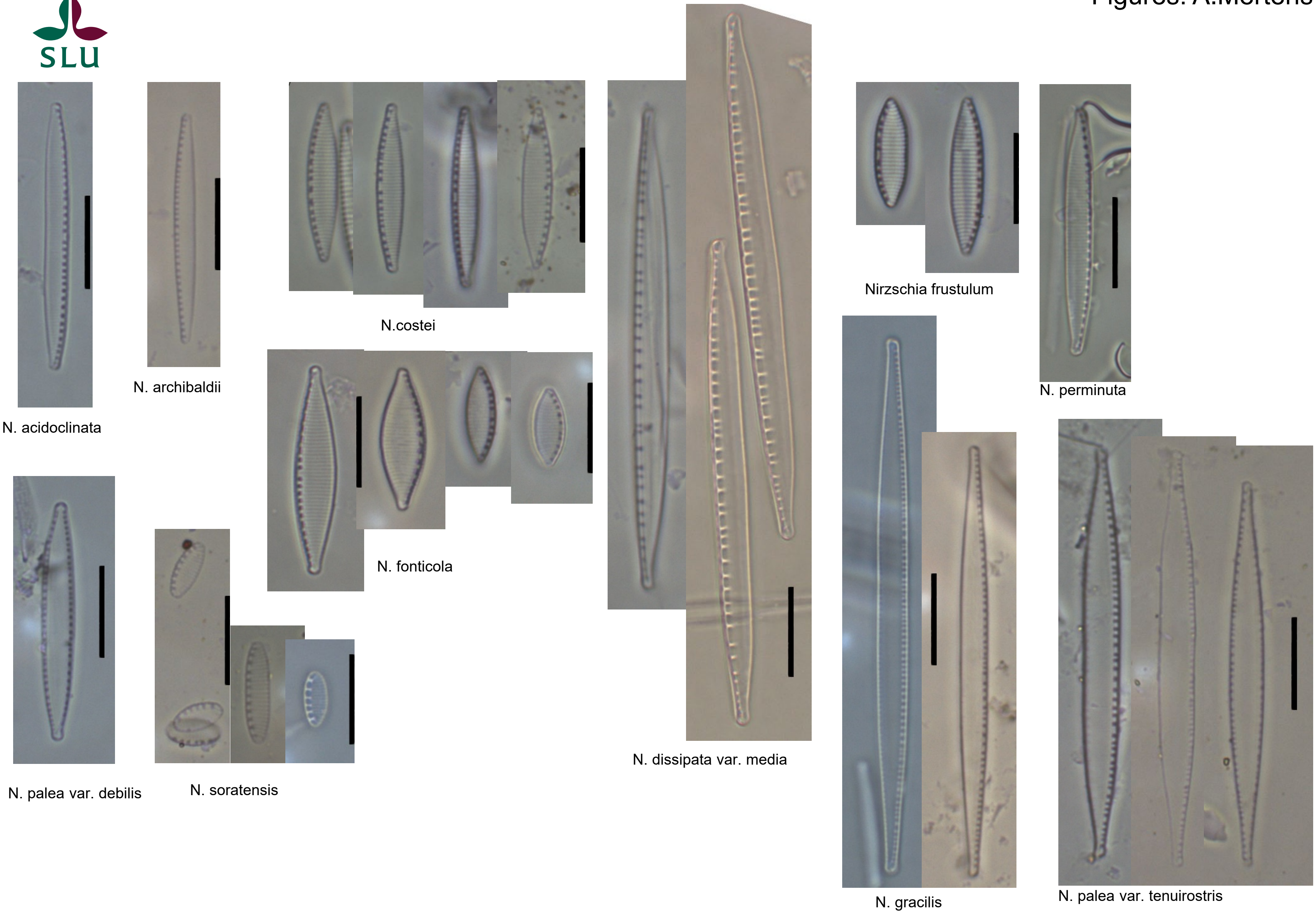


N. supralittorea



N. agnita

Figures: A.Mertens



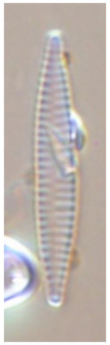
Fragilaria

NorBAF 2020 - sample3
Maria Kahlerts identifications
& corrections after workshop

See Bart Van de Vijver's lecture on sample 3


5500


5515


5527


5532

Fragilaria gracilis
2,2-2,5µmx20-22 str


5525


5517


5649
Cf.

Fragilaria ~~pararumpens~~
31,4x2,9x16

Fragilaria capucina ssp. *rumpens*

= *F. nevadensis*


5500

~~Ev. F. virescens~~ girdle 18 str
= *F nevadensis* girdle!

