



TaxonTableTools tutorial

Version 1.1.x

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TaxonTableTools tutorial

Tutorial data set will soon be available at:

- <https://github.com/TillMacher/TaxonTableTools>

Tutorial data:

- Macrozoobenthos kick-samples from 4 streams Germany
- DNA-metabarcoding data
 - Read table, produced with JAMP (<https://github.com/VascoElbrecht/JAMP>)
 - Taxonomy table, produced with BOLDigger (Buchner & Leese, in review)
- 12 samples
- 5 locations



Getting started with TTT



Install TaxonTableTools:

- <https://github.com/TillMacher/TaxonTableTools>

Installation short guide (see manual for more details):

- Install TaxonTableTools via pip:

```
$ pip3 install taxontabletools
```

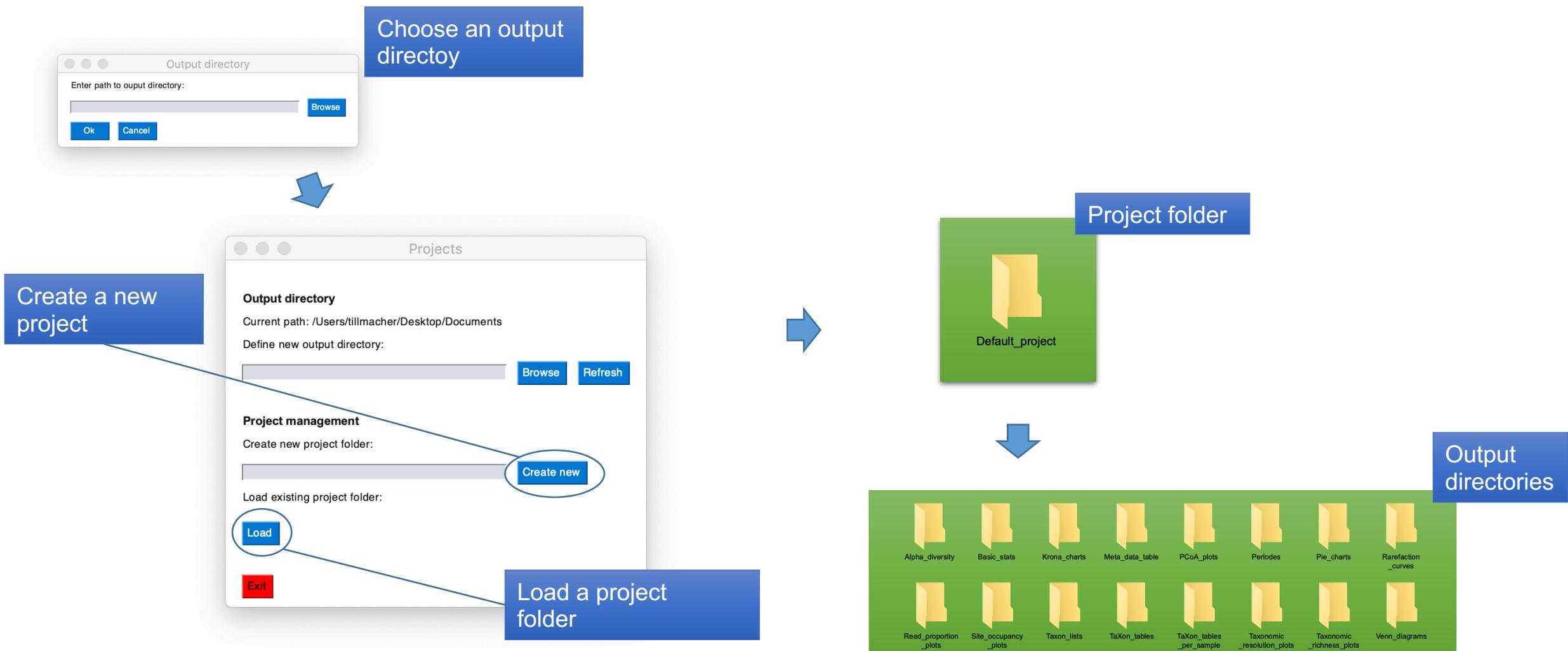
- TaxonTableTools can then be started via:

```
$ python3 -m taxontabletools
```

- Updates can be installed via:

```
$ pip3 install --upgrade taxontabletools
```

Project management



Displays the active project

All tools are found under specific tabs

TaXon tables are specified for each tab separately

Additional information can be found here

Tools are started via the „Run“ button

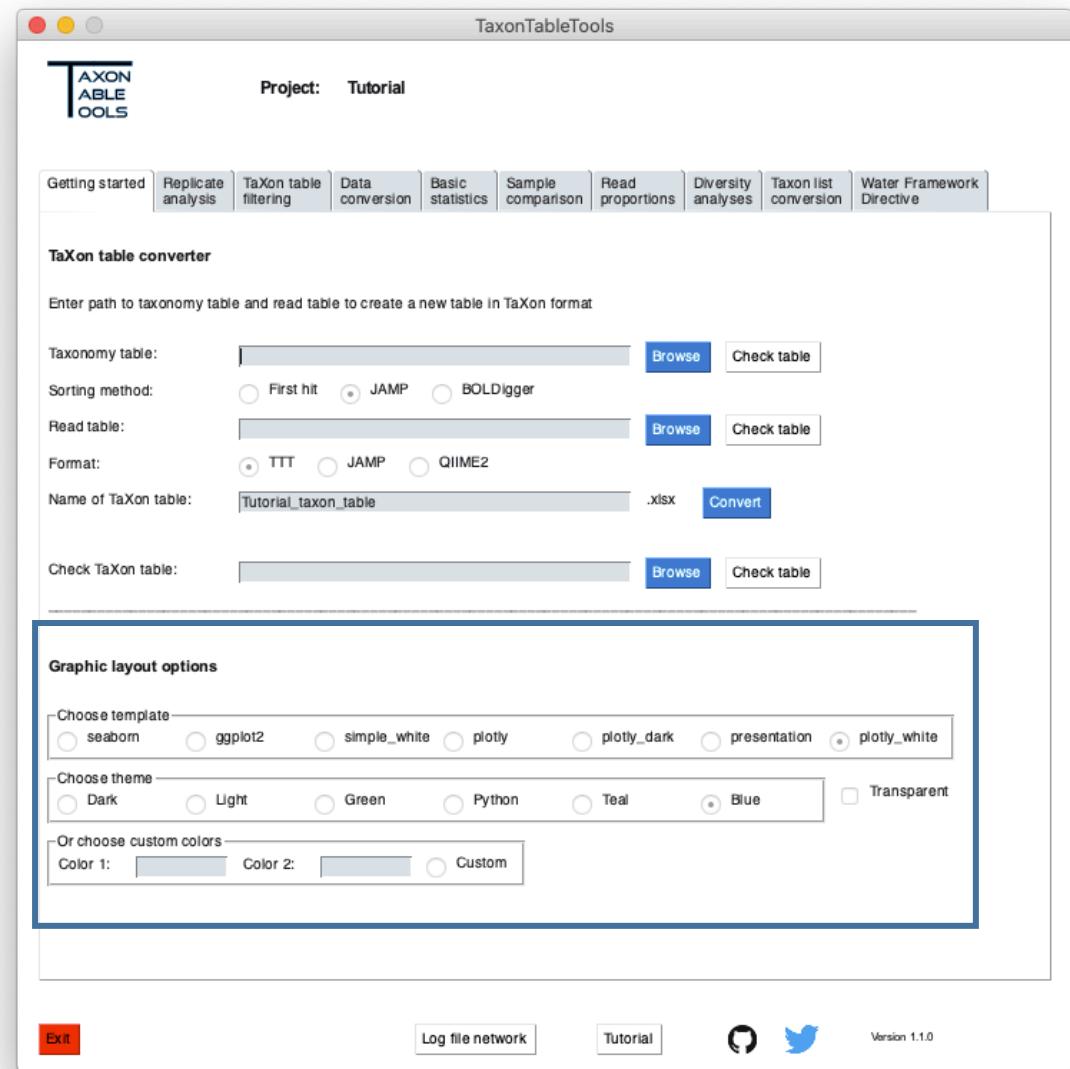


Individual styling

TTT allows the user to individualise the graphics layout

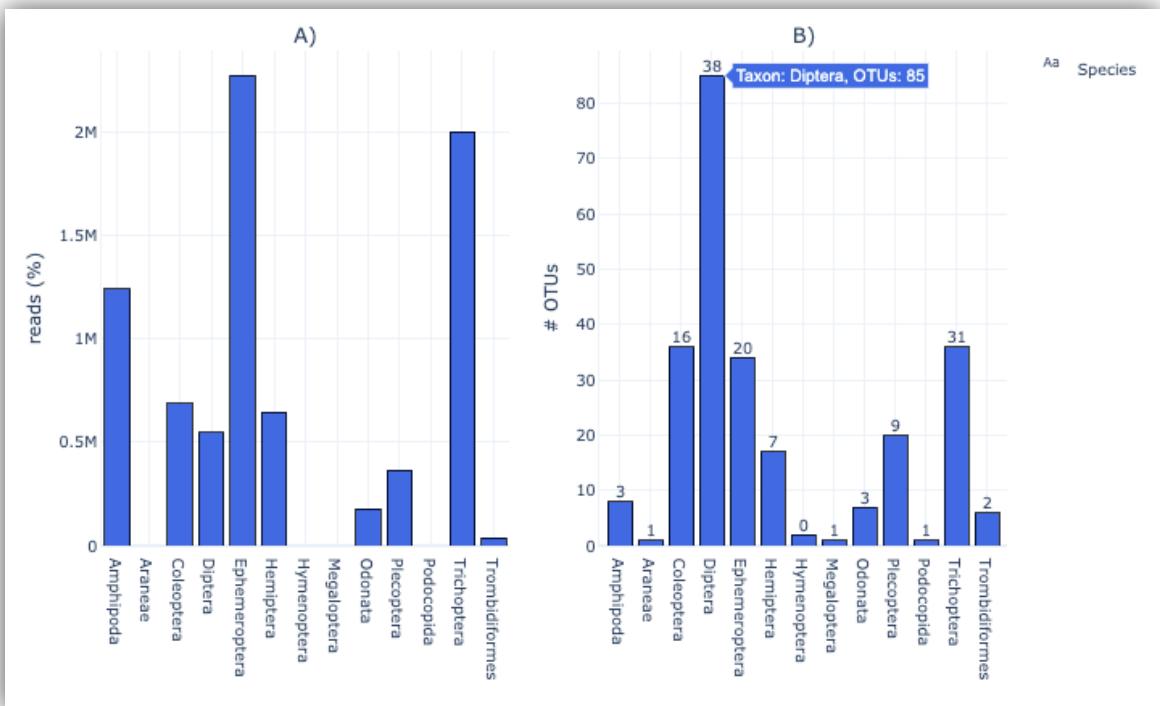
1. Choose a layout template
 - Several well known and widely used plot layouts are available such as “ggplot2” or “seaborn”
2. Choose a colour theme
 - Several pre-defined themes are available
 - Custom primary and secondary colours can be selected
3. Select transparency
 - This will return slightly transparent bars/scatters

The layout options will be applied to every plot that is generated with TTT in this session

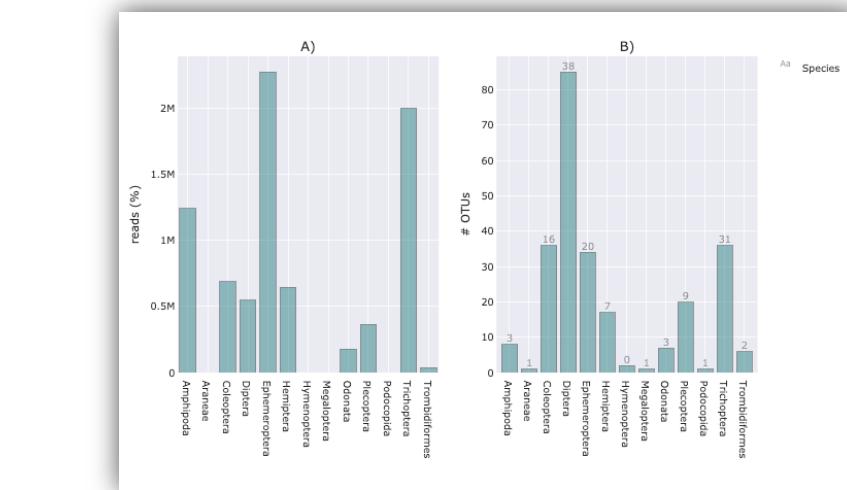
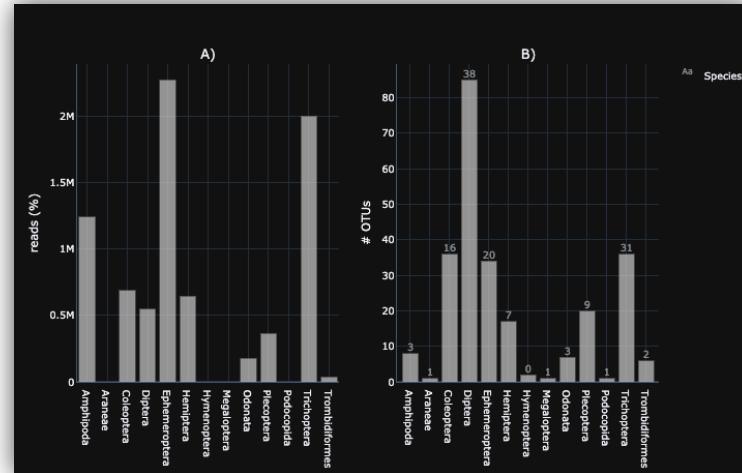


Individual styling

TTT standard



Plotly dark



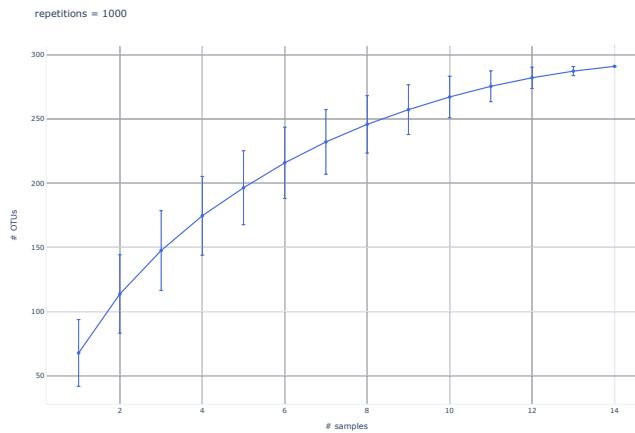
Seaborn

Plot formats

TTT exports plots into two different formats

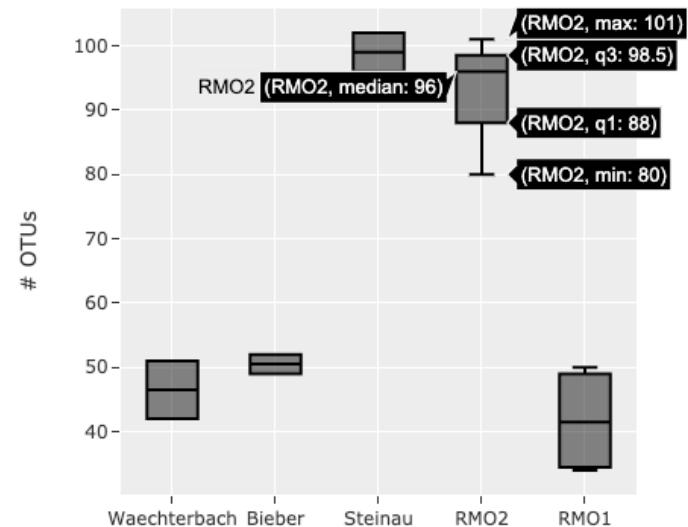
PDF

- Universal format for all kinds of graphics and documents
- These vector-based figures can be imported into any vector-editing software, such as Inkscape or Adobe Photoshop



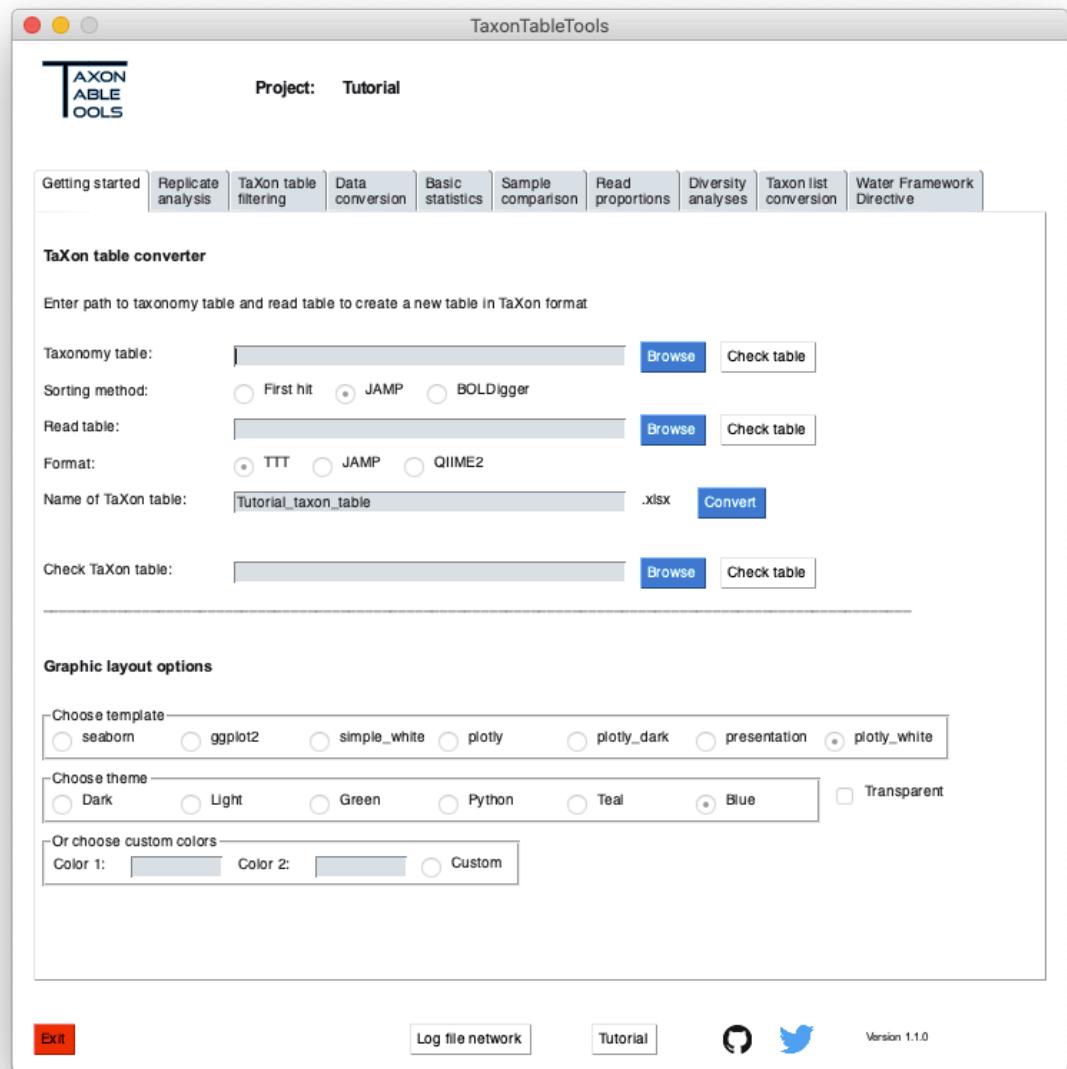
HTML

- This format can be read by any browser and is interactive
- The hovering-mode allows the user to explore the data presented within the plot



Getting started

- TaxonTableTools is based on two table formats
 - **Read table**, containing the read numbers of each OTU for each sample
 - **Taxonomy table**, containing the taxonomic assignment of each OTU
- These two tables are converted to one table, which is called “**TaXon table**”
- TaXon tables can also be manually created. If so, it is recommended to check the table for the correct format



Read table format

IDs = column for
OTU names

Sample names

Sequences = Sequence
of each OTU

Read abundances



Taxonomy table format

IDs = column for OTU names

Taxonomic level column:
Phylum to Species

Species name should consist of
the genus name and epithet

Accepted sheet names:
- JAMP hit
- BOLDigger hit
- First hit

A	B	C	D	E	F	G	H	I
IDs	Phylum	Class	Order	Family	Genus	Species	Similarity	Status
2 OTU_1	Arthropoda	Malacostraca	Amphipoda	Gammaridae	Gammarus	Gammarus pulex	100	Published
3 OTU_2	Arthropoda	Insecta	Hemiptera	Aphelocheiridae	Aphelocheirus	Aphelocheirus aestivalis	100	Private
4 OTU_3	Arthropoda	Insecta	Ephemeroptera	Baetidae	Baetis	Baetis rhodani	100	Published
5 OTU_4	Arthropoda	Malacostraca	Amphipoda	Gammaridae	Gammarus	Gammarus roeselii	100	Published
6 OTU_5	Arthropoda	Insecta	Ephemeroptera	Heptageniidae	Ecdyonurus	Ecdyonurus torrentis	100	Private
7 OTU_6	Arthropoda	Insecta	Ephemeroptera	Ephemeridae	Ephemerina	Ephemerina danica	100	Published
8 OTU_7	Arthropoda	Insecta	Ephemeroptera	Baetidae	Baetis	Baetis rhodani	99,74	Published
9 OTU_8	Arthropoda	Insecta	Trichoptera	Hydropsychidae	Hydropsyche	Hydropsyche pellucidula	100	Published
10 OTU_9	Arthropoda	Insecta	Trichoptera	Hydropsychidae	Hydropsyche	Hydropsyche siltalai	100	Published
11 OTU_10	Mollusca	Gastropoda	Littorinimorpha	Tateidae	Potamopyrgus	Potamopyrgus antipodarum	100	Published
12 OTU_11	Arthropoda	Insecta	Coleoptera	Elmidae	Limnus	Limnus volckmari	100	Private
13 OTU_12	Mollusca	Bivalvia	Venerida	Cyrenidae	Corbicula	Corbicula fluminea	100	Published
14 OTU_13	Arthropoda	Insecta	Trichoptera	Odontoceridae	Odontocerum	Odontocerum albicorne	100	Published
15 OTU_14	Arthropoda	Insecta	Trichoptera	Odontoceridae	Odontocerum	Odontocerum albicorne	100	Published
16 OTU_15	Arthropoda	Insecta	Trichoptera	Limnephilidae	Chaetopteryx	Chaetopteryx fusca	100	Published
17 OTU_16	Annelida	Clitellata	Haplotaxida	Lumbricidae	Eiseniella	Eiseniella tetraedra	100	Private
18 OTU_17	Arthropoda	Insecta	Trichoptera	Sericostomatidae	Sericostoma	Sericostoma personatum	100	Published
19 OTU_18	Arthropoda	Insecta	Coleoptera	Dytiscidae	Oreodytes	Oreodytes sanmarkii	100	Published
20 OTU_19	Arthropoda	Insecta	Odonata	Cordulegastridae	Cordulegaster	Cordulegaster boltonii	100	Private
21 OTU_20	Arthropoda	Insecta	Ephemeroptera	Baetidae	Baetis	Baetis scambus	100	Published

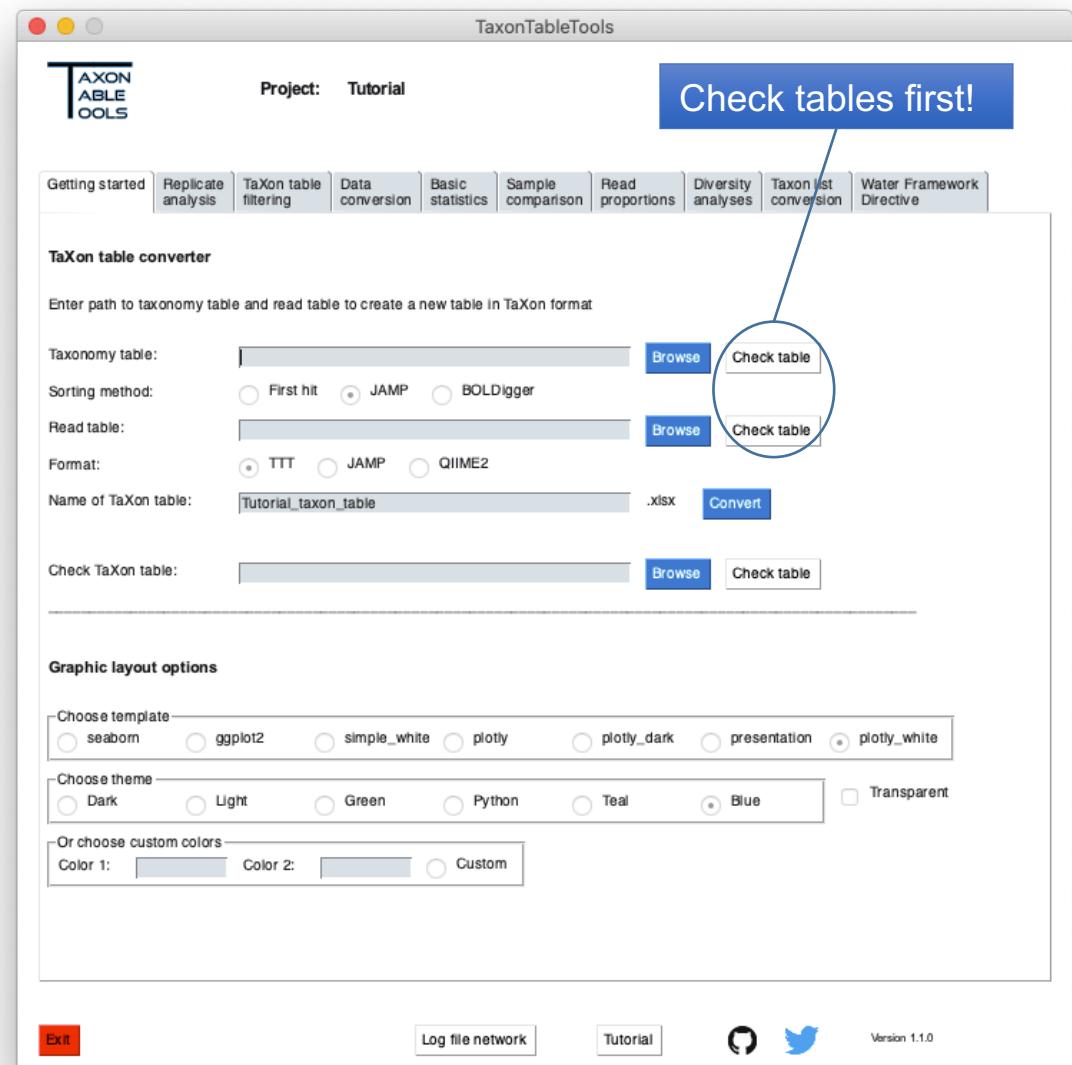
Database hit similarity

Database status

Getting started

TaXon table converter:

1. Browse both tables
2. Check the taxonomy table format
3. Check the read table format
4. Choose a name for the new TaXon table
 - For the tutorial: *TTT* (.xlsx)
5. Convert the tables



Replicate analysis

Load the TaXon table

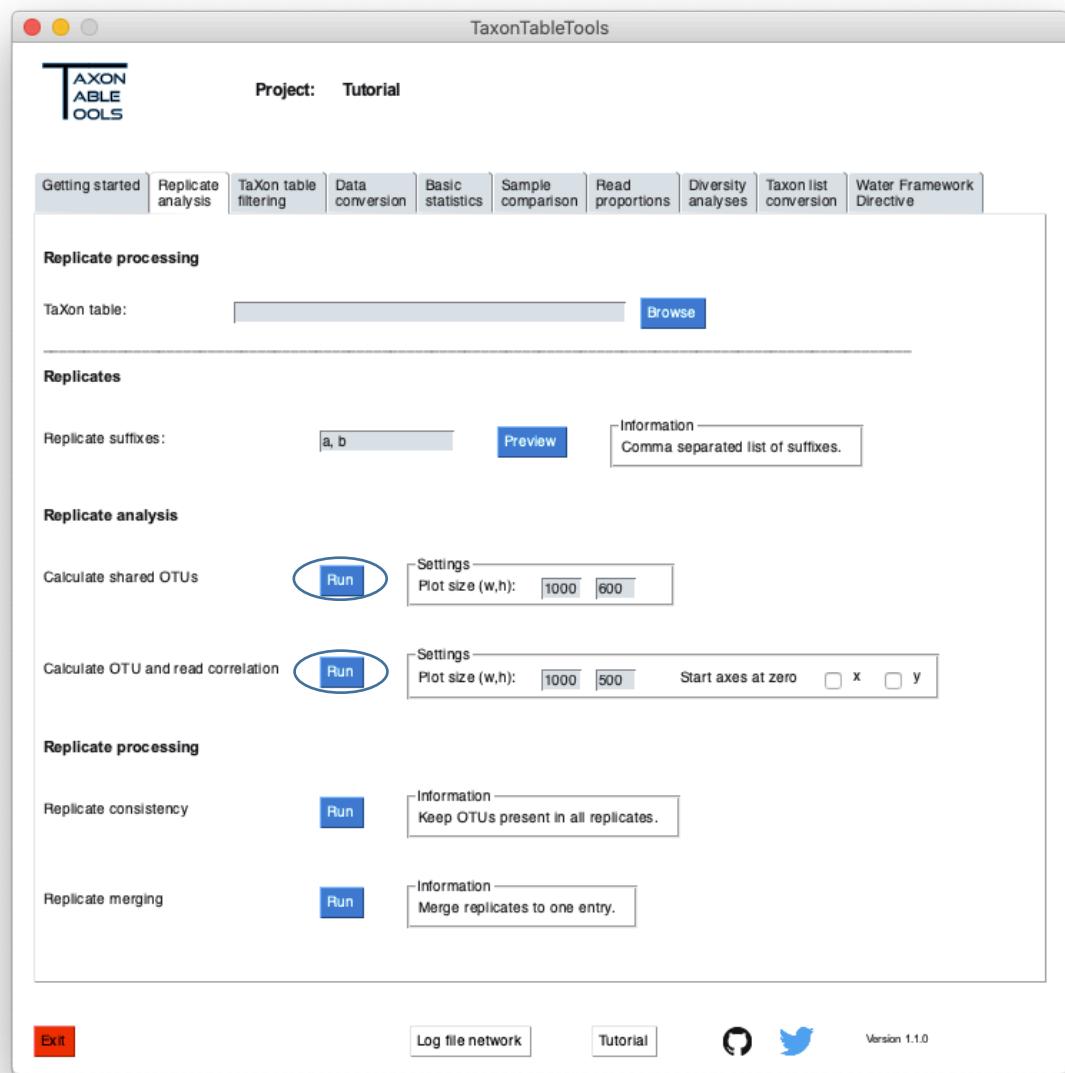
- First load the previously created raw TaXon table (*TTT.xlsx*) by clicking browse

Replicate input format

- Now type the replicate indicators (here: a, b)
- Press „Preview“ to show an example
- When merged the sample will be renamed to „_comb“

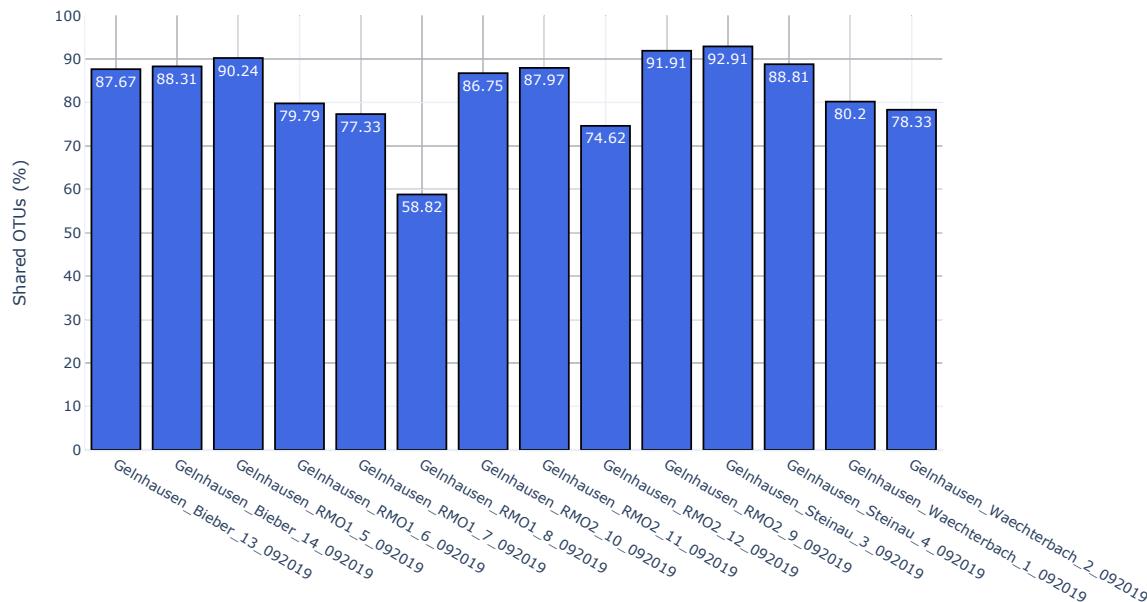
Replicate analysis

- Calculate the shared OTUs between samples
- Calculate the correlation of OTUs and reads between the replicates. This analysis is based on Spearman correlations

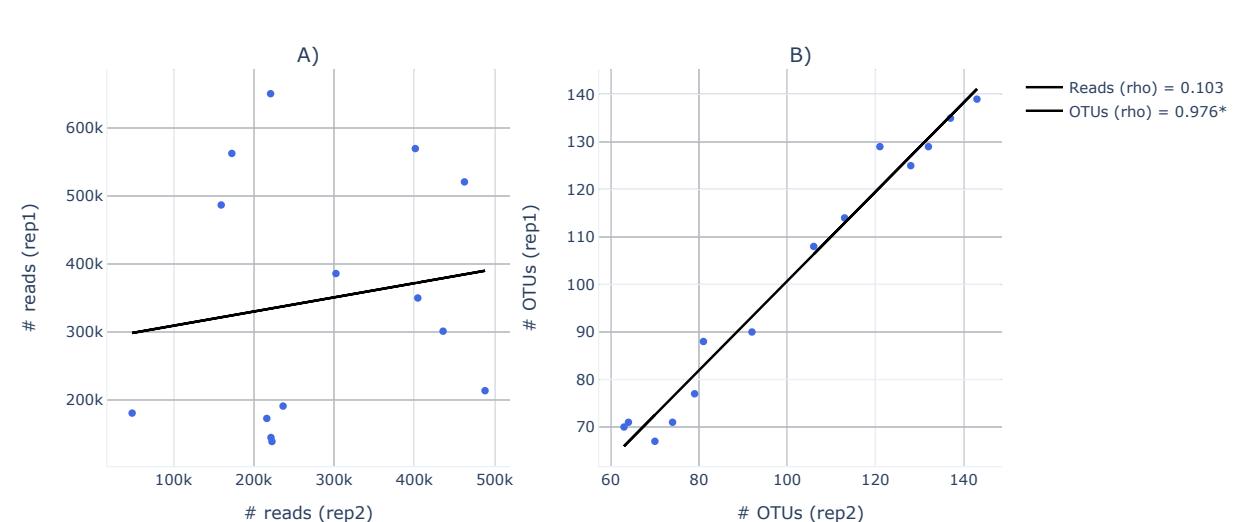


Replicate analysis

Shared OTUs between PCR replicates



Spearman correlation between PCR replicates



Replicate processing

Replicate consistency

- Now it is time to only keep OTUs that are present in both (PCR) replicates
- Run the replicate consistency module
- A new table named *TTT_cons.xlsx* was created

IDs	S1_a	S1_b
OTU_1	1230	2310
OTU_2	233	0
OTU_3	0	95



IDs	S1_a	S1_b
OTU_1	1230	2310
OTU_2	0	0
OTU_3	0	0

The screenshot shows the TaxonTableTools software window with the 'Tutorial' project selected. The 'Replicate processing' tab is active. In the 'Replicates' section, 'Replicate suffixes' are set to 'a, b'. In the 'Replicate analysis' section, 'Calculate shared OTUs' has a 'Run' button and settings for 'Plot size (w,h): 1000 | 600'. In the 'Replicate processing' section, 'Replicate consistency' has a 'Run' button circled in blue, with an information box stating 'Information - Keep OTUs present in all replicates.' Below it, 'Replicate merging' also has a 'Run' button with an information box stating 'Information - Merge replicates to one entry.' At the bottom left is an 'Exit' button, and at the bottom right are links for 'Log file network', 'Tutorial', and social media icons for GitHub and Twitter.

Replicate processing

Replicate merging

- Now load the previously created consistency filtered TaXon table (*TTT_cons.xlsx*)
- Reminder: Each module creates a new table! So, don't forget to always load the latest table**
- Now we want to merge both replicates of all samples
- A new table named *TTT_cons_derep.xlsx* was created

IDs	S1_a	S1_b
OTU_1	1230	2310
OTU_2	0	0
OTU_3	0	0



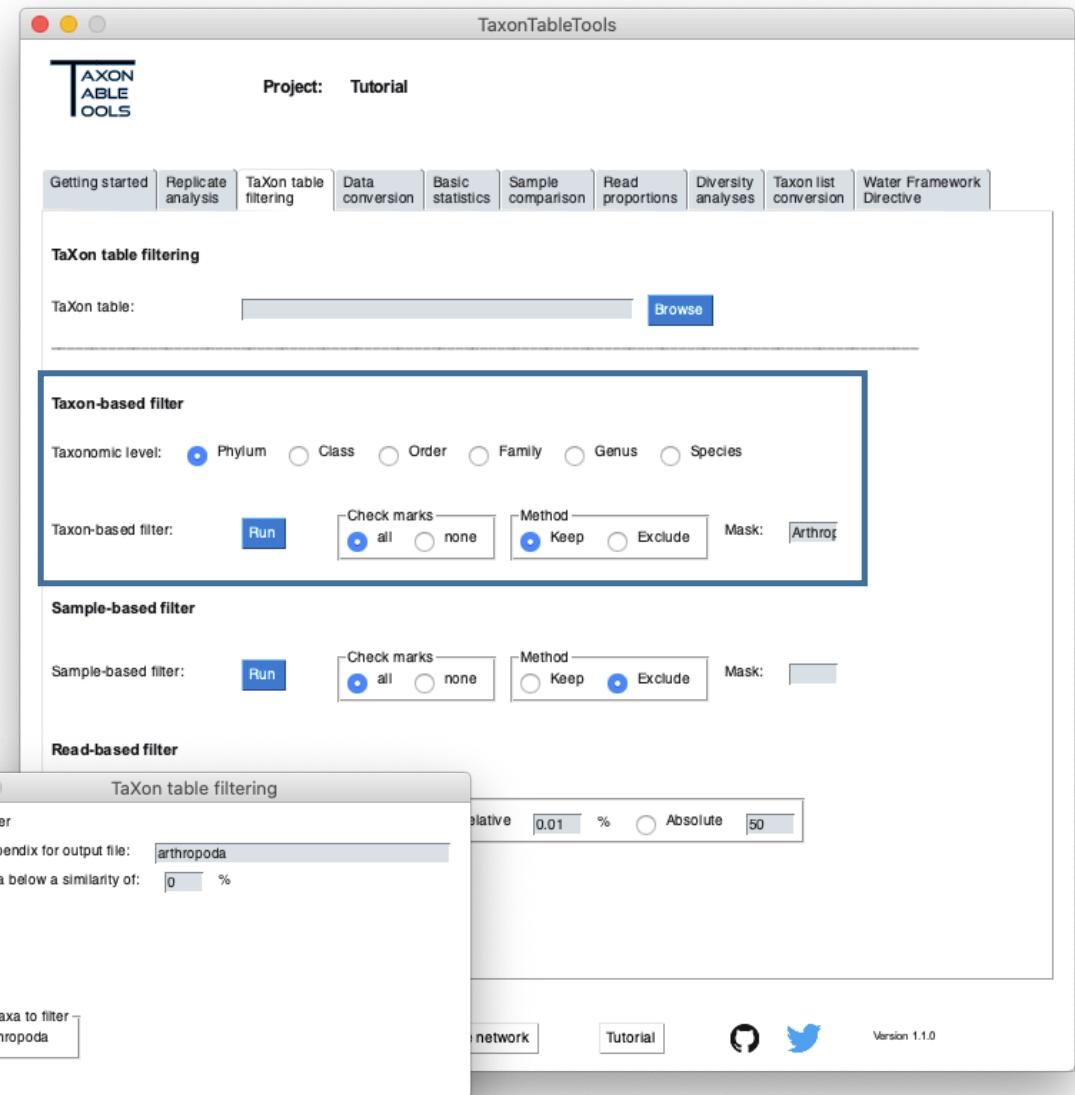
IDs	S1_comb
OTU_1	3540
OTU_2	0
OTU_3	0

The screenshot shows the TaxonTableTools software interface with the 'Tutorial' project selected. The 'Replicate processing' module is active. In the 'Replicates' section, 'Replicate suffixes' are set to 'a, b'. In the 'Replicate analysis' section, 'Calculate shared OTUs' has a 'Run' button and settings for 'Plot size (w,h): 1000 | 600'. In the 'Replicate processing' section, 'Replicate consistency' has a 'Run' button with an information message about keeping OTUs present in all replicates. The 'Replicate merging' button is highlighted with a red oval and has an information message about merging replicates to one entry. At the bottom, there are 'Exit', 'Log file network', 'Tutorial', and social media links for GitHub and Twitter, along with a 'Version 1.1.0' link.

TaXon table filtering

Taxon-based filter

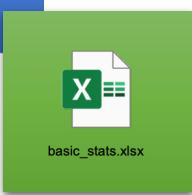
- Since there are lots of non-target taxa present in this dataset, we want to focus on just the arthropods
- Therefore, load the latest TaXon table (*TTT_cons_derep.xlsx*)
- Set the marks to “Phylum”, “all” and “keep”
- Write “Arthropoda” in the mask field (case sensitive!)
- Click on Run and a new window will pop up
- Click Filter
- A new table named *TTT_cons_derep_arthropoda.xlsx* was created, which only includes Arthropoda hits



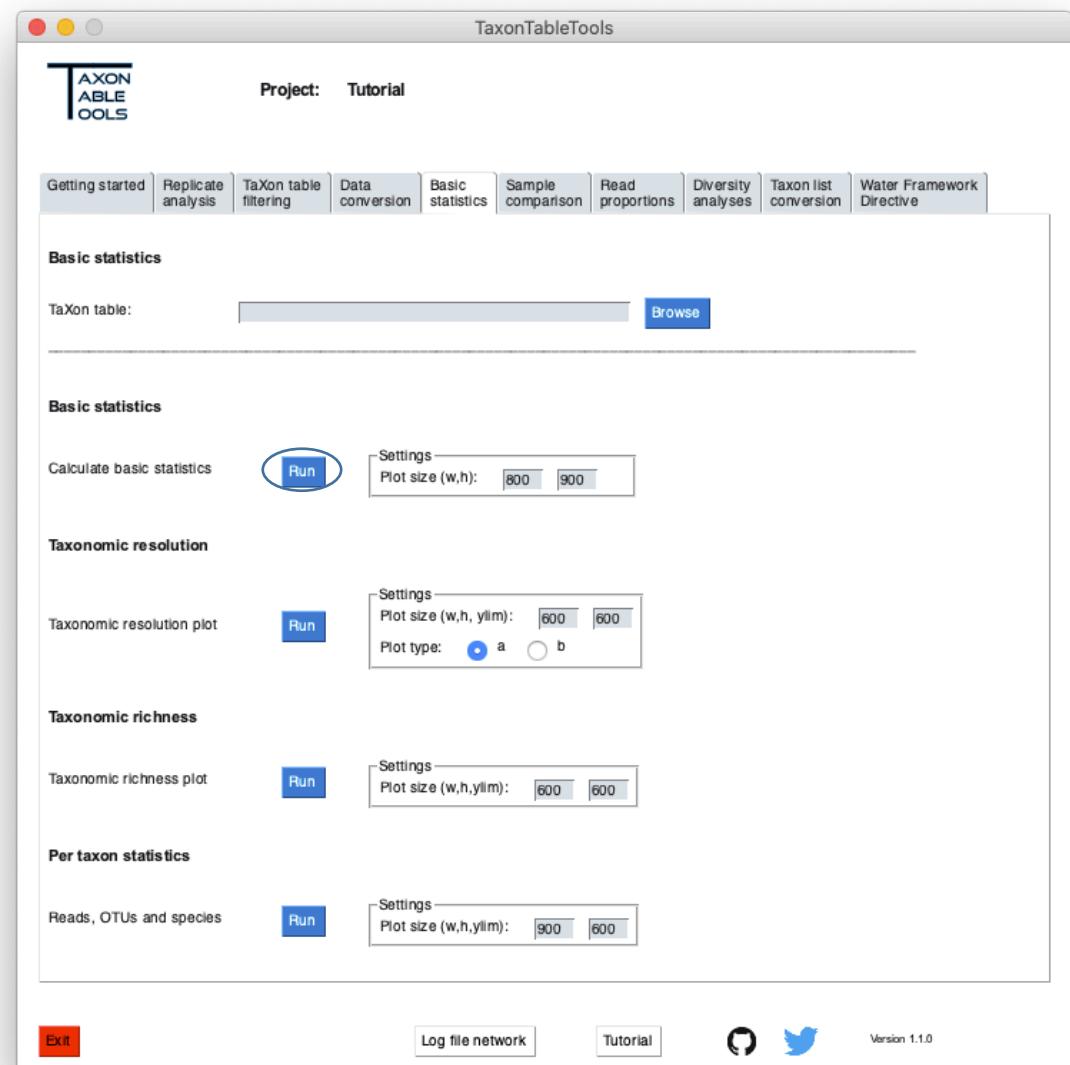
Basic statistics

- To get an overview of the data set we can calculate some basic statistics and plots
- Load the latest TaXon table (*TTT_... arthropoda.xlsx*) in the
- Click on Run
- Two windows will appear after each other:
 1. Three basic plots
 2. A table with useful statistics

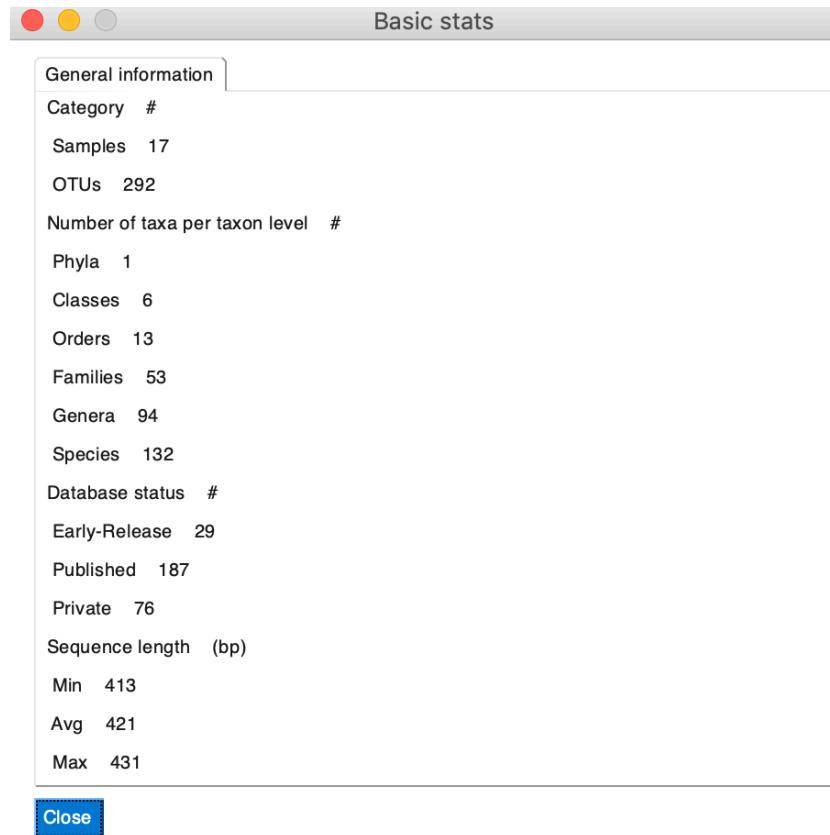
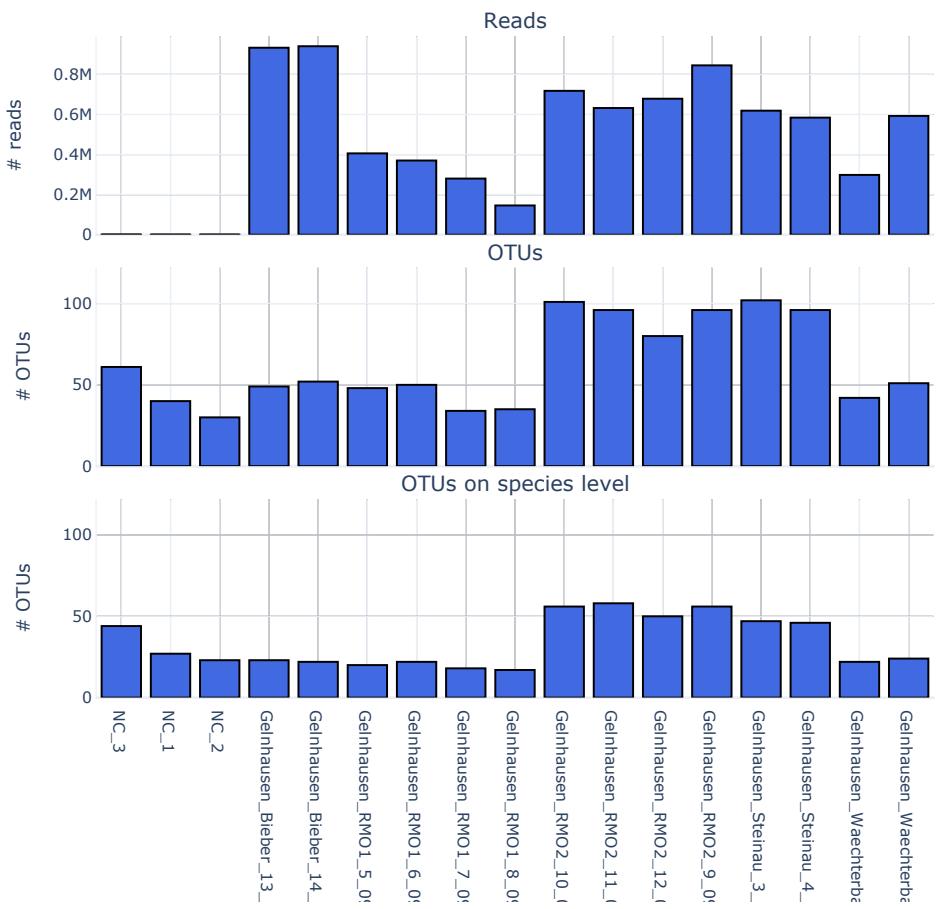
Statistics table