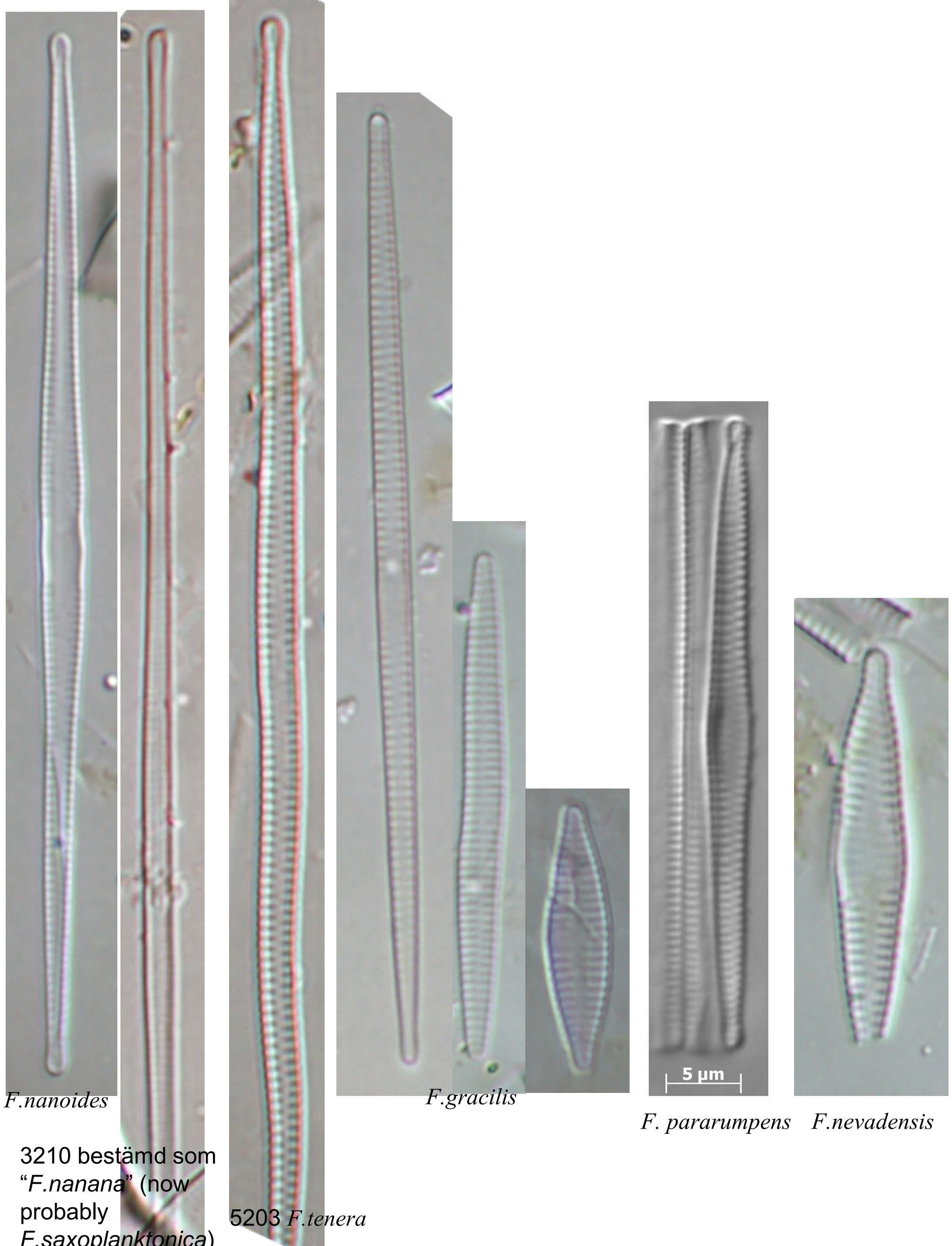
Valve size and features from Krammer and Lange-Bertalot (1991b) and Lange-Bertalot and Metzeltin (1996). $^{+}$ from Tuji and Williams (2006). Additionally features suggested on Nordic-Baltic intercalibration workshops marked with *