D	E	F	G	H
Sample	avg reads	total reads	n OTUs	n Species
Gelnhausen_Bieber_13_092019_comb	1604	466651	49	23
Gelnhausen_Bieber_14_092019_comb	1616	470354	52	22
Gelnhausen_RMO1_5_092019_comb	697	202958	48	20
Gelnhausen_RMO1_6_092019_comb	636	185120,5	50	22
Gelnhausen_RMO1_7_092019_comb	481	140084,5	34	18
Gelnhausen_RMO1_8_092019_comb	251	72992,5	35	17
Gelnhausen_RMO2_10_092019_comb	1234	359008	101	56
Gelnhausen_RMO2_11_092019_comb	1086	316136,5	96	58
Gelnhausen_RMO2_12_092019_comb	1166	339359	80	50
Gelnhausen_RMO2_9_092019_comb	1452	422607,5	96	56
Gelnhausen_Steinau_3_092019_comb	1064	309528	102	47
Gelnhausen_Steinau_4_092019_comb	1004	292194	96	46
Gelnhausen_Waechterbach_1_092019_comb	513	149179	42	22
Gelnhausen_Waechterbach_2_092019_comb	1019	296444,5	51	24
Total reads		4022617		



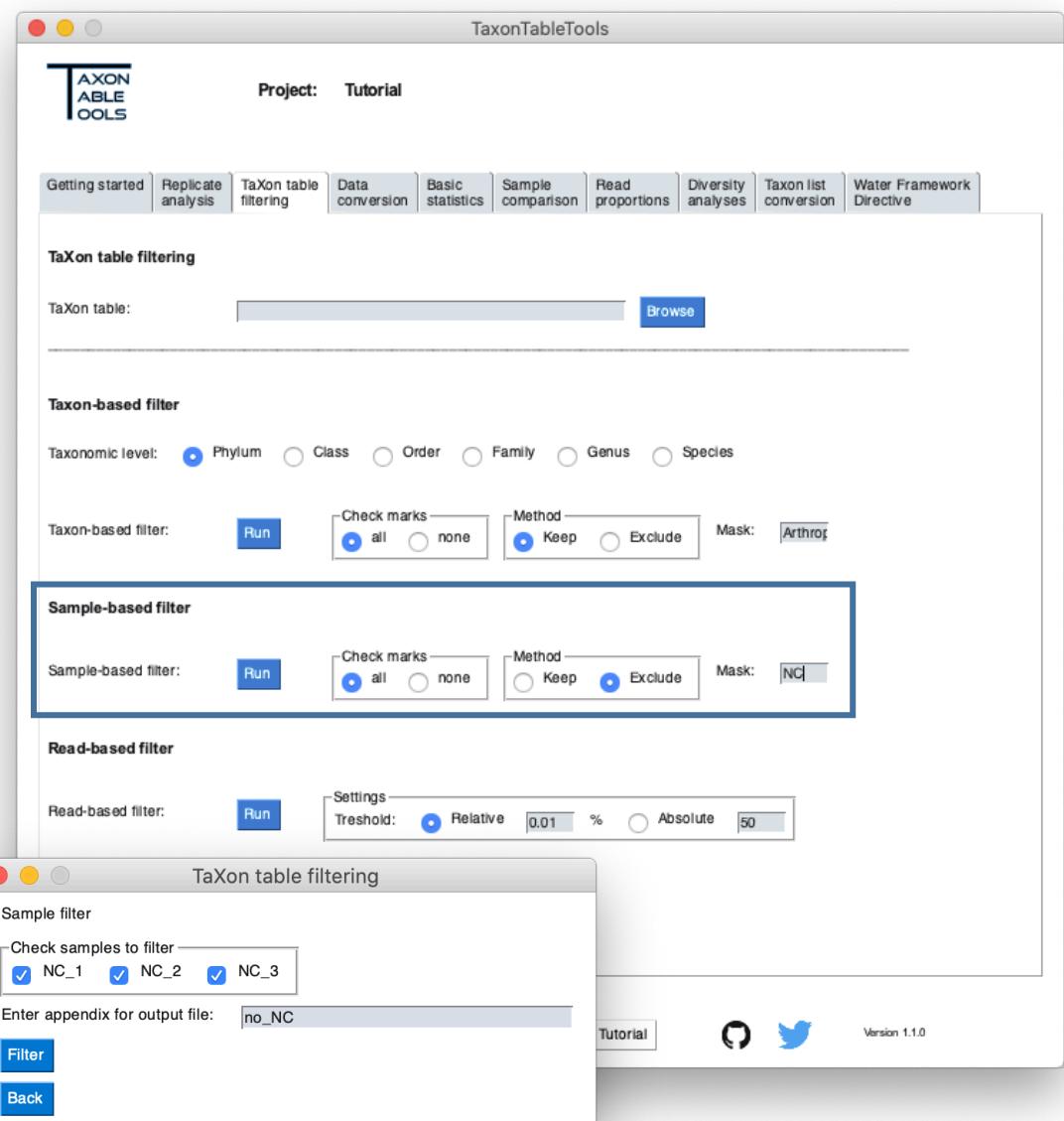
Basic statistics



TaXon table filtering

Sample-based filter

- Now we want to remove the negative controls from the data set
- Load the latest TaXon table (*TTT_..._arthropoda.xlsx*)
- Set the marks to “all” and “exclude”
- Write “NC” in the mask field (case sensitive!)
- Click on Run and a new window will pop up
- All three negative controls are check marked
- Enter a new appendix name (e.g.”no_NC“)
- Click Filter
- A new table named *TTT_cons_derep_arthropoda_no_NC.xlsx* was created



TaXon table filtering

But what if it's easier to filter my samples via Excel?

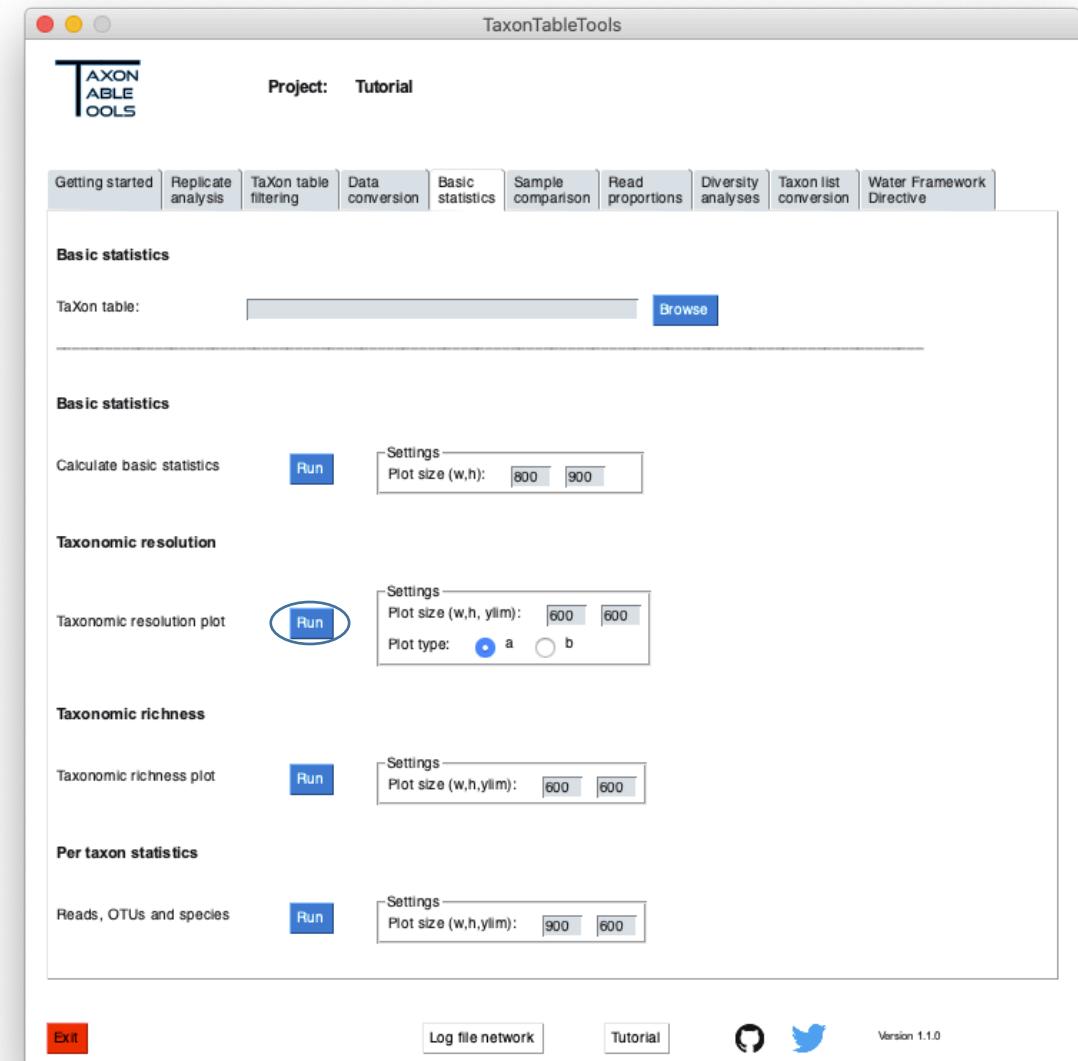
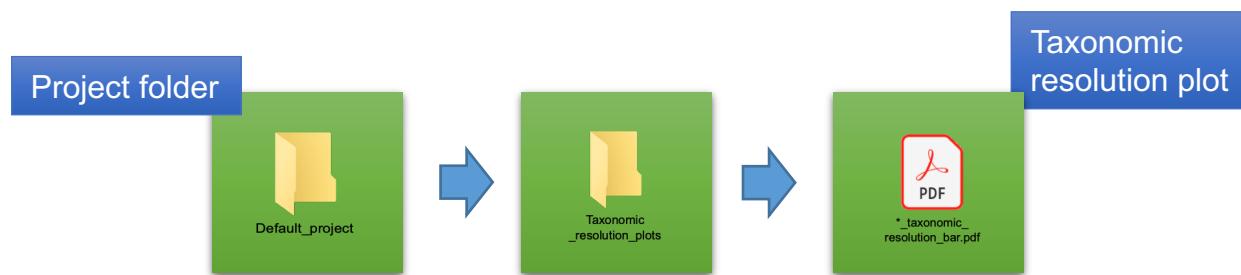
- This is also possible but can lead to biased analyses!
- Example:
 - Deleting samples by simply removing the column can lead to OTUs that are not present in the dataset anymore (i.e. 0 reads in all remaining samples)
 - The TaXon table format expects that if an OTU is present in the table, it is also represented by at least one sample!

Solution

- Prepare your TaXon table as desired
- Now use the „Check TaXon table“ function
- All OTUs that were only present in the deleted samples will be removed from the dataset

Taxonomic resolution

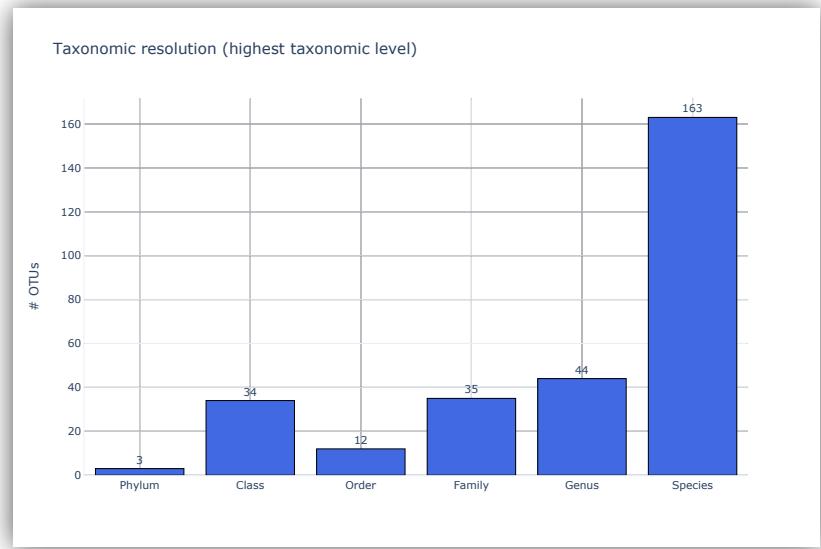
- Now we can check the taxonomic resolution of the data set
- Load the latest TaXon table (*TTT_cons_derep_arthropods_no_NC.xlsx*)
- Click on Run (repeat for plot type „b“)
- A new plot was created in the *Taxonomic_resolution_plots* folder



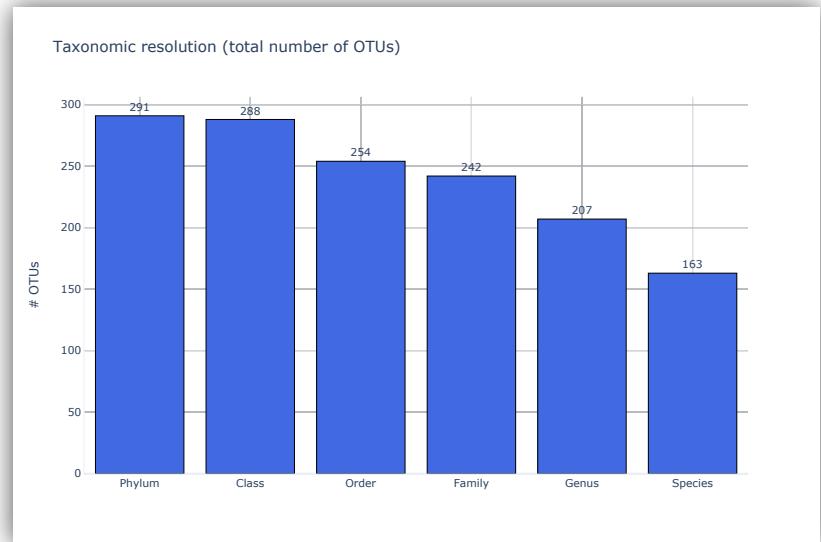
Taxonomic resolution

- Taxonomic resolution shows the highest level to which an OTU was identified
- In this case 3 OTUs could only be identified on phylum level
- Respectively 34 OTU were identified to class level
- And 163 were identified to species level

Plot a)

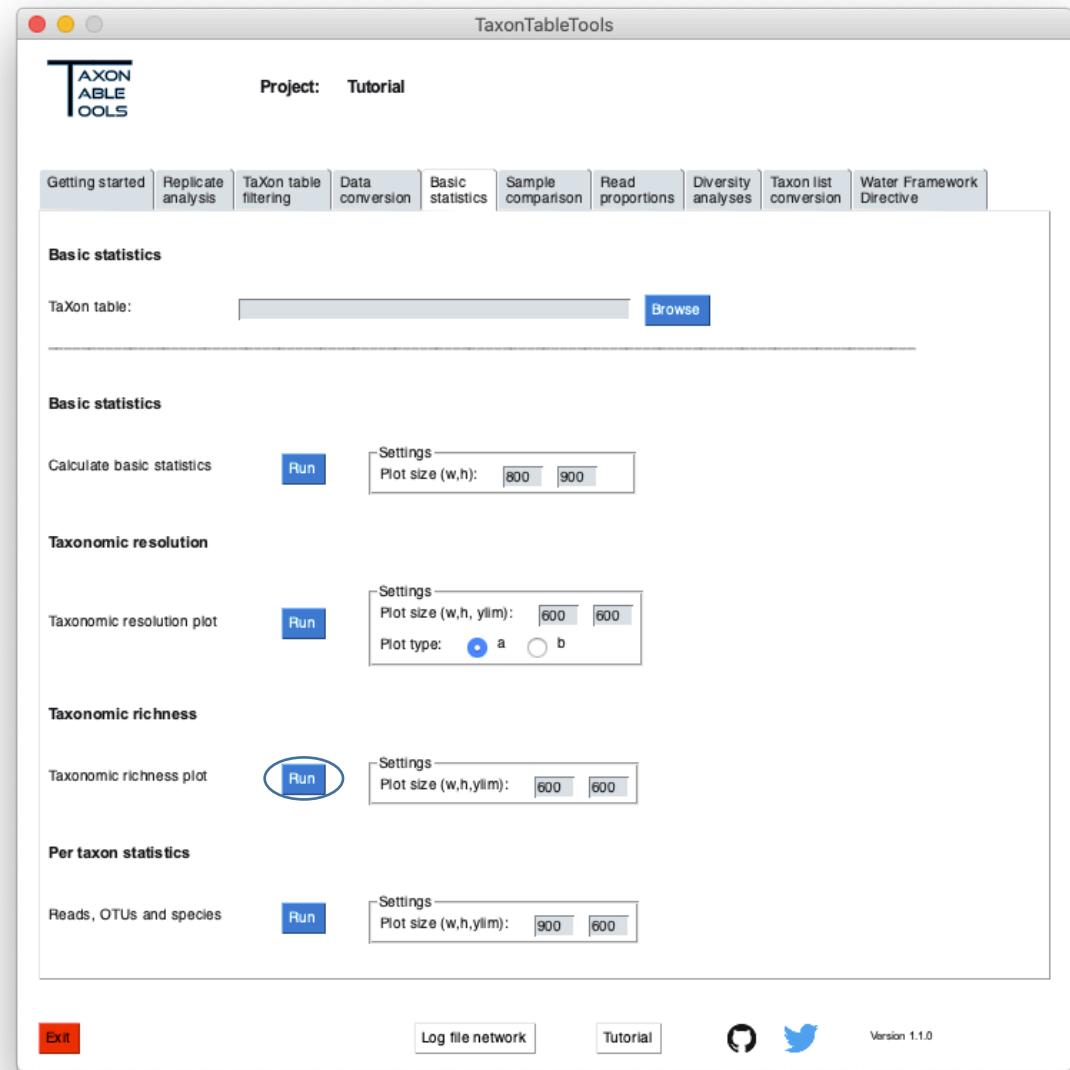
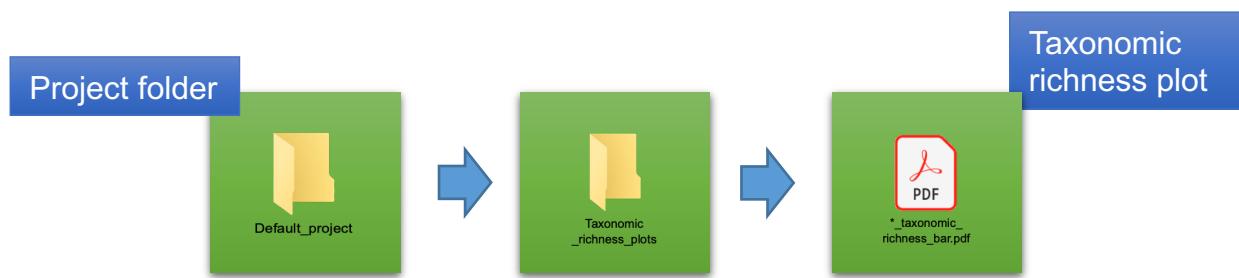


Plot b)



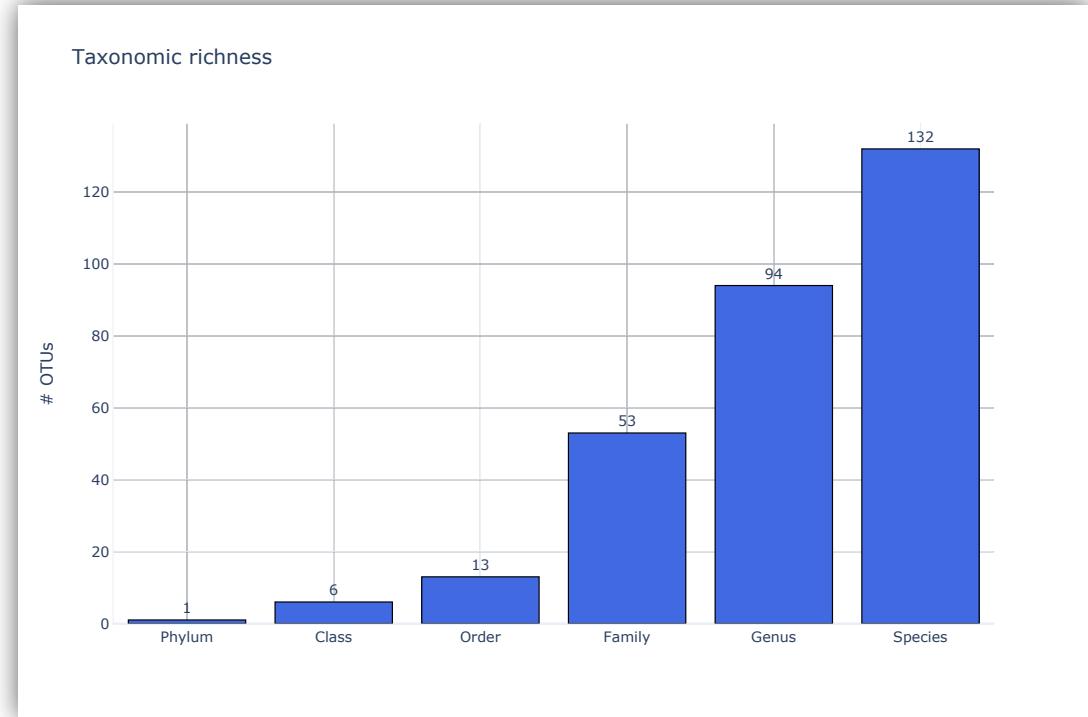
Taxonomic richness

- Now we can check how many taxa are present in the data set
- Load the latest TaXon table (*TTT_cons_derep_arthropods_no_NC.xlsx*)
- Click on Run
- A new plot was created in the *Taxonomic_richness_plots* folder



Taxonomic richness

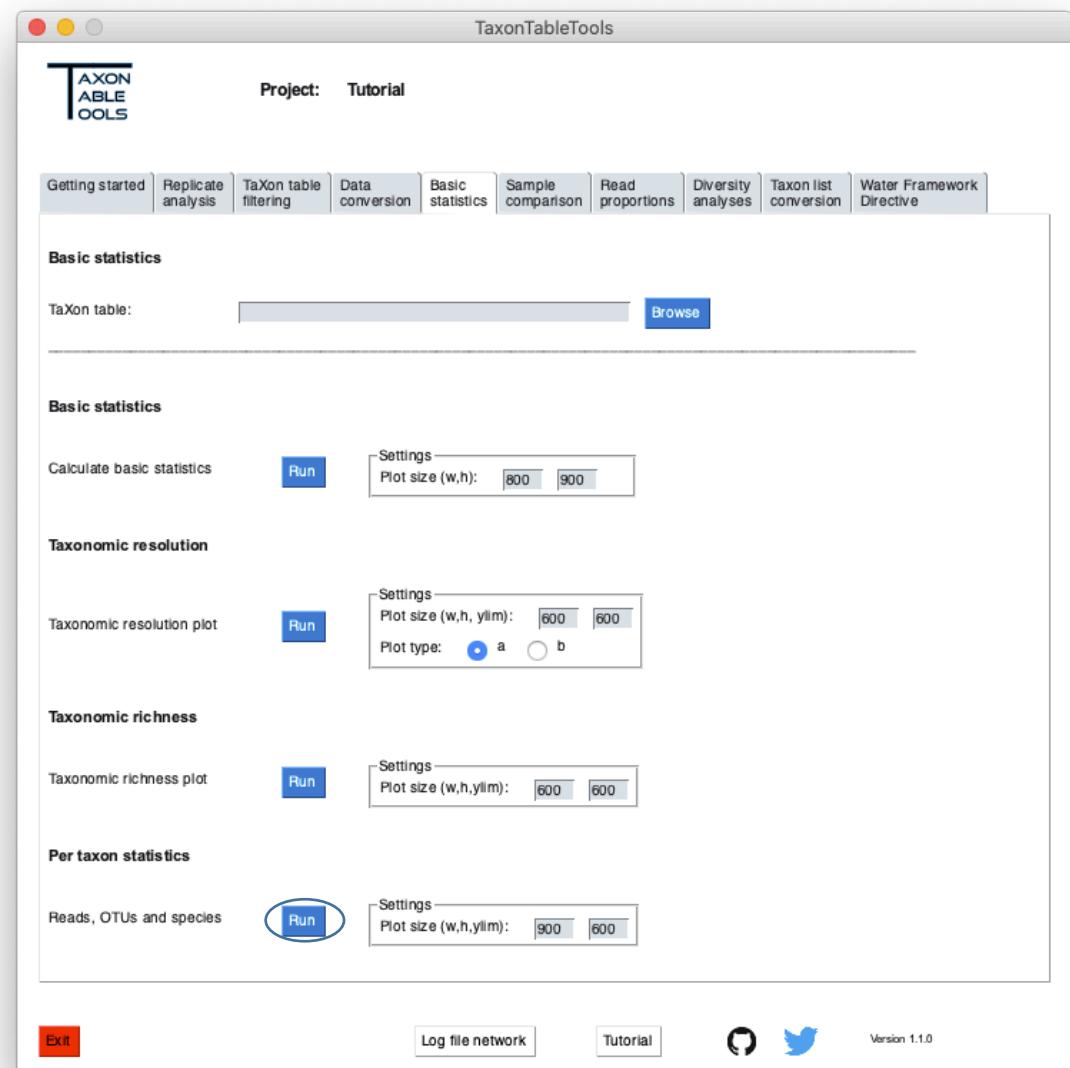
- Taxonomic richness shows the number of taxa for each taxonomic level
- In this case we only included the phylum „Arthropoda“ which results in one phylum
- Within the Arthropoda we found
 - 6 classes
 - 13 Orders
 - 53 Families
 - 94 Genera
 - 132 Species



Reads and OTUs per taxon

Next we should check which orders are present in the dataset

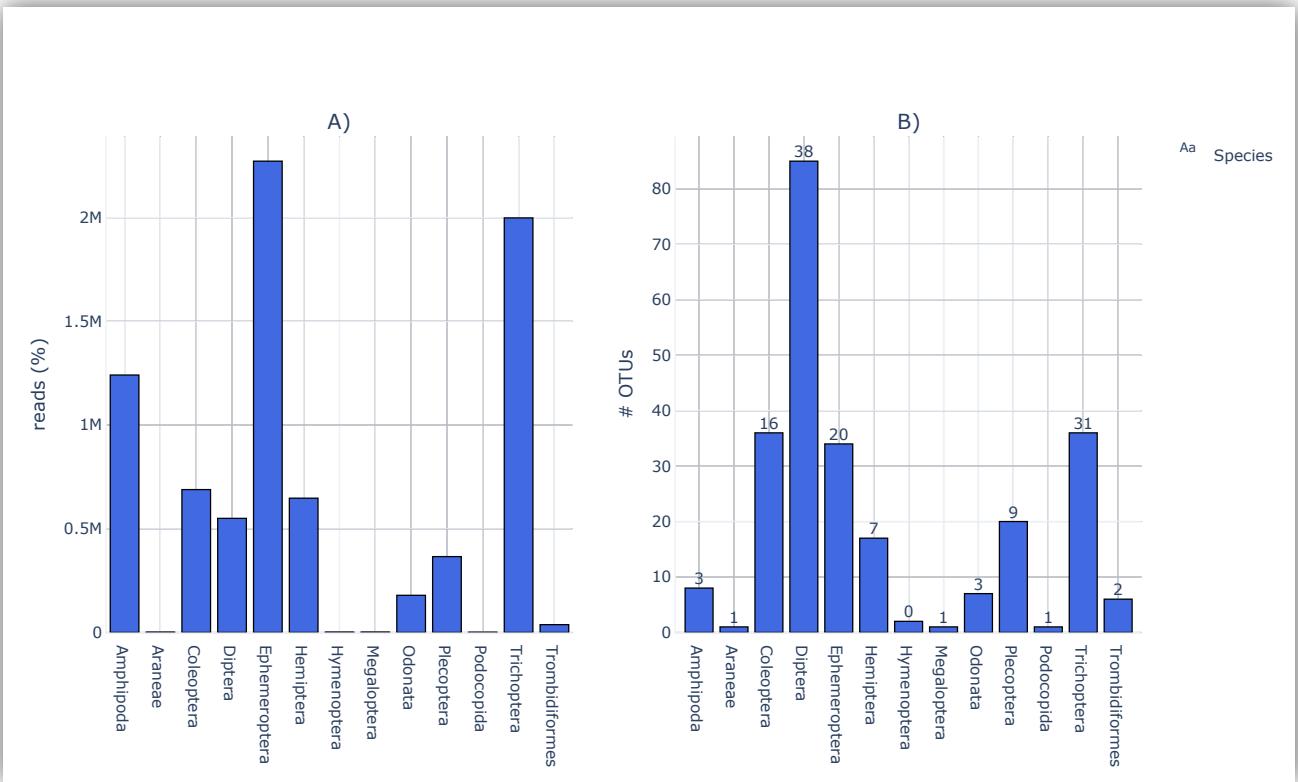
- Load the latest TaXon table (*TTT_cons_derep_arthropods_no_NC.xlsx*)
- Click on Run
- A new plot was created in the *Per_taxon_analysis* folder



Reads, OTUs and species per taxon

This plot shows the number of total reads, the number of OTUs and the number of species

- Note: This is the actual number of species.
NOT the number of OTUs on species level!
- Within the Arthropoda we can conclude that
 - Most reads belong to Ephemeroptera
 - Most OTUs were assigned to Diptera
 - Most species were found for Diptera



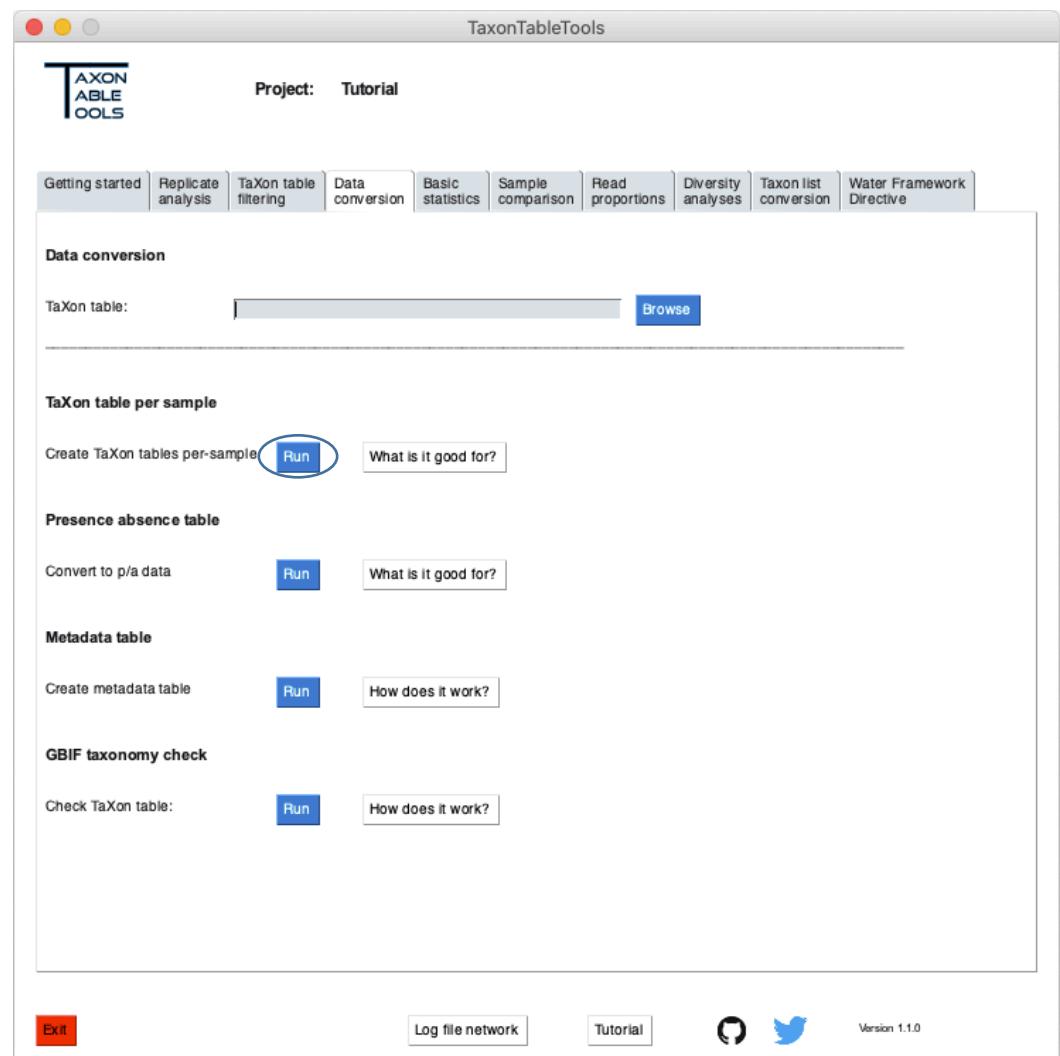
Creating sub sets

a. TaXon table per sample

- A first way to compare samples is to create individual TaXon tables
- To do so go to the **Data conversion tab** and use the TaXon table per sample tool
- This will create an individual table for each sample in a new folder
- We will use 3 of these to create venn diagrams

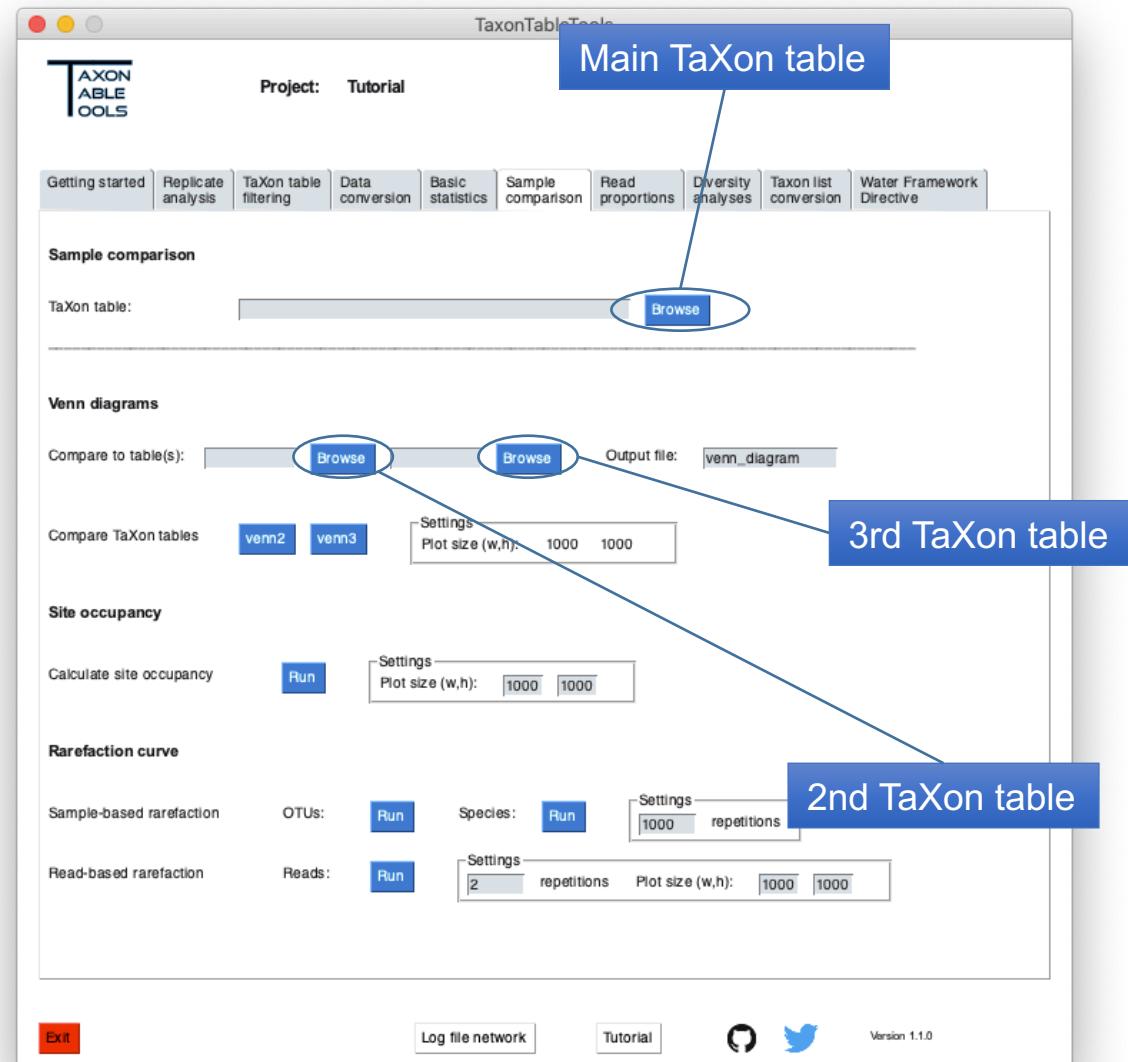
b. TaXon table subset

- Alternatively we can create subsets of the original table using the „sample-based filter“ tool



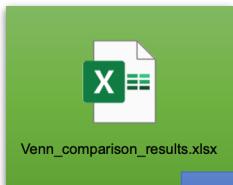
Venn diagrams

- The tables are ordered as follows:
 - Main TaXon table
 - Venn2 TaXon table
 - Venn3 TaXon table
- Venn2**
 - Load the main TaXon table (i.e. Bieber_13)
 - Load the second TaXon table (i.e. RMO1_5)
 - Press venn2
- Venn3**
 - Load the main TaXon table
 - Load the second TaXon table
 - Load the third TaXon table (i.e. Waechterbach_2)
 - Press venn3

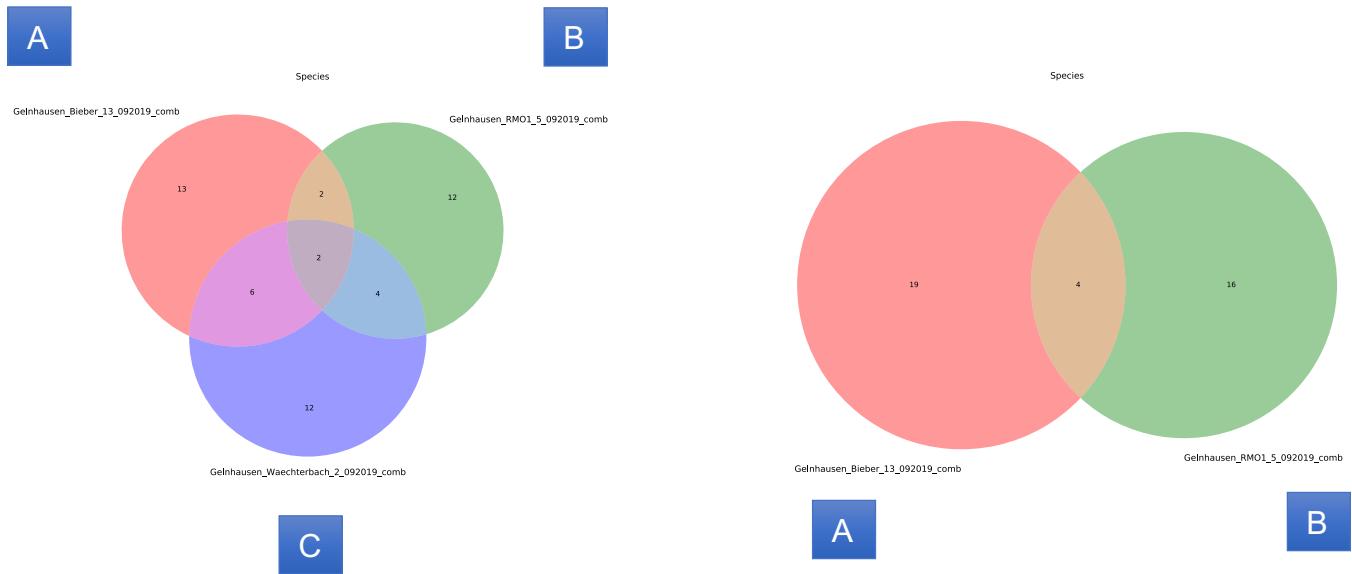


Venn diagrams

- 6 new plots will be created (from phylum to species level)
- Additionally the results will be saved to a new table named „Venn_comparison_results“
- It is recommended to adjust the venn diagrams in e.g. Inkscape



Venn diagram table

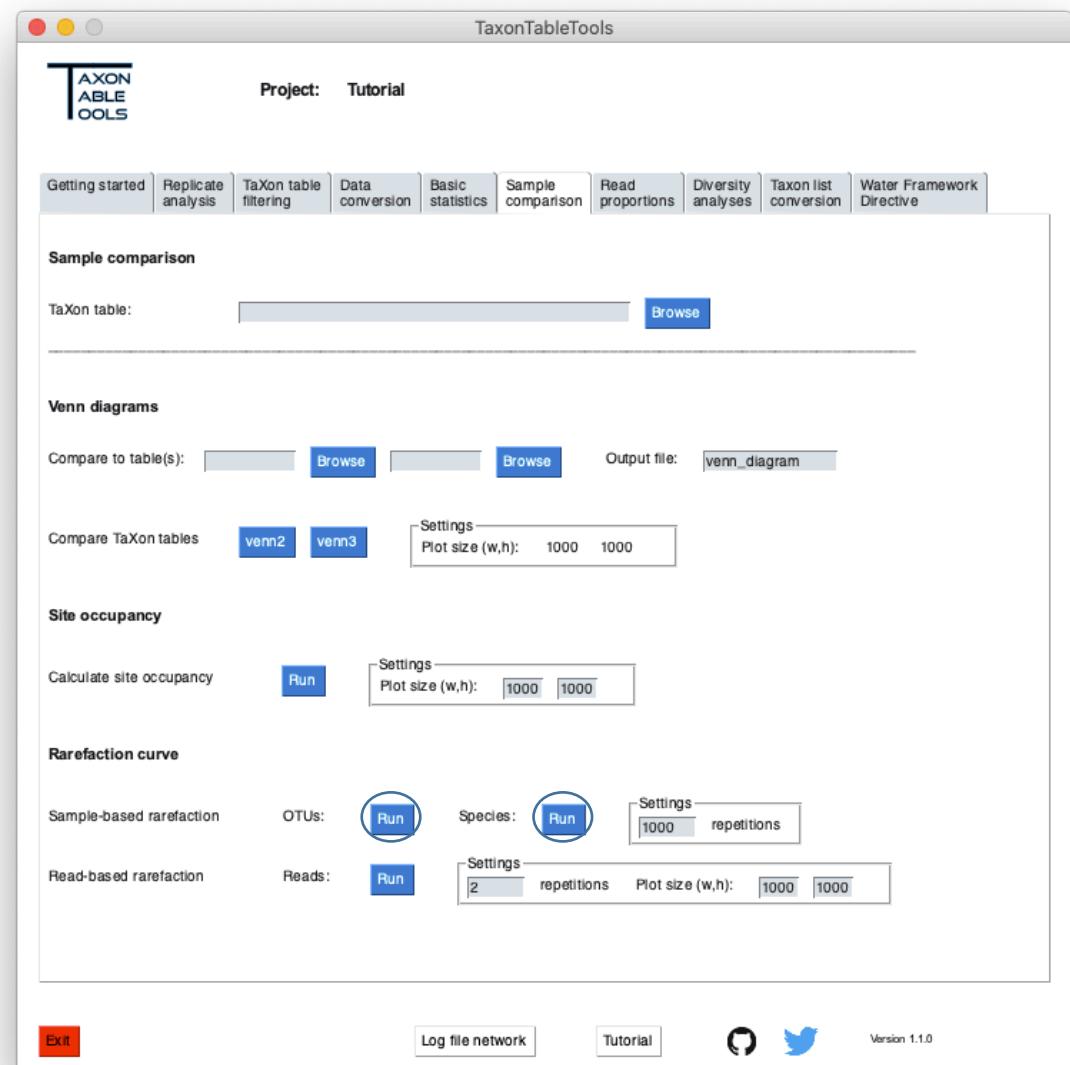
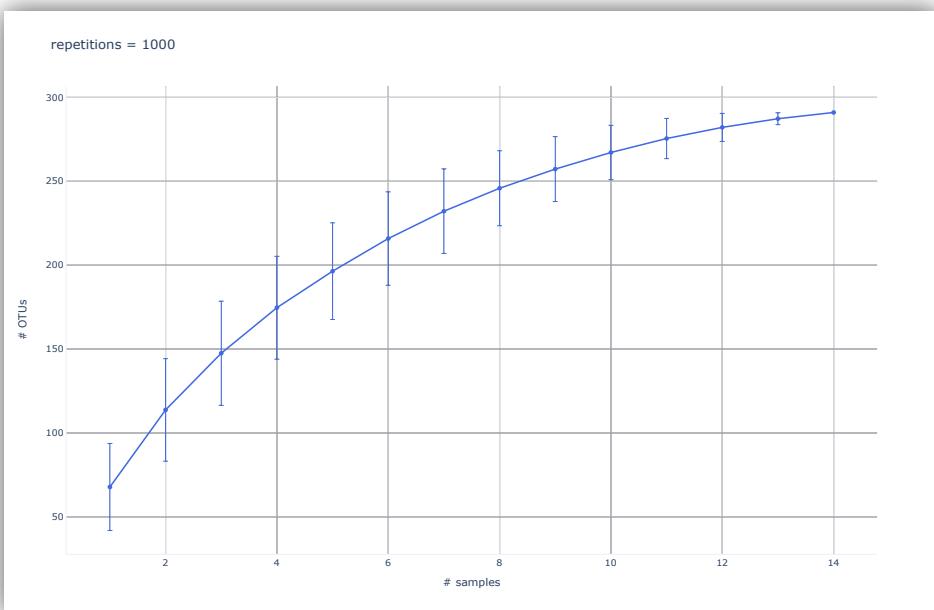


Species_a_only	Species_b_only	Species_c_only	Species_shared_all	Species_shared_a_b	Species_shared_a_c	Species_shared_b_c
Hydraena fosterorum	Simulium erythrocephalum	Baetis vardarensis	Gammarus pulex	Oulimnius tuberculatus	Esolus parallelepipedus	Aphelocheirus aestivalis
Rhithrogena semicolorata	Tanytarsus brundini	Heptagenia sulphurea	Hydropsyche pellucida	Orectochilus villosus	Elmis maugetii	Dicranota sp.
Hydraena riparia	Baetis vernus	Halesus tessellatus			Baetis rhodani	Baetis fuscatus
Chaetopteryx fusca	Polyphemidium aegyptium	Atherix ibis			Limnius volckmari	Ephemera danica
Rhyacophilus nobilis	Ephemerella ignita	Lepidostoma hirtum			Elmis rioloides	
Rheotanytarsus distinctissimus	Heptagenia flava	Halesus digitatus			Hydraena gracilis	
Oreodytes sanmarkii	Goera pilosa	Polycentropus flavomaculatus				
Tvetenia verralli	Cricotopus vierriensis	Habroleptoides confusa				
Elmis aenea	Prodiamesa olivacea	Lebertia porosa				
Dicranota pavida	Psychomyia pusilla	Leuctra geniculata				
Hydropsyche siltalai	Gammarus roeselii	Leuctra fusca				
Ecdyonurus torrentis	Tipula sp. XJB	Linyphia hortensis				
Baetis scambus						