Updated table NorBAF2020

FRAGILARIA	author	reference	Length [µm]	Width [µm]	Striae/10µm	colony ?	characterist
F.capucina sensu lato	Desmazieres	SWF 2/3	< 10 - > 100	2-6.5	9-22		taxa fitting into F. capucina sensu latu but nowhere else identified as "FCAPsl"
F.capucina s.str.	Desmazieres	Delgado et al. 2015. Phytotaxa 231:001-18. Tuji & Williams 2006. Taxon 55:193	28-47	3.3-4.2	14-17	yes	"F.capucina s.lat. with colonies" - complex not separable in LM – see Kahlert et al 2019
F.gracilis	Østrup	Tuji 2007, Bull. Natl. Mus. Nat. Sci. Ser. B 33(1):9-12 Lange-Bertalot & Ulrich 2014. Lauterbornia 78:1-73	30-50	ca. 2-3, in SE down to 1.7*	ca. 20* (20-22)	no	opposite, parallel striae; valve form ± linear, short valves getting slight alternating striae & lanceolate form; (*F. aquaplus***: 22-24 str)
F.rumpens	(Kütz.) G. W. F. Carlson	Tuji & Williams 2006, Phycological research, 54: 99-103	25-63	> 3* (3-4, New SWF 3.5-4)	18-20	yes	striae ± alternate, width > 3 µm; pictures: New SWF
F. pararumpens	Lange-Bertalot, G.Hofmann & Werum	New SWF	25-50	2,5-3	16-18	yes	striae alternate; central area quadratic **swelling, subcapitate ends**, needle-formed; pictures: New SWF, SWF3/110-22; DS-BM 8-4-10
F.nevadensis (former *F.capucina* ssp. *rumpens* (Kützing) Lange-Bertalot	Linares Cuesta & Sanchez Castillo	Linares Cuesta & Sanchez Castillo 2007. Diat. Res. 22(1):127-134	30-50 From pictures in ICO2: 23-37	3.5-5 From pictures: 3,3	14-20 (!) From pictures: 18-19	no info	Striae alternate; "weak" ZA; form rhombic with ± **"shoulders"** and heads, pictures: ICO2 7/17-20 [NOT synonym to *F. capucina var rumpens*] (check also: *F. austriaca*: 12-15 str, New SWF)
F.tenera	(W.Smith) Lange Bertalot	Lange-Bertalot & Ulrich 2014. Lauterbornia 78:1-73 Almeida et al. 2016. Phytotaxa 246:163–83	60-120	1.8-2.5	18-20	no	needle shaped, valves linear-lanceolate with only slightly convex margins, subcapitate, striae alternate
*F. saxoplanctonica (*former *F. nanana* sensu Lange-Bertalot (1991)	Lange-Bertalot & S.Ulrich	Lange-Bertalot & Ulrich 2014. Lauterbornia 78:1-73, New SWF	40-170	1.5-2.5	23-28	no	needle shaped, L/B extremely high (38–87), no heads, striae very delicate, see slide 17 for notes on *F.nanana*
F.nanoides	Lange Bertalot	Lange-Bertalot & Metzeltin 1996, p. 55, plate 109, figs 2-6	40-90	1.8-2.4	22.5-23	no	spindle shaped, L/B extremely high, heads, striae more gross than in *F.nanana*
*F.perdelicatissima (*former *F. delicatissima)*	Lange-Bertalot & Van de Vijver	Lange-Bertalot & Ulrich 2014. Lauterbornia 78:1-73	36-95	2.5-2.6	14-16	no	spindle shaped, heads, striae marginal
*F.vaucheriae****	(Kütz.) J.B.Petersen	Wetzel & & Ector 2015. Cryptogamie, Algologie 36:271-89.	14.1-50.4	3.8-5.1	11-14	no	Few striae

***Please note that there are MANY more relatively short taxa than *F. vaucheriae*, which Maria thinks are not separable morphologically by LM, see slide 16 & feel invited to discuss this issue! ** not separable by barcode rbcL from FGRA

F.capucina sensu lato
F.capucina s.str.
F.gracilis
F.rumpens
F. pararumpens
F.nevadensis (former *F.capucina* ssp. *rumpens* (Kützing) Lange-Bertalot
F.tenera
F.nanana sensu Lange-Bertalot (1991)
F. saxoplanctonica
F.nanoides
F.delicatissima
F.vaucheriae
F. austriaca



F.nanoides

3210 bestämd som "*F.nanana*" (now probably *F.saxoplanktonica*)

5203 *F.tenera*

F.gracilis

F. pararumpens

F.nevadensis

Fragilaria

Important: there is a lot of taxonomical work going on within the genus Fragilaria right now – very instable taxonomy for the moment.