Sample-based rarefaction

Test the species richness from the results of sampling

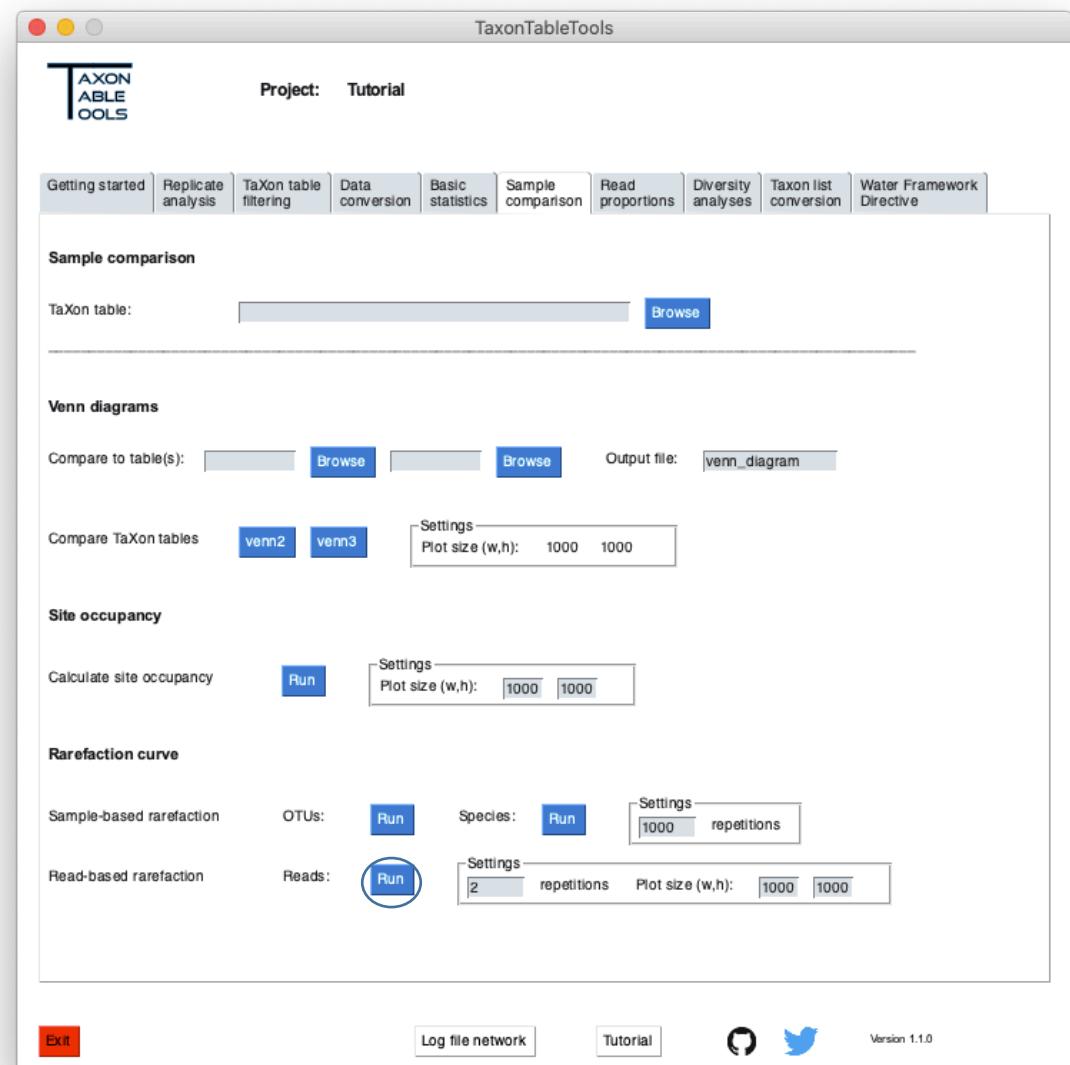
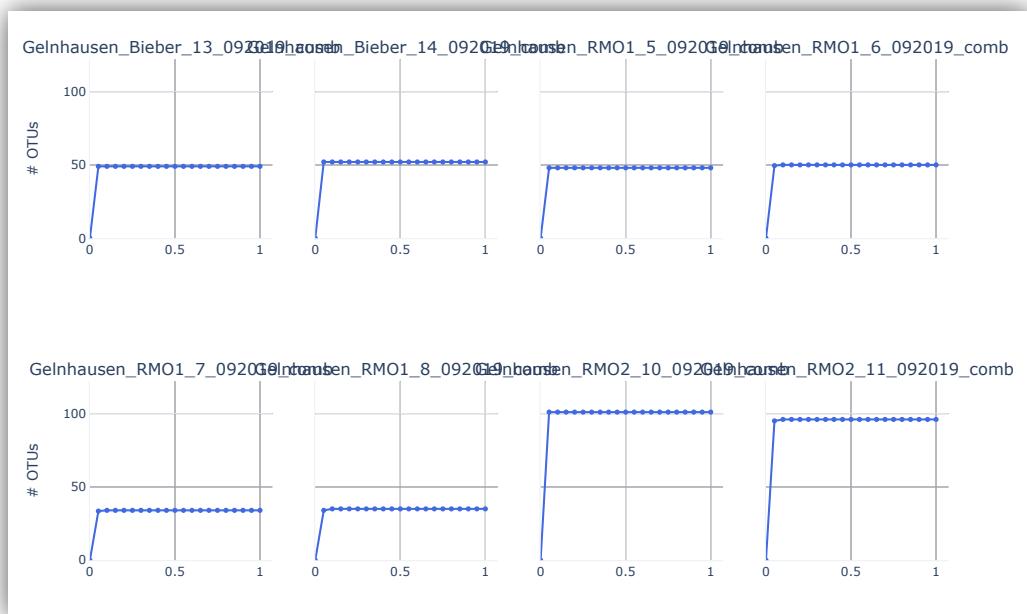
- Load the latest TaXon table (*TTT_cons_derep_arthropoda_no_NC.xlsx*)
- Enter the number of repetitions (e.g. 1000)
- Click on Run to test on either species or OTU level



Read-based rarefaction

Test the effect of sequencing depth

- Load the latest TaXon table (*TTT_cons_derep_arthropoda_no_NC.xlsx*)
- Enter the number of repetitions (e.g. 2 for test purposes)
- Click on Run



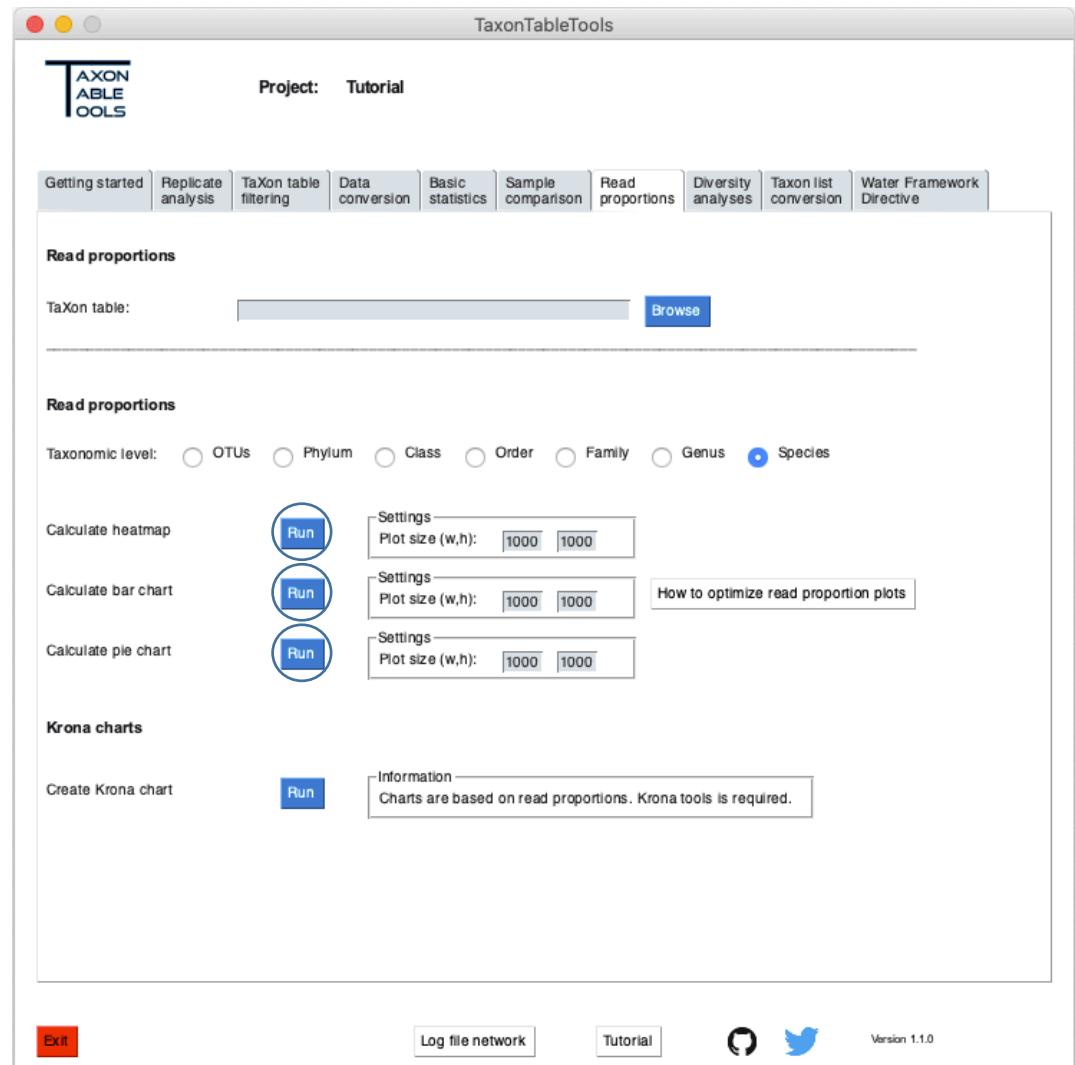
Read proportions

Read proportions per taxon for each sample

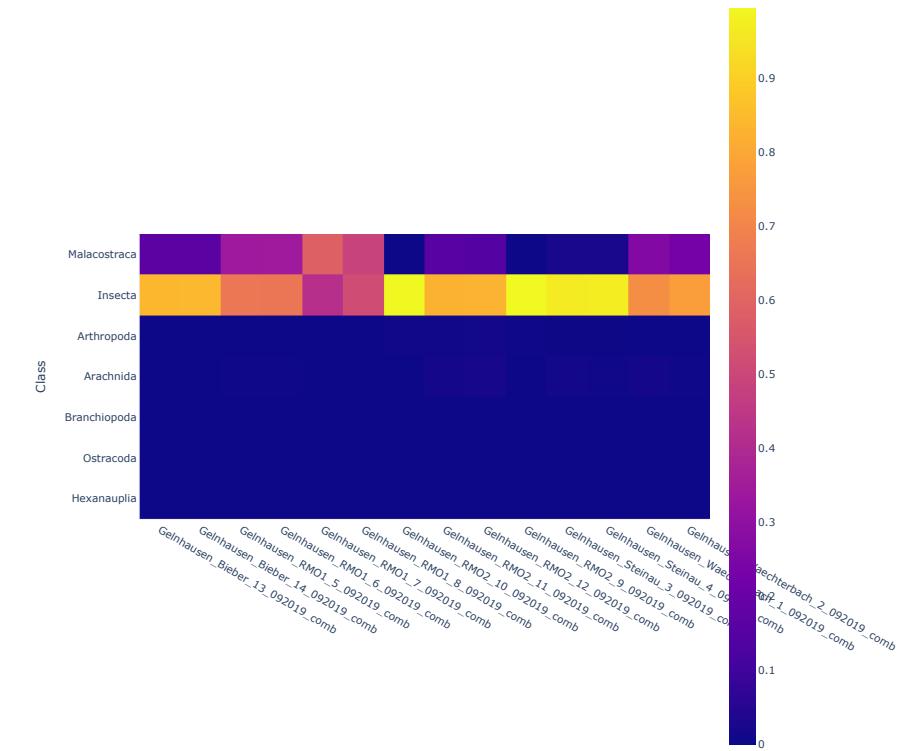
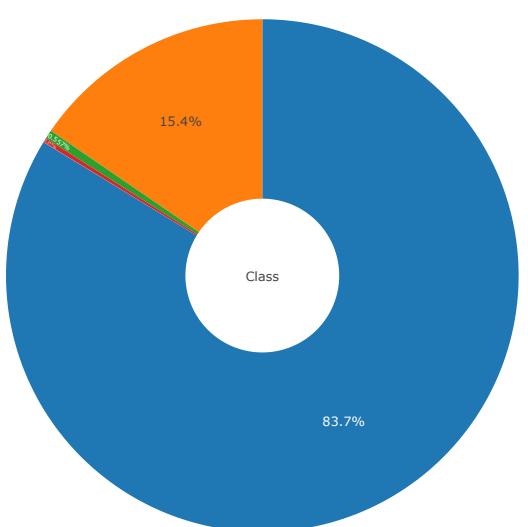
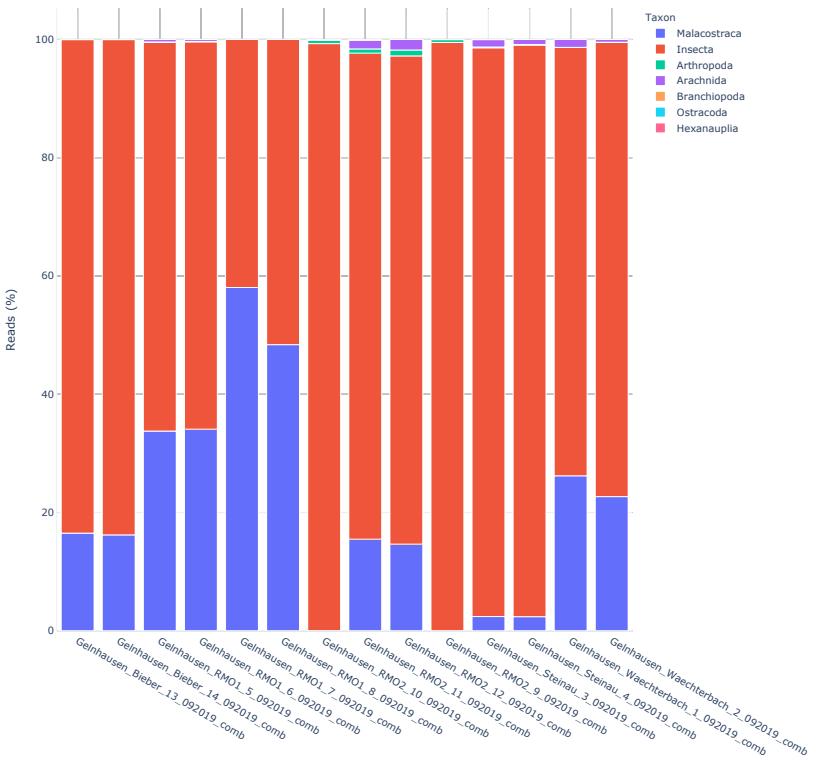
- Load the latest TaXon table (*TTT_cons_derep_arthropoda_no_NC.xlsx*)
- Check the taxonomic level for which to calculate the read proportions (i.e. family)
- Choose to either display the OTU as „best hit“ or as „nan“
- Click on Run

Optimize your plots by a priori filtering!

- OTUs that do not have a hit on the respective level will be set back to their last present taxonomic level
- To create clearer plots it is e.g. useful to filter for certain taxonomic groups and keep only hit on e.g. species level



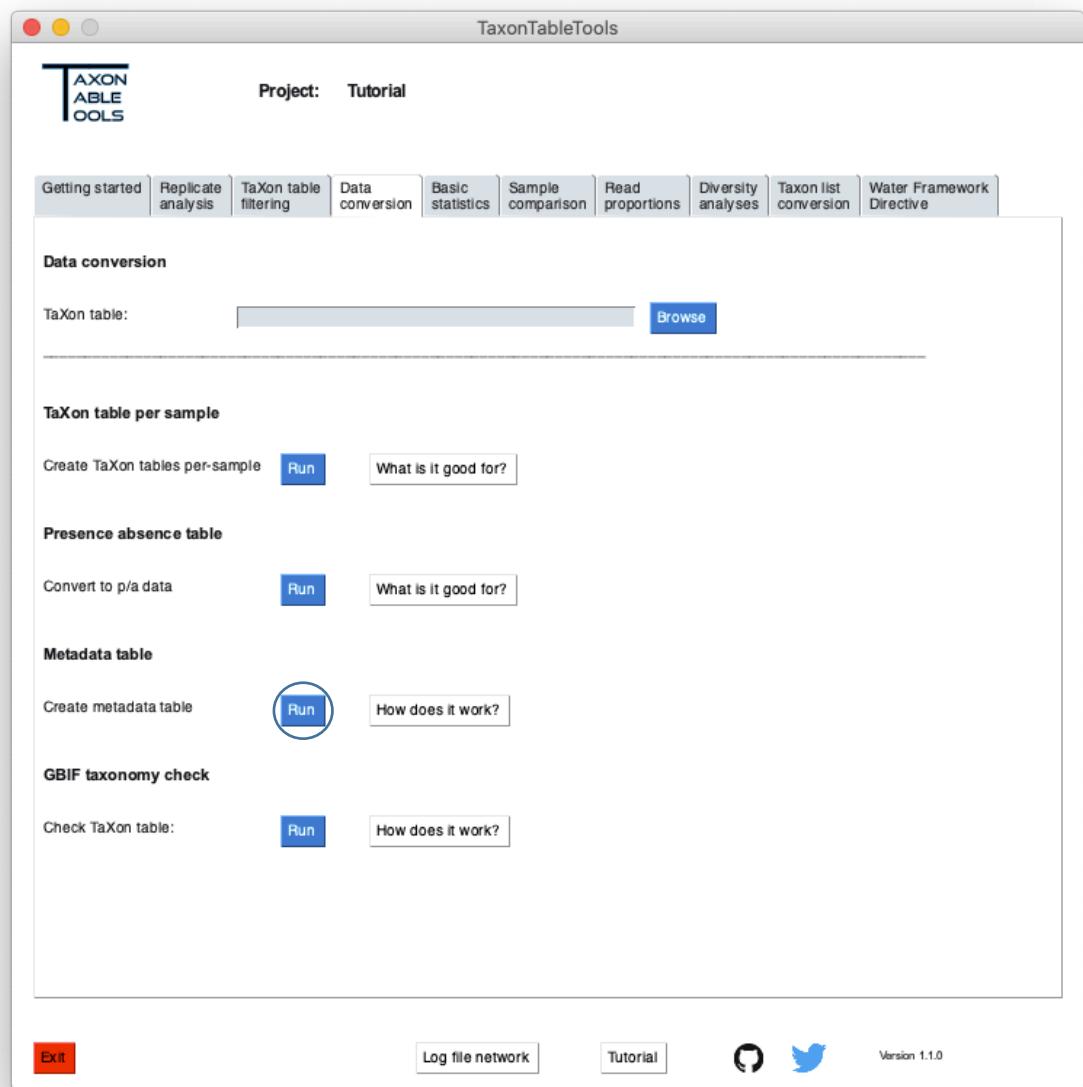
Read proportions



Metadata

Creating a new metadata table

- Go to the **Data conversion** tab
- Load the latest TaXon table (*TTT_cons_derep_arthropoda_no_NC.xlsx*)
- For more information click on „How does it work?“
- To create a new metadata table for the currently active file, click on Run
- You don't have to load the table separately when tools require it, as they will be automatically loaded. So do not change the name of the file
- ***The metadata table requires user-input outside from TTT!***



Metadata table

Adjusting the metadata table

- Open the metadata table with e.g. Excel
- The first column holds the sample names
 - Never change the names of the samples, as they must be equivalent to the respective TaXon table file
 - You can re-arrange the order of the samples for a better sorting
- Now adjust the metadata for each sample and rename the column headers according to your data
- The column header will show up in TTT and can be used to select the metadata to test on

Name of the metadata

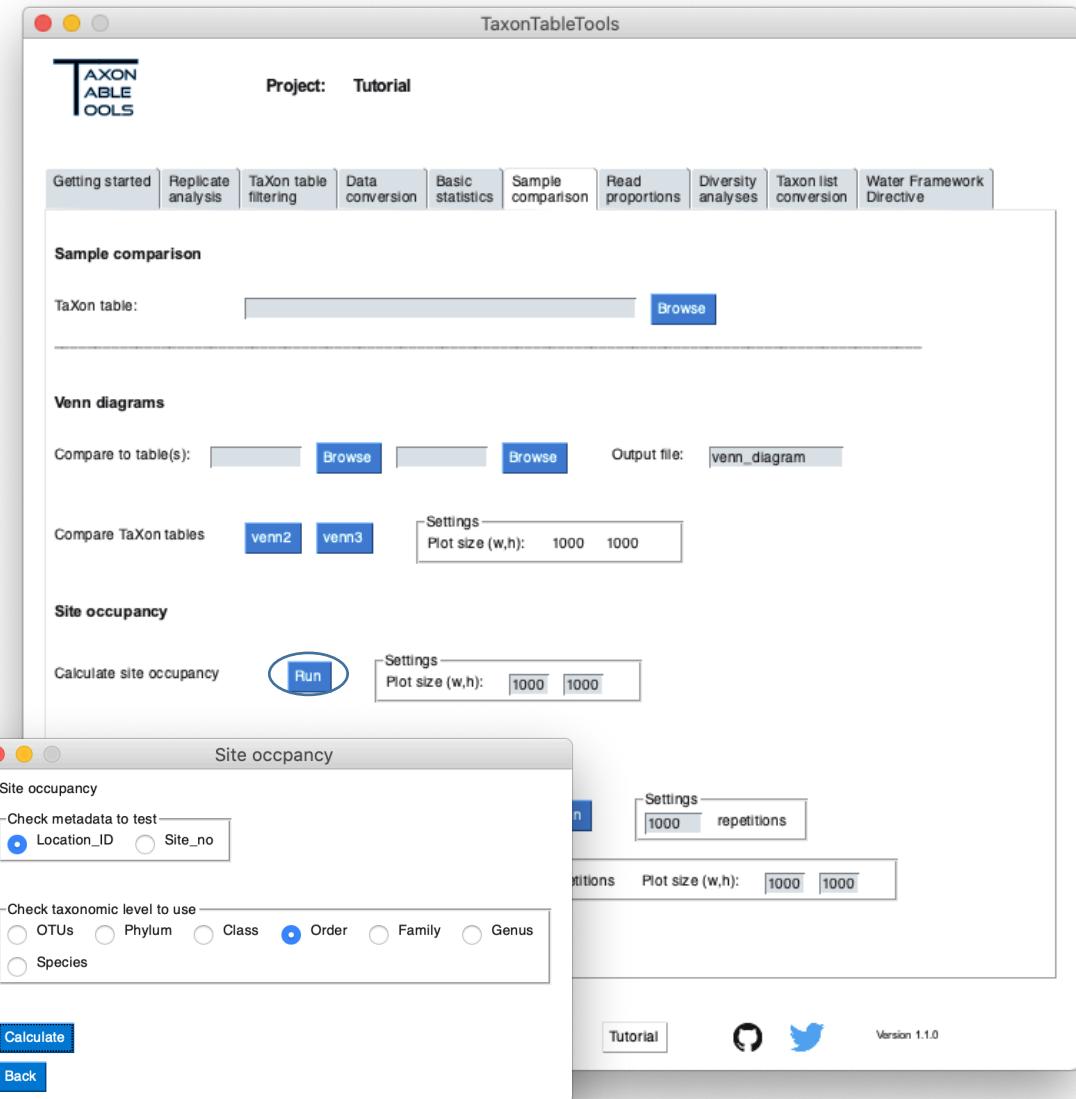
Samples	1	2	3	4	5
Gelnhausen_Bieber_13_092019_comb	Gelnhausen	Bieber	13	092019	comb
Gelnhausen_Bieber_14_092019_comb	Gelnhausen	Bieber	14	092019	comb
Gelnhausen_RMO1_5_092019_comb	Gelnhausen	RMO1	5	092019	comb
Gelnhausen_RMO1_6_092019_comb	Gelnhausen	RMO1	6	092019	comb
Gelnhausen_RMO1_7_092019_comb	Gelnhausen	RMO1	7	092019	comb
Gelnhausen_RMO1_8_092019_comb	Gelnhausen	RMO1	8	092019	comb
Gelnhausen_RMO2_10_092019_comb	Gelnhausen	RMO2	10	092019	comb
Gelnhausen_RMO2_11_092019_comb	Gelnhausen	RMO2	11	092019	comb
Gelnhausen_RMO2_12_092019_comb	Gelnhausen	RMO2	12	092019	comb
Gelnhausen_RMO2_9_092019_comb	Gelnhausen	RMO2	9	092019	comb
Gelnhausen_Steinau_3_092019_comb	Gelnhausen	Steinau	3	092019	comb
Gelnhausen_Steinau_4_092019_comb	Gelnhausen	Steinau	4	092019	comb
Gelnhausen_Waechterbach_1_092019_comb	Gelnhausen	Waechterbach	1	092019	comb
Gelnhausen_Waechterbach_2_092019_comb	Gelnhausen	Waechterbach	2	092019	comb



Samples	Location_ID	Site_No
Gelnhausen_Bieber_13_092019_comb	Bieber	13
Gelnhausen_Bieber_14_092019_comb	Bieber	14
Gelnhausen_RMO1_5_092019_comb	RMO1	5
Gelnhausen_RMO1_6_092019_comb	RMO1	6
Gelnhausen_RMO1_7_092019_comb	RMO1	7
Gelnhausen_RMO1_8_092019_comb	RMO1	8
Gelnhausen_RMO2_10_092019_comb	RMO2	10
Gelnhausen_RMO2_11_092019_comb	RMO2	11
Gelnhausen_RMO2_12_092019_comb	RMO2	12
Gelnhausen_RMO2_9_092019_comb	RMO2	9
Gelnhausen_Steinau_3_092019_comb	Steinau	3
Gelnhausen_Steinau_4_092019_comb	Steinau	4
Gelnhausen_Waechterbach_1_092019_comb	Waechterbach	1
Gelnhausen_Waechterbach_2_092019_comb	Waechterbach	2

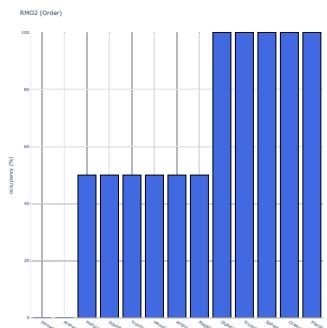
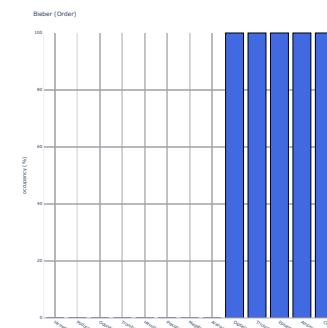
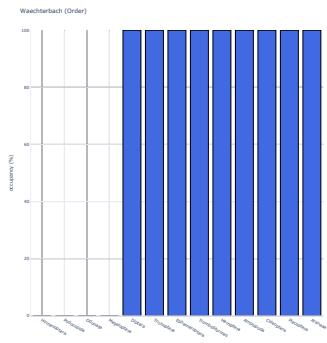
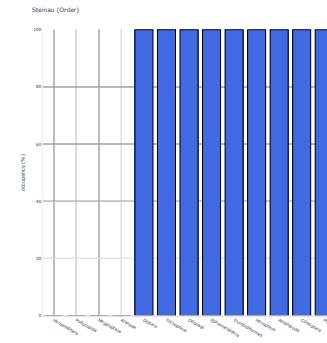
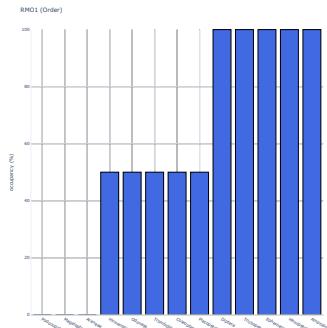
Site occupancy

- Load the latest TaXon table (*TTT_cons_derep_arthropoda_no_NC.xlsx*) in the **Analysis #3 tab**
- Remember: This TaXon table now has an according metadata table
- A new window will pop up and ask for additional information
 - In this case we choose the „Location_ID“ as metadata and „Order“ as taxonomic level
- The site occupancy will be calculated and the last (!) plot will be shown and all (!) plots will be saved



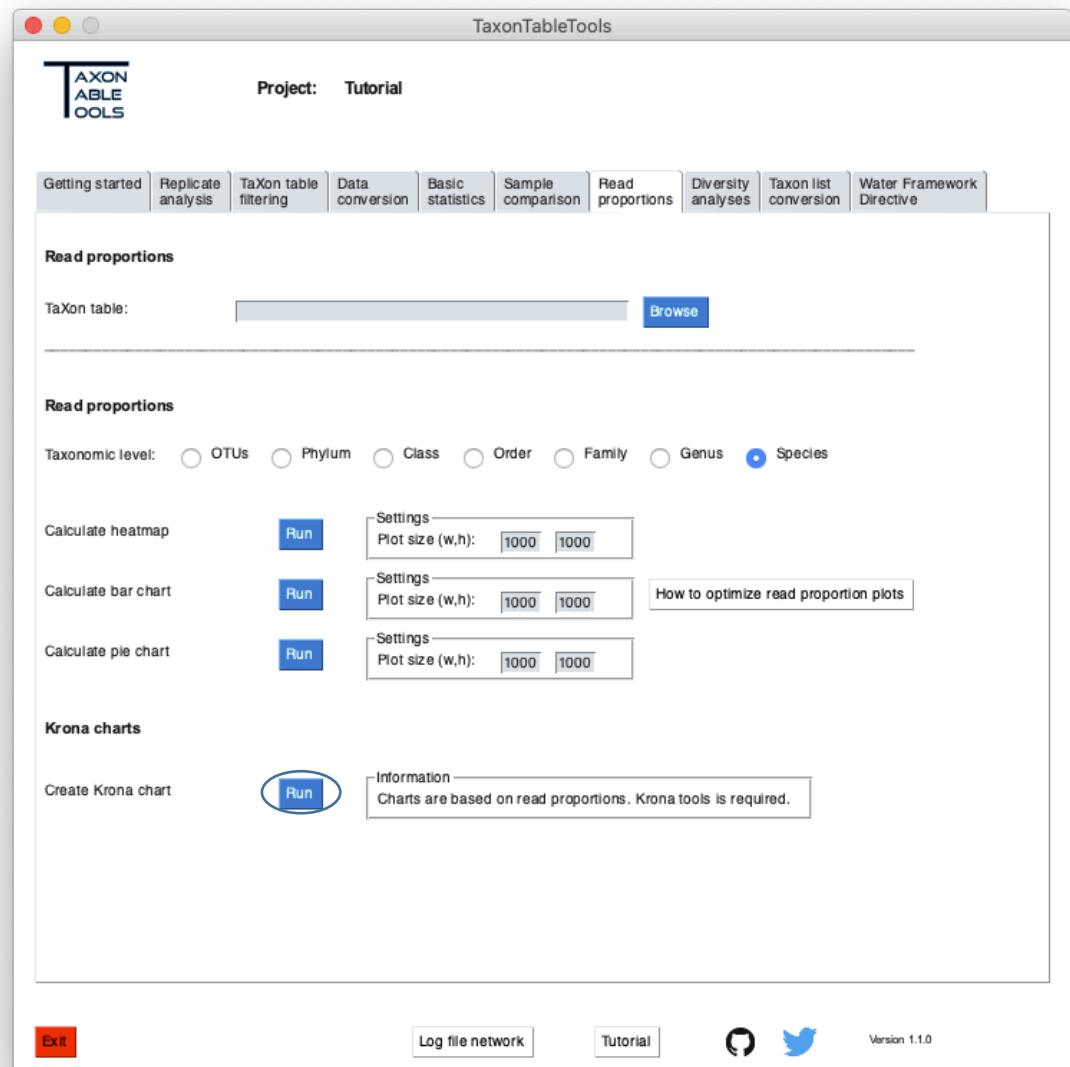
Site occupancy

- Each metadata (here: sampling site) was saved as an individual plot
- The x-axis shows the occupancy, ranging from 0 (present in none of the samples) to 100 (present in all of the samples)
- Note: despite its name, this tool is not limited to calculate the occupancy of a sampling site, but rather the taxon occupancy of any given metadata

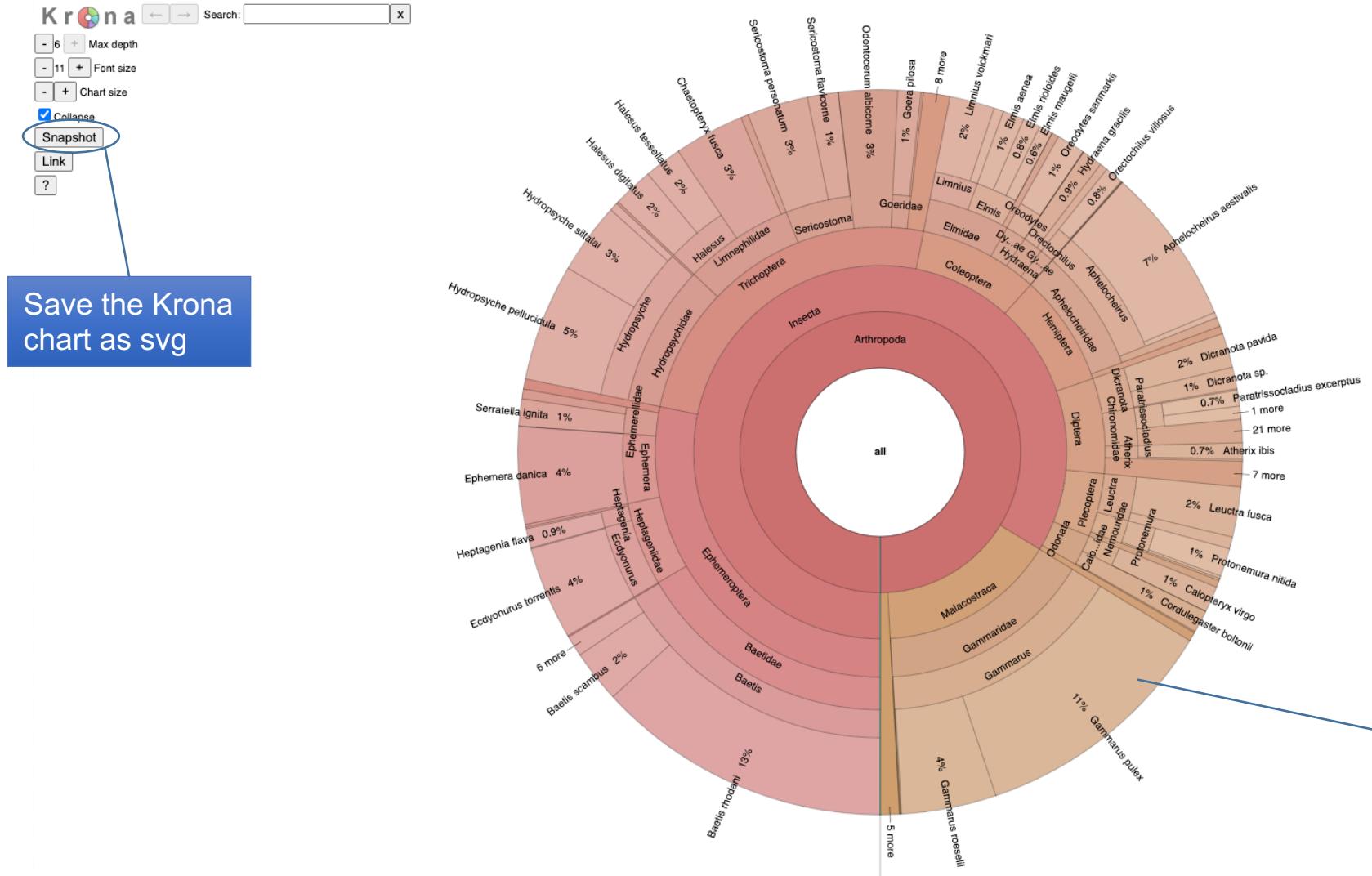


Krona charts

- Note: Krona tools is currently not available for Windows
- Load the latest TaXon table (*TTT_cons_derep_arthropods_no_NC.xlsx*)
- Click on Run
- The newly created Krona chart will be saved as html file
- The illustrated proportions are relative read abundances
- Open the file with any Browser (e.g. Chrome or Firefox)
- This interactive chart allows the user to zoom in to specific taxonomic level



Krona charts

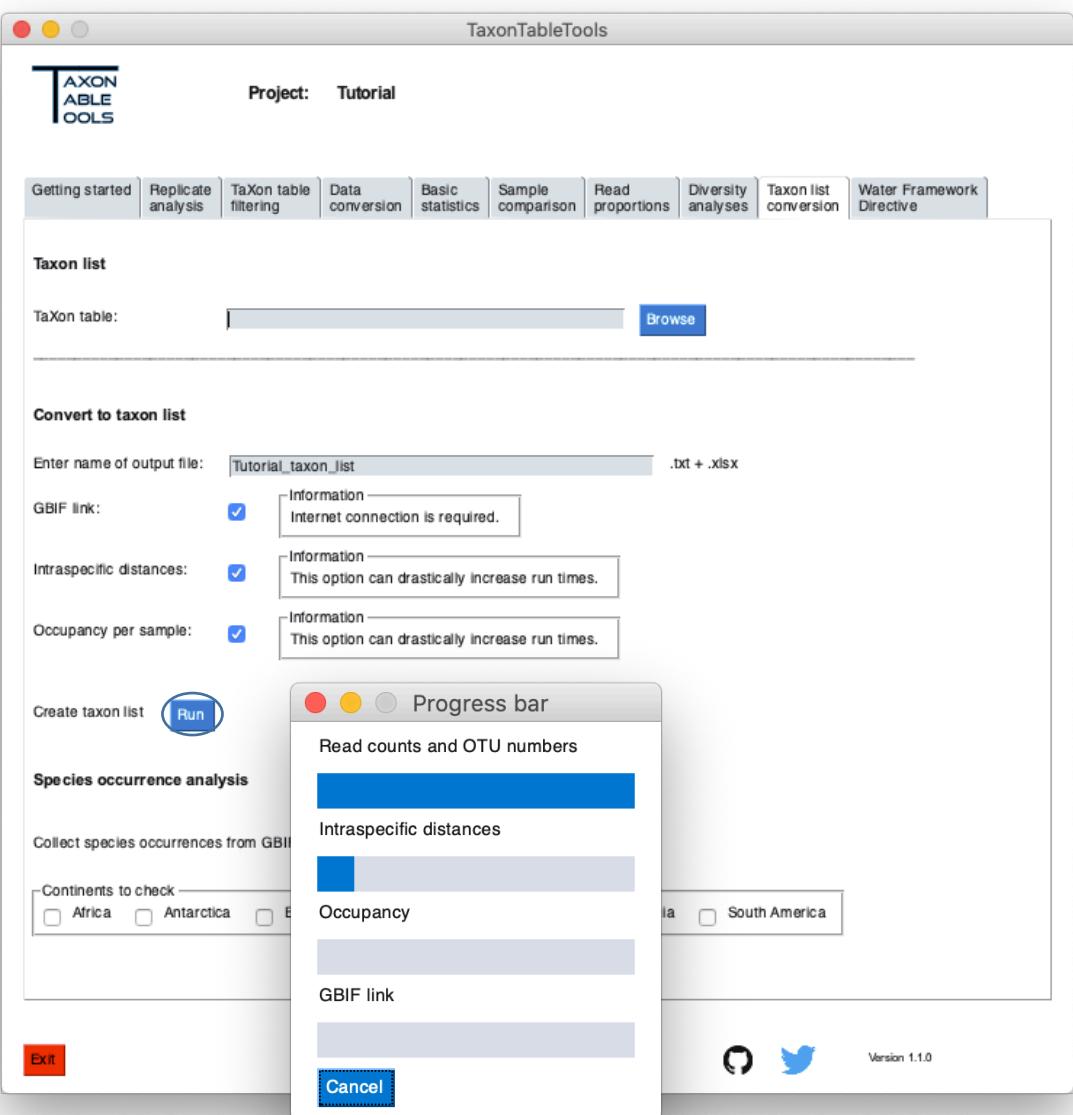


TAXON
ABLE
TOOLS



Taxon list

- Load the latest TaXon table (*TTT_cons_derep_arthropods_no_NC.xlsx*)
- Enter the name of the output file
- Leave the all check mark
 - This requires internet connection
- Click on Run
- A new taxon list will be created that includes
 - All present taxa
 - Read counts (absolute, relative)
 - Occupancy across samples
 - Genetic distance for species level hits with multiple OTUs
 - GBIF link to the species



Taxon list

Taxon list statistics

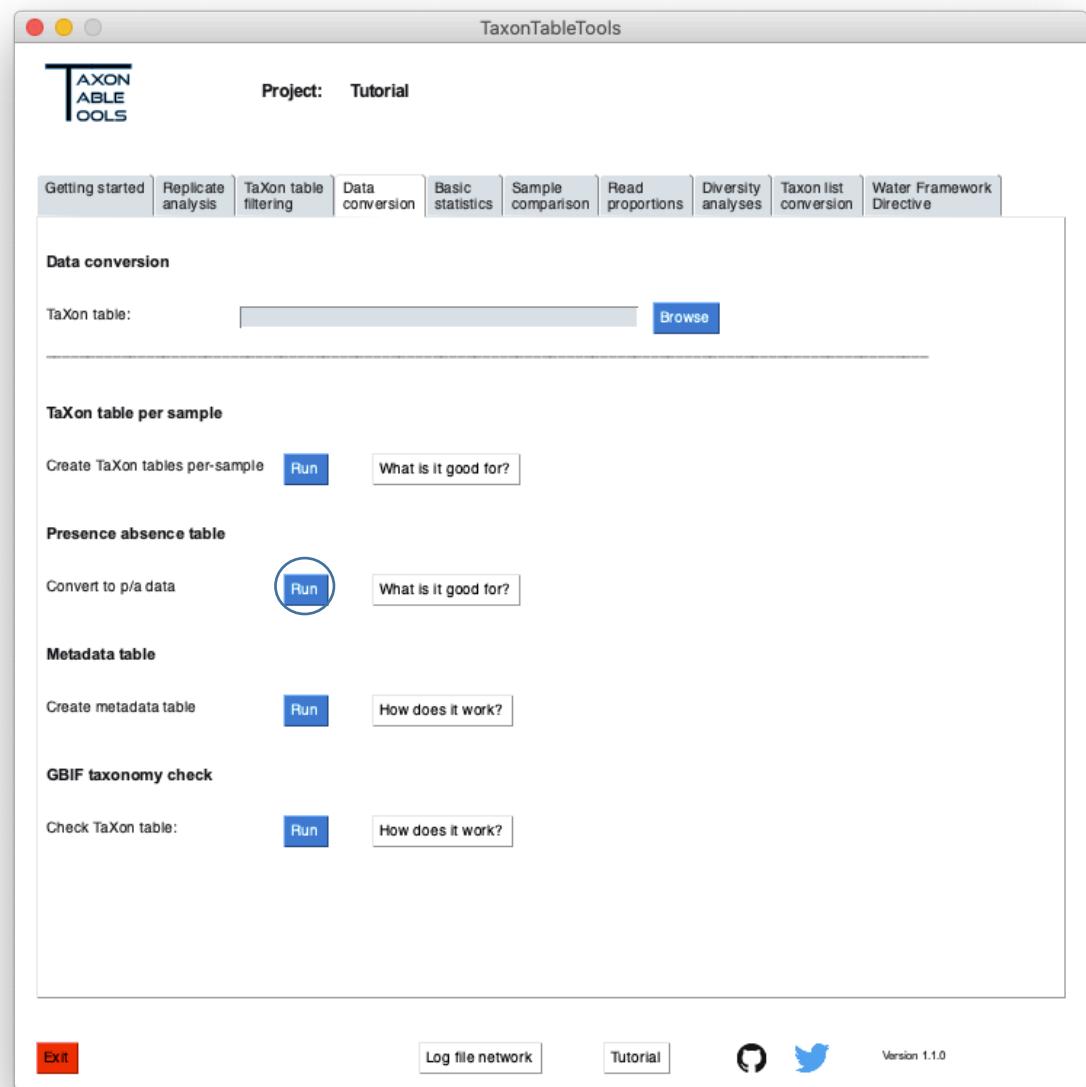
Link to the gbif database

Phylum	Class	Order	Family	Genus	Species	reads	OTUs	occupancy	dist max	dist min	dist avg	gbif
Arthropoda	Malacostraca	Amphipoda	Gammaridae	Gammarus	Gammarus pulex	894888	2	0,71	3,09	3,09	3,09	https://www.gbif.org/species/2219853
Arthropoda	Insecta	Hemiptera	Aphelocheiridae	Aphelocheirus	Aphelocheirus aestivalis	567267	1	0,5				https://www.gbif.org/species/4485511
Arthropoda	Insecta	Ephemeroptera	Baetidae	Baetis	Baetis rhodani	1062588	2	0,64	13,3	13,3	13,3	https://www.gbif.org/species/4481106
Arthropoda	Malacostraca	Amphipoda	Gammaridae	Gammarus	Gammarus roeselii	340348	3	0,43	9,26	3,09	6,97	https://www.gbif.org/species/5864277
Arthropoda	Insecta	Ephemeroptera	Heptageniidae	Ecdyonurus	Ecdyonurus torrentis	334421	1	0,43				https://www.gbif.org/species/4481477
Arthropoda	Insecta	Ephemeroptera	Ephemeridae	Ephemeria	Ephemeria danica	348767	1	0,86				https://www.gbif.org/species/5716472
Arthropoda	Insecta	Trichoptera	Hydropsychidae	Hydropsyche	Hydropsyche pellucidula	420537	1	0,86				https://www.gbif.org/species/5054150
Arthropoda	Insecta	Trichoptera	Hydropsychidae	Hydropsyche	Hydropsyche siltalai	256128	1	0,71				https://www.gbif.org/species/5054160
Arthropoda	Insecta	Coleoptera	Elmidae	Limnius	Limnius volckmari	160851	1	0,71				https://www.gbif.org/species/4427719
Arthropoda	Insecta	Trichoptera	Odontoceridae	Odontocerum	Odontocerum albicorne	210463	2	0,29	3,8	3,8	3,8	https://www.gbif.org/species/1437449
Arthropoda	Insecta	Trichoptera	Limnephilidae	Chaetopteryx	Chaetopteryx fusca	251747	1	0,36				https://www.gbif.org/species/1442278
Arthropoda	Insecta	Trichoptera	Sericostomatidae	Sericostoma	Sericostoma personatum	218930	2	0,29	3,8	3,8	3,8	https://www.gbif.org/species/5053104
Arthropoda	Insecta	Coleoptera	Dytiscidae	Oreodytes	Oreodytes sanmarkii	102208	2	0,29	3,33	3,33	3,33	https://www.gbif.org/species/1038118
Arthropoda	Insecta	Odonata	Cordulegastridae	Cordulegaster	Cordulegaster boltonii	80464	1	0,14				https://www.gbif.org/species/1421161
Arthropoda	Insecta	Ephemeroptera	Baetidae	Baetis	Baetis scambus	188247	4	0,57	4,04	2,61	3,44	https://www.gbif.org/species/4481160
Arthropoda	Insecta	Coleoptera	Elmidae	Elmis	Elmis aenea	76848	1	0,57				https://www.gbif.org/species/4427707
Arthropoda	Insecta	Diptera	Pediciidae	Dicranota	Dicranota pavida	123630	1	0,29				https://www.gbif.org/species/1510411
Arthropoda	Insecta	Ephemeroptera	Heptageniidae	Heptagenia	Heptagenia flava	69636	1	0,14				https://www.gbif.org/species/4481427
Arthropoda	Insecta	Trichoptera	Limnephilidae	Halesus	Halesus digitatus	143908	1	0,14				https://www.gbif.org/species/1441931
Arthropoda	Insecta	Trichoptera	Limnephilidae	Halesus	Halesus tessellatus	134187	1	0,29				https://www.gbif.org/species/119642498
Arthropoda	Insecta	Trichoptera	Goeridae	Goera	Goera pilosa	82978	1	0,14				https://www.gbif.org/species/1441388
Arthropoda	Insecta	Plecoptera	Leuctridae	Leuctra	Leuctra fusca	179718	2	0,71	2,85	2,85	2,85	https://www.gbif.org/species/2001954
Arthropoda	Insecta	Odonata	Calopterygidae	Calopteryx	Calopteryx virgo	93328	1	0,29				https://www.gbif.org/species/1427037
Arthropoda	Insecta	Coleoptera	Hydraenidae	Hydraena	Hydraena gracilis	74092	1	0,71				https://www.gbif.org/species/5748088
Arthropoda	Insecta	Diptera	Chironomidae	Paratrichocladius	nan	46912	1	0,29				
Arthropoda	Insecta	Ephemeroptera	Ephemerellidae	Serratella	Serratella ignita	97111	1	0,14				https://www.gbif.org/species/4481256
Arthropoda	Insecta	Trichoptera	Sericostomatidae	Sericostoma	Sericostoma flavicorne	110244	1	0,43				https://www.gbif.org/species/5053131
Arthropoda	Insecta	Coleoptera	Elmidae	Limnius	Limnius perrisi	34261	1	0,14				https://www.gbif.org/species/4427727
Arthropoda	Insecta	Trichoptera	Rhyacophilidae	Rhyacophila	Rhyacophila nubila	47439	1	0,43				https://www.gbif.org/species/1433809
Arthropoda	Insecta	Ephemeroptera	Baetidae	Baetis	Baetis vernus	39676	2	0,43	5,46	5,46	5,46	https://www.gbif.org/species/4481086
Arthropoda	Insecta	Coleoptera	Elmidae	Elmis	Elmis riolooides	62192	3	0,71	4,28	3,09	3,49	https://www.gbif.org/species/4427709
Arthropoda	Insecta	Diptera	Pediciidae	Dicranota	Dicranota sp.	77673	4	0,86	7,13	3,33	5,9	

Taxonomic information

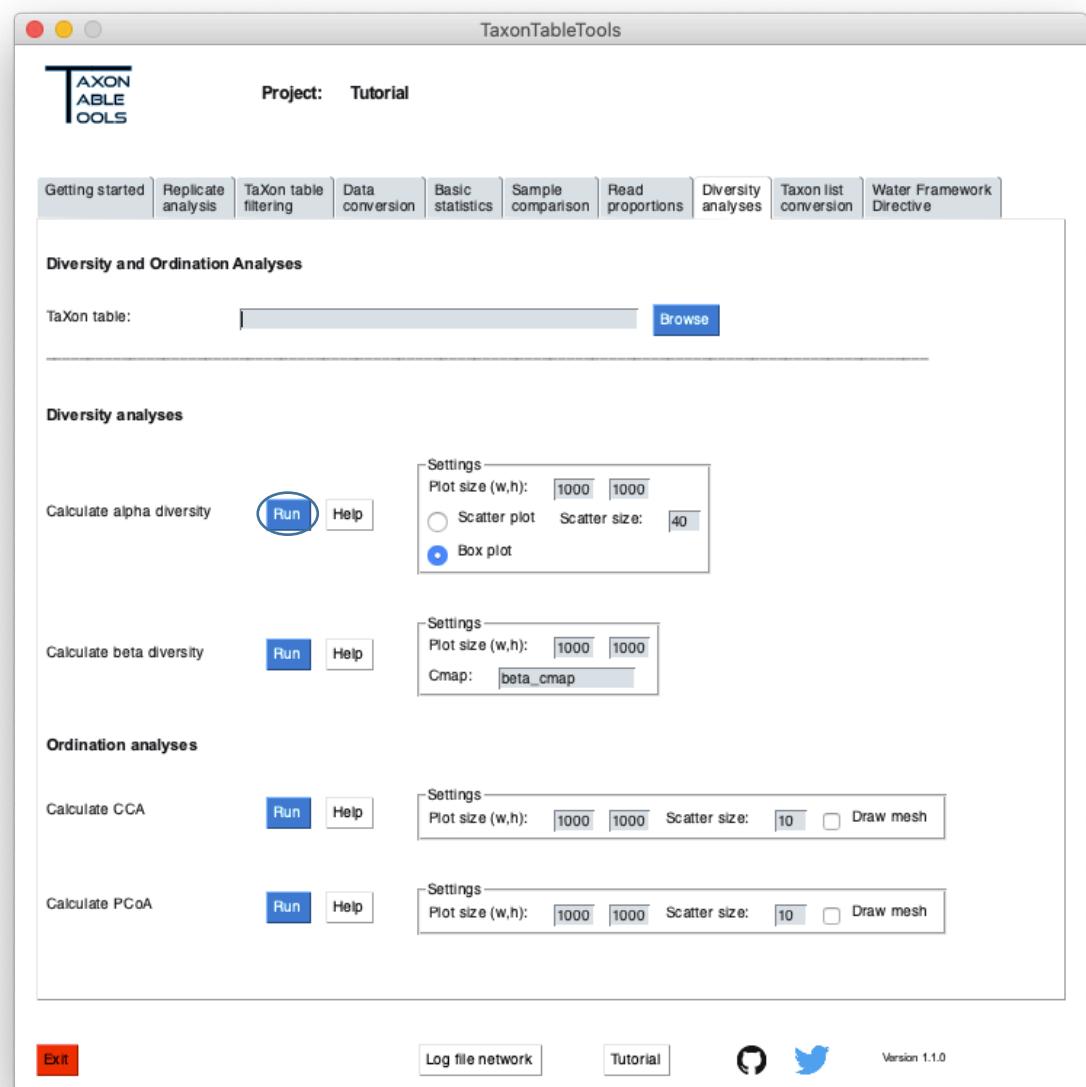
Presence / absence data

- Load the latest TaXon table (*TTT_cons_derep_arthropods_no_NC.xlsx*) in the **Data conversion** tab
- Convert the table to presence / absence data
- Note: This will create a new table and thus also a new meta data table is required
- You can either copy the previous meta data table and add the „_pa“ suffix to the file name or use the TTT module (but then you'll need to again adjust the meta data table)



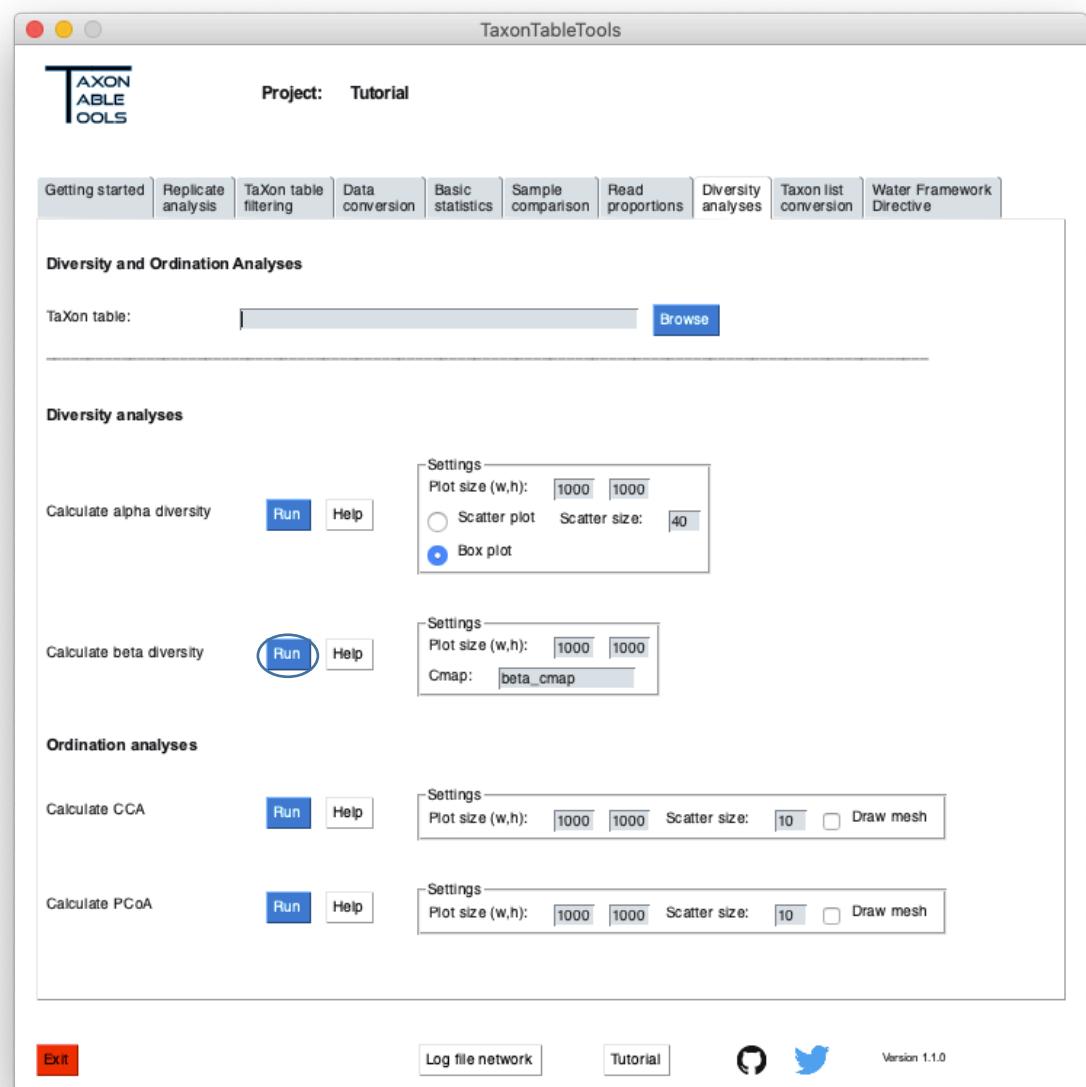
Diversity analyses

- Load the latest TaXon table (*TTT_cons_derep_arthropods_no_NC_pa.xlsx*)
- Note: the diversity analyses require **presence absence data** and a **respective meta data table**
- Calculate the Alpha diversity
 - ***Alpha diversity is measured as OTU richness***
 - Choose a meta data to test (e.g. Location_ID)
 - This will plot the number of OTUs per sample
 - Create a scatter plot and a boxplot



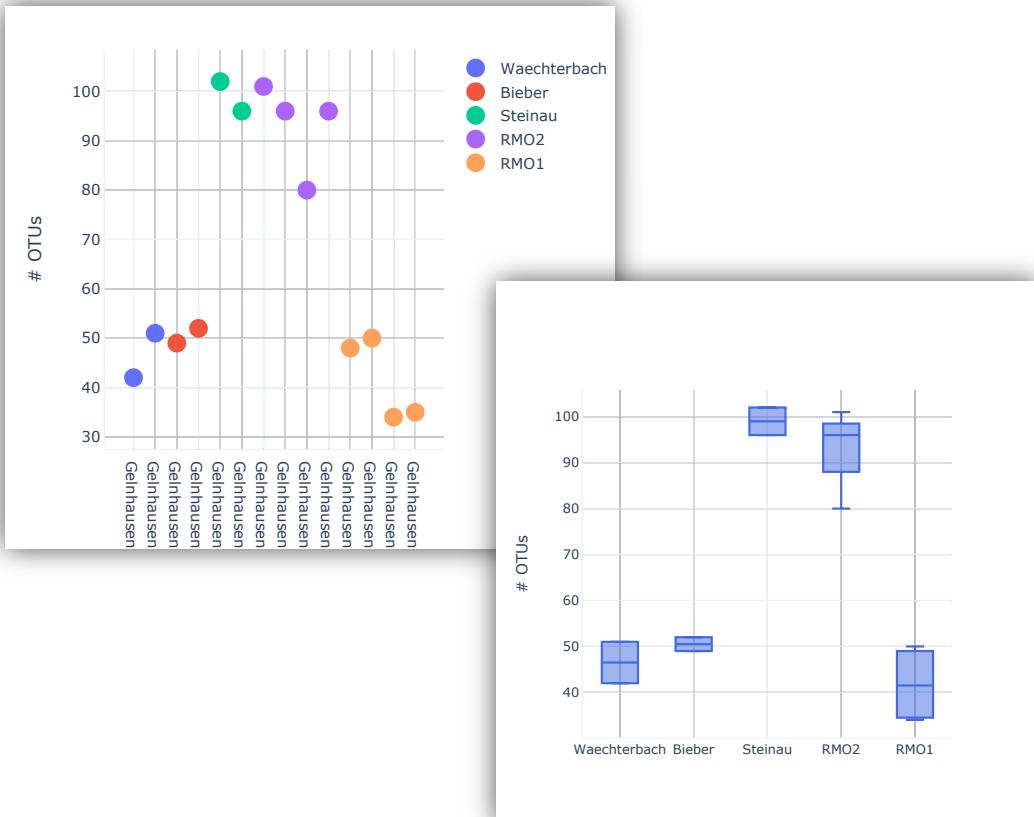
Diversity analyses

- Load the latest TaXon table (*TTT_cons_derep_arthropods_no_NC_pa.xlsx*)
- Note: the diversity analyses require **presence absence data** and a **meta data table**
- Calculate the Beta diversity
 - Choose a meta data to test (e.g. Location_ID)
 - This will calculate **Jaccard distances** and perform an ANOSIM
 - The colour of the plot can be adjusted with colourmaps,

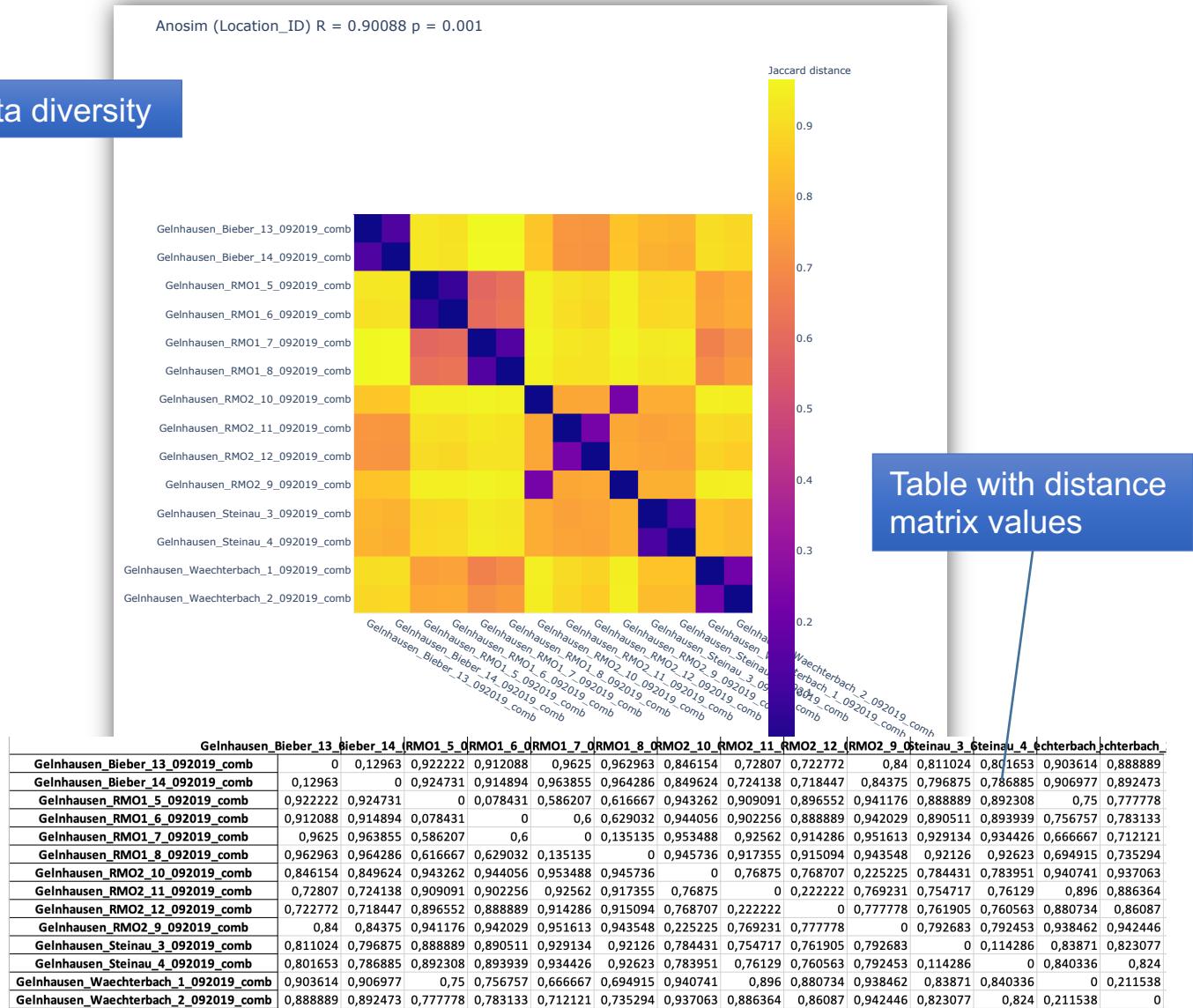


Diversity analyses

Alpha diversity

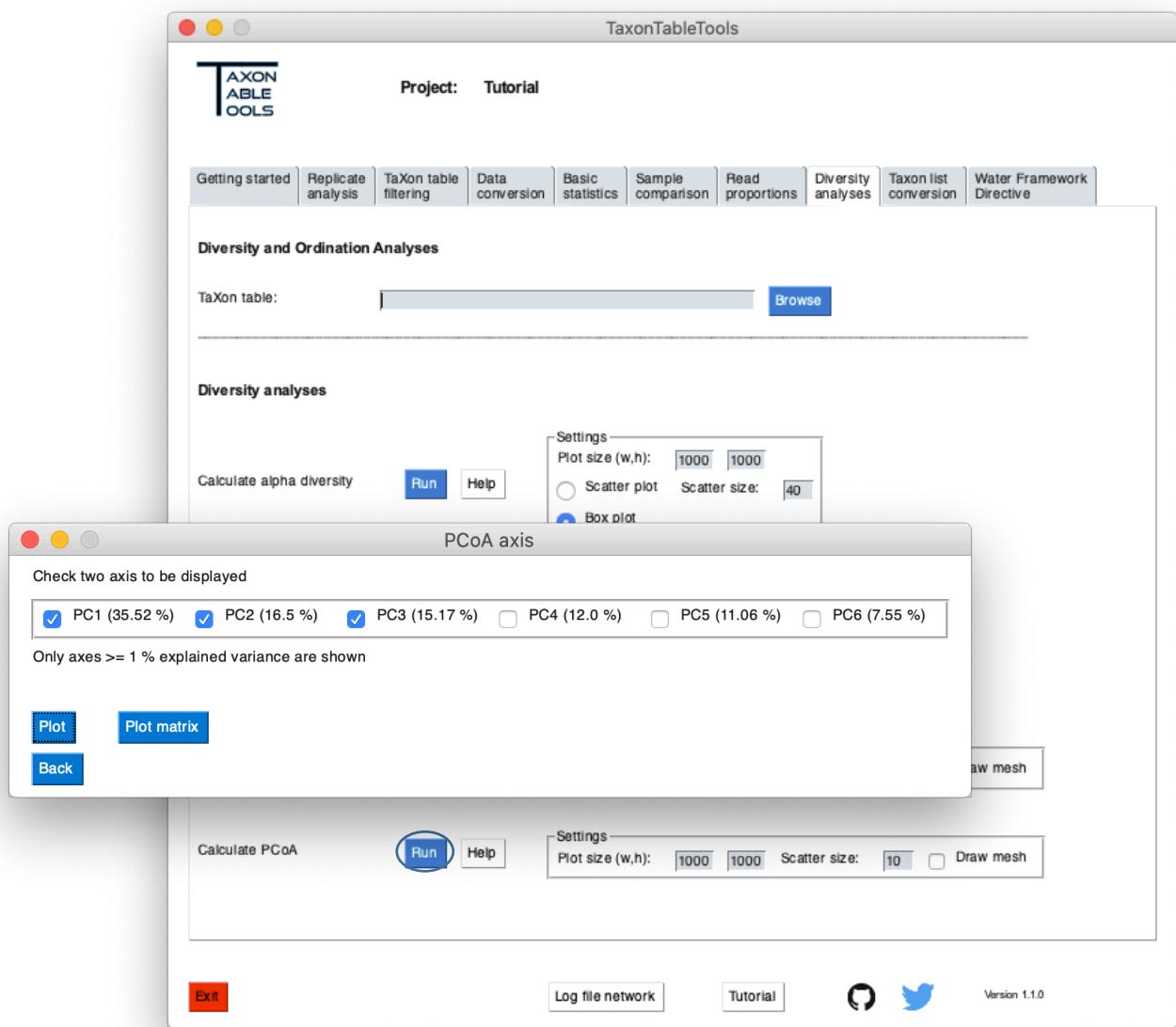


Beta diversity



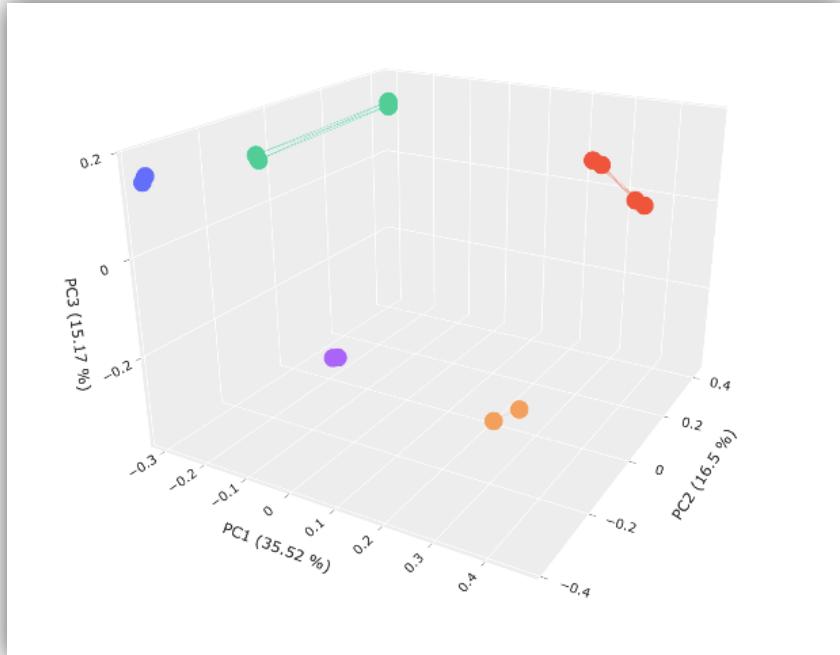
Ordination analyses

- Load the latest TaXon table (*TTT_cons_derep_arthropods_no_NC.xlsx*)
- All ordination analyses require **presence absence data and a meta data table**
- Perform a PCoA analysis
 - Choose a meta data to test (e.g. Location_ID)
 - This will plot the number of OTUs per sample
- Three options are available
 - Choosing 2 axes will create a 2D plot
 - Choosing 3 axes will create a 3D plot
 - The plot matrix option will create a matrix of the 4 first axes

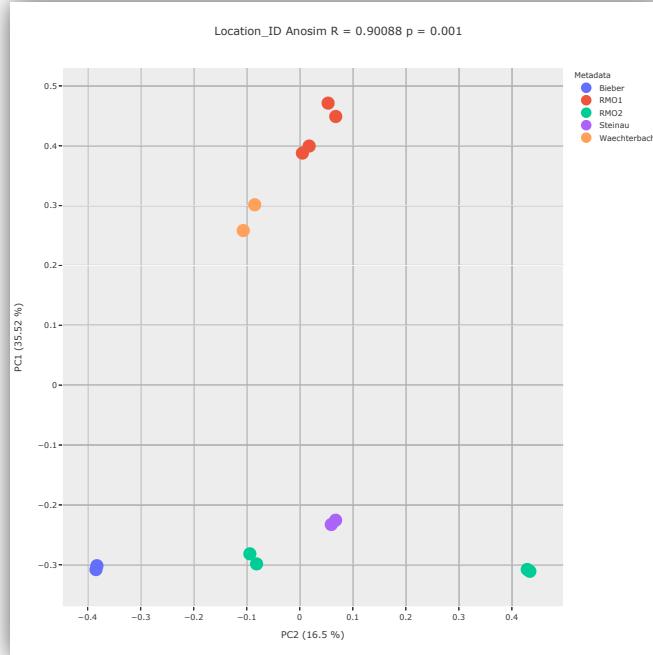


Ordination analyses

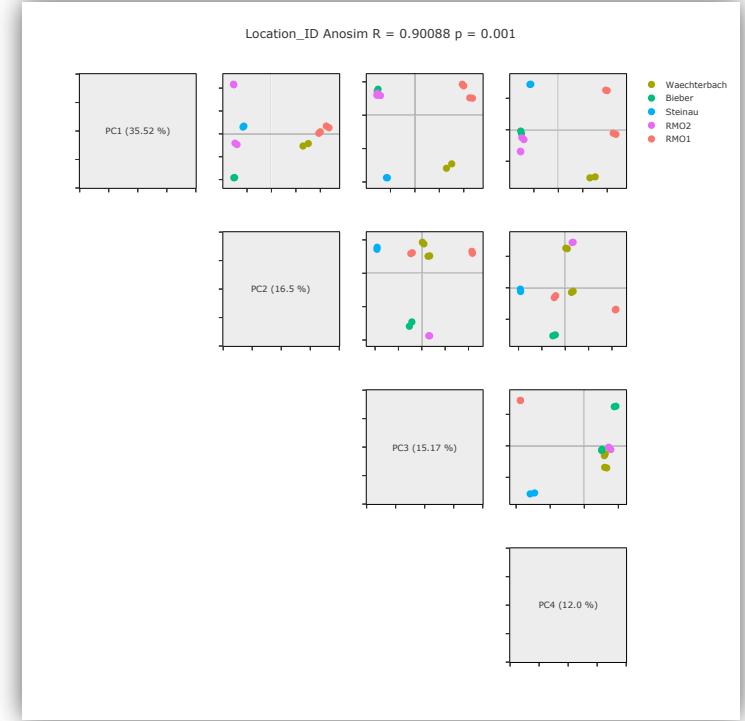
PCoA 3d plot



PCoA 2d plot



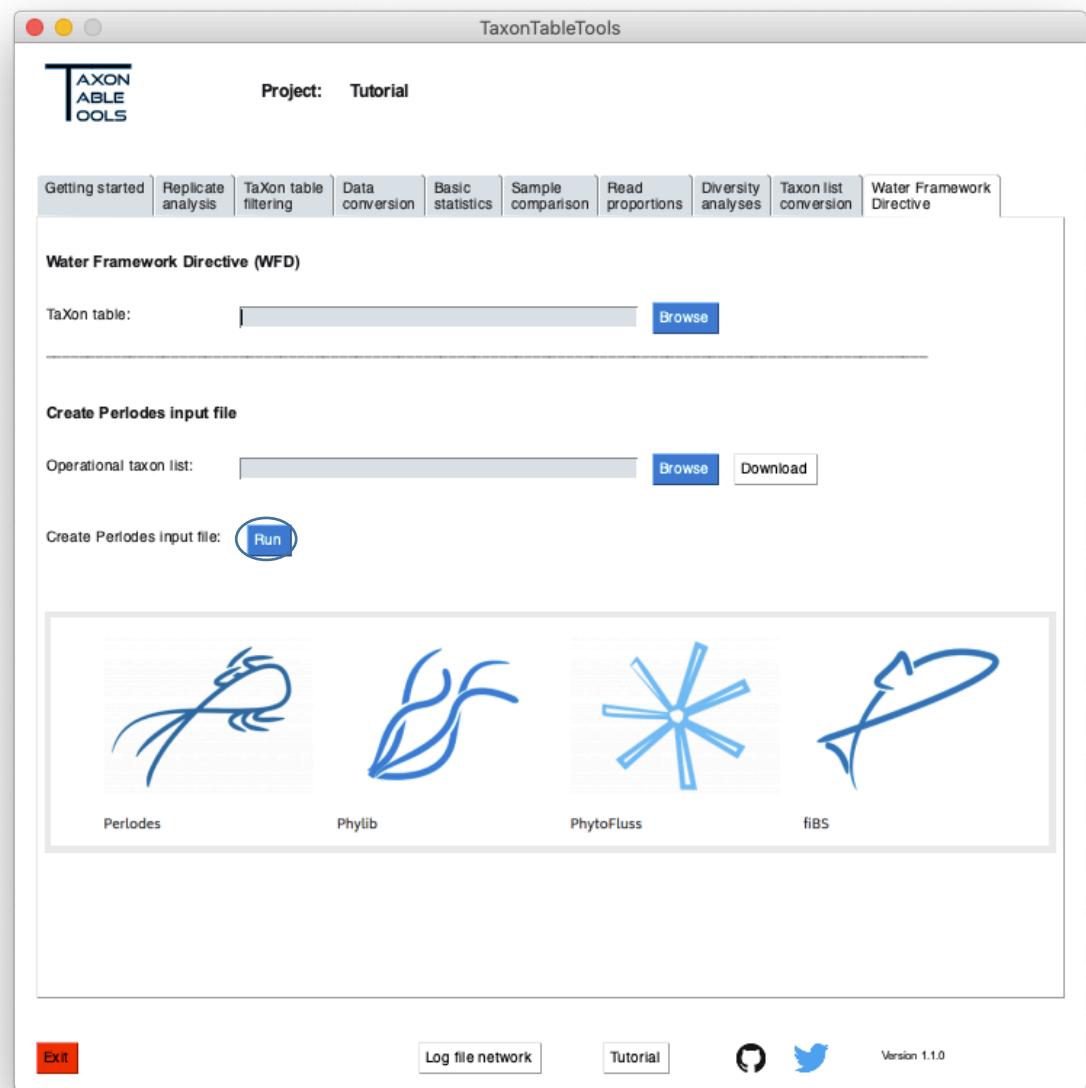
PCoA matrix plot



Water Framework Directive

TTT offer a conversion tool for the ecological quality assessment of streams according to the Water Framework Directive

- ***This is currently beta***
- Only macrozoobenthos data can be converted for now
- The conversion is based on the German evaluation program
- Future versions will include more conversions
- Load the latest TaXon table (*TTT_cons_derep_arthropods_no_NC.xlsx*)
- Download the latest operational taxon list
- Convert the TaXon table to the perlodes format



Water Framework Directive

The operational taxon list is used as reference to assign the WFD specific ID to each species present in the dataset

Two tables are created:

- A conversion history table to check for potential errors
- A perlodes input-ready table for quality assessment evaluations

A	B	C	D	E	F	G	I	J
Operationelle Taxonliste								
Gruppe	Familie	DV-Nr.	Taxonname (Bundesstaatliste)	ID-Art (Perlodes-Datenbank)	zu verwendende Bestimmungsliteratur	Anmerkungen		
PORIFERA								
9	1014	Spongidae	8846 Spongidae Gen. sp.					
10	5892	Hydrozoa	9247 Hydrozoa Gen. sp.	Holstein (1995), Bröch (1928)	Bröch (1928) nur relevant für Typ 2 & 3 Gewässer			
11	5289	Cordylophoridae	4743 Cordylophora caspia		häufigsteart			
TURBELLARIA								
12				Reynoldson & Young (2000) plus Ergänzung Pauls (2004)				
13	1274	Turbellaria	8181 Turbellaria Gen. sp.					
14	1230	Bellidiscularia punctata	111561 Bellidiscularia punctata		für unvollständige oder schlecht konservierte Exemplare			
15	1265	Dendrocoelidae	9862 Dendrocoelum sp.		für unvollständige oder schlecht konservierte Exemplare			
16	1007	Dendrocoelum lacteum	4911 Dendrocoelum lacteum					
17	1243	Dendrocoelum romanoanomale	9189 Dendrocoelum romanoanomale					
18	1946	Dugesiidae	5021 Dugesia sp.	Pauls (2004)	Nearctic aus Prämeistischen Raum, bisher aus Donau, Main und Rhein bekannt			
19	1011	Dugesia gonocephala	5018 Dugesia gonocephala		für unvollständige oder schlecht konservierte Exemplare			
20	1217	Dugesia lugubris / polyphemus	91745 Dugesia lugubris/polyphemus	Pauls (2004)				
21	1104	Dugesia lugubris	519 Dugesia lugubris					
22	1046	Crenobia alpina	4771 Crenobia alpina					
23	1262	Phagocotyla	13646 Phagocotyla sp.					
24	1200	Polycelidae	615 Polycelidae					
25	1371	Polycelidae	7744 Polycelidae sp.		für unvollständige oder schlecht konservierte Exemplare			
26	1016	Polycelidae felina	6463 Polycelidae felina		Quellen, Quellbäche, Bachoberläufe			
27	1222	Polycelidae nigra / fennicus	13866 Polycelidae nigra/fennicus					
GASTROPODA								
28				Göber & Meier-Brook (2003), Göber (2002)				
29	1095	Aciculidae	4205 Aciculidae leucostoma					
30	1202	Assimineidae	14464 Assiminea granaea					
31	1112	Bithynidae	4461 Bithynia sp.					
32	1398	Littorinidae lascoria	416 Littorina lascoria					
33	1009	Bithynia tentaculata	4462 Bithynia tentaculata					
34	1917	Bithynia triserialis	16772 Bithynia triserialis					
35	1564	Calyptraeidae	919 Calyptraeidae Gen. sp.					
36	1067	Bythidae	4513 Bythidae sp.		für Juvenile			
37	1991	Bythophoreum	8808 Bythophoreum sp.		Quellen und Quellbäche, kalkmeidend			
38	1233	Limnephilidae	1233 Limnephilidae					
39	1070	Lithoglyphus naticoides	5896 Lithoglyphus naticoides		Brackwasser			
40	1200	Marionellidae schultzii	5847 Marionellidae schultzii					
41	8551	Monopeltis aciculoides	8551 Monopeltis aciculoides					
42								
Anmerkungen		Operationelle Taxonliste						

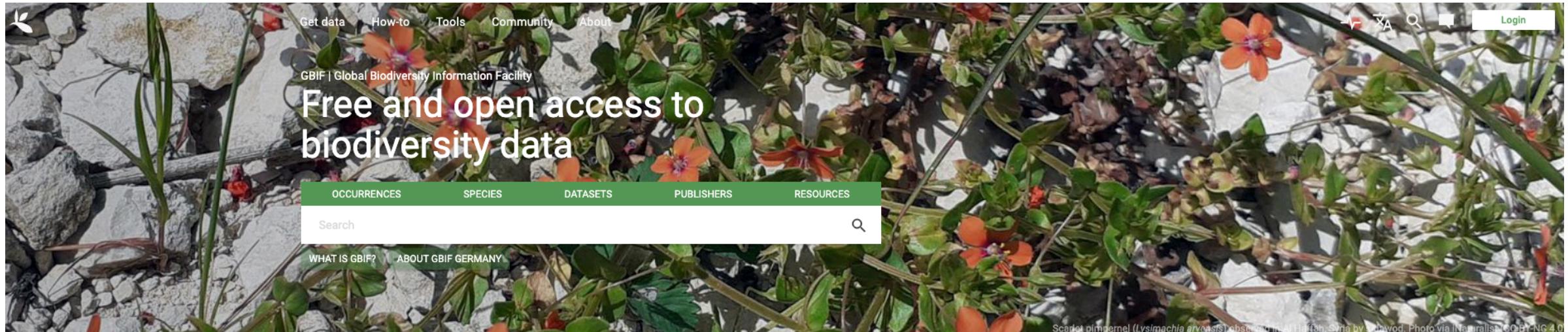


1	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	ID_ART	TAXON_NAME
2	OTU_1	Arthropoda	Malacostraca	Amphipoda	Gammaridae	Gammarus	Gammarus pulex	5291	Gammarus pulex									
3	OTU_2	Arthropoda	Insecta	Hemiptera	Aphelocheiridae	Aphelocheirus	Aphelocheirus aestivalis	5335	Aphelocheirus aestivalis									
4	OTU_3	Arthropoda	Insecta	Ephemeroptera	Baetidae	Baetis	Baetis rhodani	5415	Baetis rhodani									
5	OTU_4	Arthropoda	Malacostraca	Amphipoda	Gammaridae	Gammarus	Gammarus roeselli	5292	Gammarus roeselli									
6	OTU_5	Arthropoda	Insecta	Ephemeroptera	Heptageniidae	Ecdyonurus	Ecdyonurus torrentis	5053	Ecdyonurus sp.									
7	OTU_6	Arthropoda	Insecta	Ephemeroptera	Ephemeridae	Ephemera	Ephemera danica	5124	Ephemera danica									
8	OTU_7	Arthropoda	Insecta	Ephemeroptera	Baetidae	Baetis	Baetis rhodani	5415	Baetis rhodani									
9	OTU_8	Arthropoda	Insecta	Trichoptera	Hydropsychidae	Hydropsyche	Hydropsyche pellucida	13023	Hydropsyche pellucida									
10	OTU_9	Arthropoda	Insecta	Trichoptera	Hydropsychidae	Hydropsyche	Hydropsyche siltalai	5604	Hydropsyche siltalai									
11	OTU_11	Arthropoda	Insecta	Coleoptera	Elmidae	Limnius	Limnius volckmari	18421	Limnius volckmari									
12	OTU_13	Arthropoda	Insecta	Trichoptera	Odontoceridae	Odontocerum	Odontocerum albicorne	6168	Odontocerum albicorne									
13	OTU_14	Arthropoda	Insecta	Trichoptera	Odontoceridae	Odontocerum	Odontocerum albicorne	6168	Odontocerum albicorne									
14	OTU_15	Arthropoda	Insecta	Trichoptera	Limnephilidae	Chaetopteryx	Chaetopteryx fusca	5809	Limnephilidae Gen. sp.									
15	OTU_17	Arthropoda	Insecta	Trichoptera	Sericostomatidae	Sericostoma	Sericostoma personatum	6818	Sericostoma sp.									
16	OTU_18	Arthropoda	Insecta	Coleoptera	Dytiscidae	Oreodytes	Oreodytes samarkii	18616	Oreodytes samarkii									
17	OTU_19	Arthropoda	Insecta	Odonata	Cordulegastridae	Cordulegaster	Cordulegaster boltonii	4740	Cordulegaster boltonii									
18	OTU_20	Arthropoda	Insecta	Ephemeroptera	Baetidae	Baetis	Baetis scambus	4416	Baetis scambus									
19	OTU_21	Arthropoda	Insecta	Elmidae	Elmis	Elmis aenea	17779	Elmis sp.										
20	OTU_22	Arthropoda	Insecta	Diptera	Dicranota	Dicranota	Dicranota pavida	4955	Dicranota sp.									
21	OTU_23	Arthropoda	Insecta	Ephemeroptera	Heptageniidae	Heptagenia	Heptagenia flava	5450	Heptagenia flava									
22	OTU_24	Arthropoda	Insecta	Trichoptera	Limnephilidae	Halesus	Halesus digitatus	5378	Halesus sp.									

| 1 | A | B | C | D | E | F | G | H | I | J | K | L | M | N | O | P | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 | 57 | 58 | 59 | 60 | 61 | 62 | 63 | 64 | 65 | 66 | 67 | 68 | 69 | 70 | 71 | 72 | 73 | 74 | 75 | 76 | 77 | 78 | 79 | 80 | 81 | 82 | 83 | 84 | 85 | 86 | 87 | 88 | 89 | 90 | 91 | 92 | 93 | 94 | 95 | 96 | 97 | 98 | 99 | 100 | 101 | 102 | 103 | 104 | 105 | 106 | 107 | 108 | 109 | 110 | 111 | 112 | 113 | 114 | 115 | 116 | 117 | 118 | 119 | 120 | 121 | 122 | 123 | 124 | 125 | 126 | 127 | 128 | 129 | 130 | 131 | 132 | 133 | 134 | 135 | 136 | 137 | 138 | 139 | 140 | 141 | 142 | 143 | 144 | 145 | 146 | 147 | 148 | 149 | 150 | 151 | 152 | 153 | 154 | 155 | 156 | 157 | 158 | 159 | 160 | 161 | 162 | 163 | 164 | 165 | 166 | 167 | 168 | 169 | 170 | 171 | 172 | 173 | 174 | 175 | 176 | 177 | 178 | 179 | 180 | 181 | 182 | 183 | 184 | 185 | 186 | 187 | 188 | 189 | 190 | 191 | 192 | 193 | 194 | 195 | 196 | 197 | 198 | 199 | 200 | 201 | 202 | 203 | 204 | 205 | 206 | 207 | 208 | 209 | 210 | 211 | 212 | 213 | 214 | 215 | 216 | 217 | 218 | 219 | 220 | 221 | 222 | 223 | 224 | 225 | 226 | 227 | 228 | 229 | 230 | 231 | 232 | 233 | 234 | 235 | 236 | 237 | 238 | 239 | 240 | 241 | 242 | 243 | 244 | 245 | 246 | 247 | 248 | 249 | 250 | 251 | 252 | 253 | 254 | 255 | 256 | 257 | 258 | 259 | 260 | 261 | 262 | 263 | 264 | 265 | 266 | 267 | 268 | 269 | 270 | 271 | 272 | 273 | 274 | 275 | 276 | 277 | 278 | 279 | 280 | 281 | 282 | 283 | 284 | 285 | 286 | 287 | 288 | 289 | 290 | 291 | 292 | 293 | 294 | 295 | 296 | 297 | 298 | 299 | 300 | 301 | 302 | 303 | 304 | 305 | 306 | 307 | 308 | 309 | 310 | 311 | 312 | 313 | 314 | 315 | 316 | 317 | 318 | 319 | 320 | 321 | 322 | 323 | 324 | 325 | 326 | 327 | 328 | 329 | 330 | 331 | 332 | 333 | 334 | 335 | 336 | 337 | 338 | 339 | 340 | 341 | 342 | 343 | 344 | 345 | 346 | 347 | 348 | 349 | 350 | 351 | 352 | 353 | 354 | 355 | 356 | 357 | 358 | 359 | 360 | 361 | 362 | 363 | 364 | 365 | 366 | 367 | 368 | 369 | 370 | 371 | 372 | 373 | 374 | 375 | 376 | 377 | 378 | 379 | 380 | 381 | 382 | 383 | 384 | 385 | 386 | 387 | 388 | 389 | 390 | 391 | 392 | 393 | 394 | 395 | 396 | 397 | 398 | 399 | 400 | 401 | 402 | 403 | 404 | 405 | 406 | 407 | 408 | 409 | 410 | 411 | 412 | 413 | 414 | 415 | 416 | 417 | 418 | 419 | 420 | 421 | 422 | 423 | 424 | 425 | 426 | 427 | 428 | 429 | 430 | 431 | 432 | 433 | 434 | 435 | 436 | 437 | 438 | 439 | 440 | 441 | 442 | 443 | 444 | 445 | 446 | 447 | 448 | 449 | 450 | 451 | 452 | 453 | 454 | 455 | 456 | 457 | 458 | 459 | 460 | 461 | 462 | 463 | 464 | 465 | 466 | 467 | 468 | 469 | 470 | 471 | 472 | 473 | 474 | 475 | 476 | 477 | 478 | 479 | 480 | 481 | 482 | 483 | 484 | 485 | 486 | 487 | 488 | 489 | 490 | 491 | 492 | 493 | 494 | 495 | 496 | 497 | 498 | 499 | 500 | 501 | 502 | 503 | 504 | 505 | 506 | 507 | 508 | 509 | 510 | 511 | 512 | 513 | 514 | 515 | 516 | 517 | 518 | 519 | 520 | 521 | 522 | 523 | 524 | 525 | 526 | 527 | 528 | 529 | 530 | 531 | 532 | 533 | 534 | 535 | 536 | 537 | 538 | 539 | 540 | 541 | 542 | 543 | 544 | 545 | 546 | 547 | 548 | 549 | 550 | 551 | 552 | 553 | 554 | 555 | 556 | 557 | 558 | 559 |
<th
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |

New in version 1.1: GBIF API-based tools

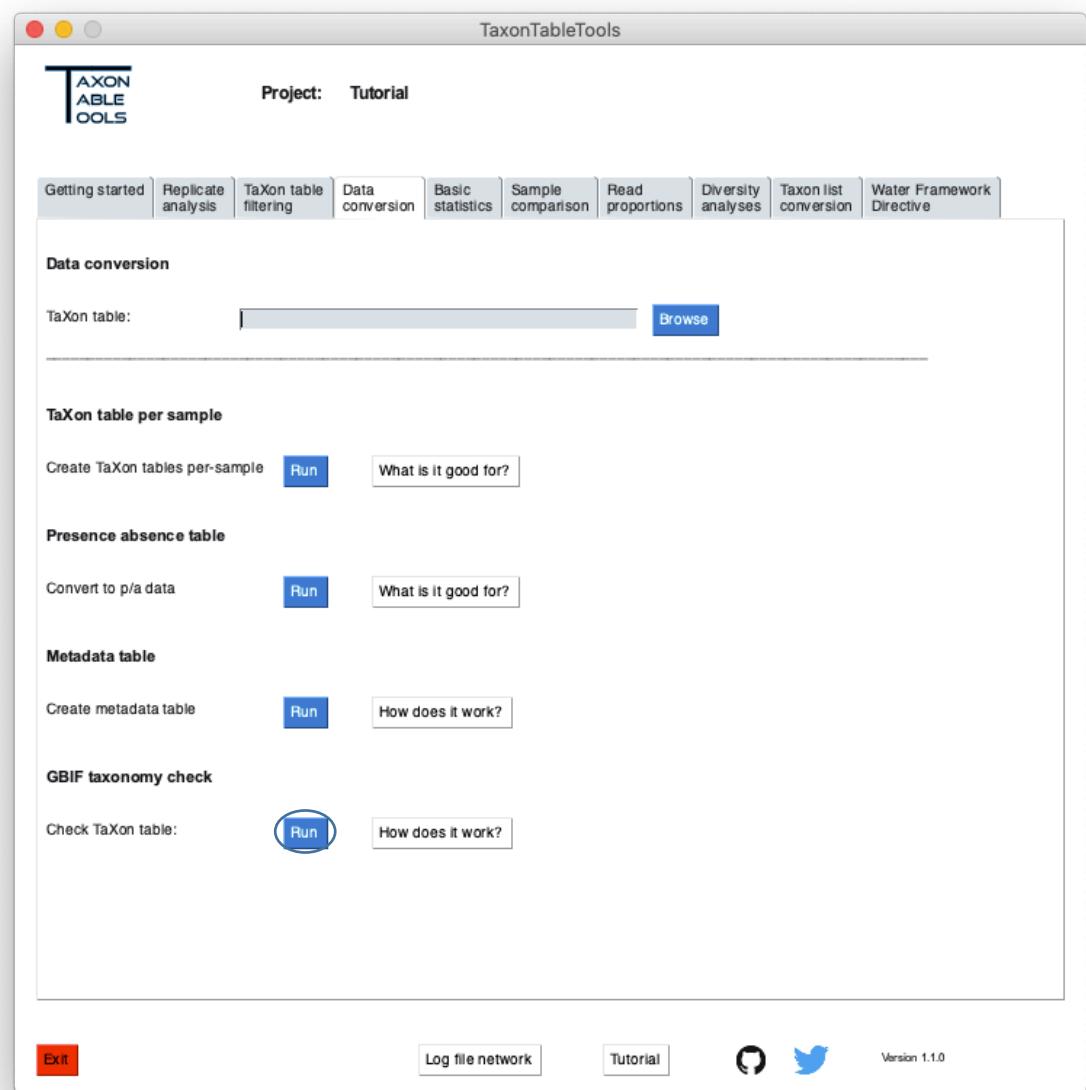
The GBIF (Global Biodiversity Information Facility) database offers several useful functions to download information on taxonomic data



GBIF taxonomy check

GBIF offers the correction for spelling mistakes and for synonyms of taxonomic datasets

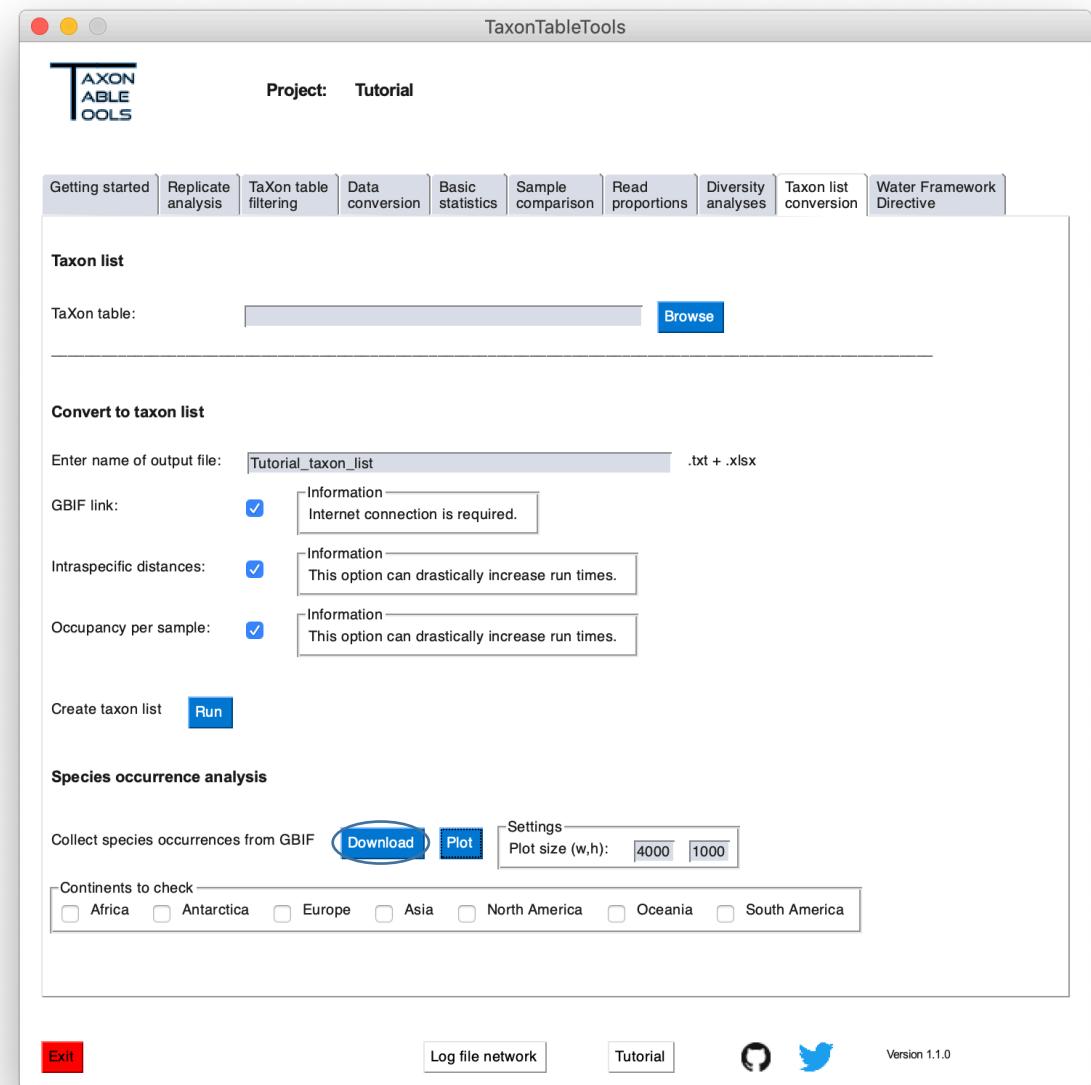
- Load the latest TaXon table (*TTT_cons_derep_arthropods_no_NC.xlsx*)
- Run the GBIF taxonomy check
- Two tables will be created:
 - A new, corrected TaXon table
 - A log file where each correction can be tracked
- Warning: Always check the GBIF log file for possible mistakes
- For some groups information on specific taxonomic levels is not available and will be left blank



GBIF species occurrence

GBIF offers the assessment of occurrence data for species

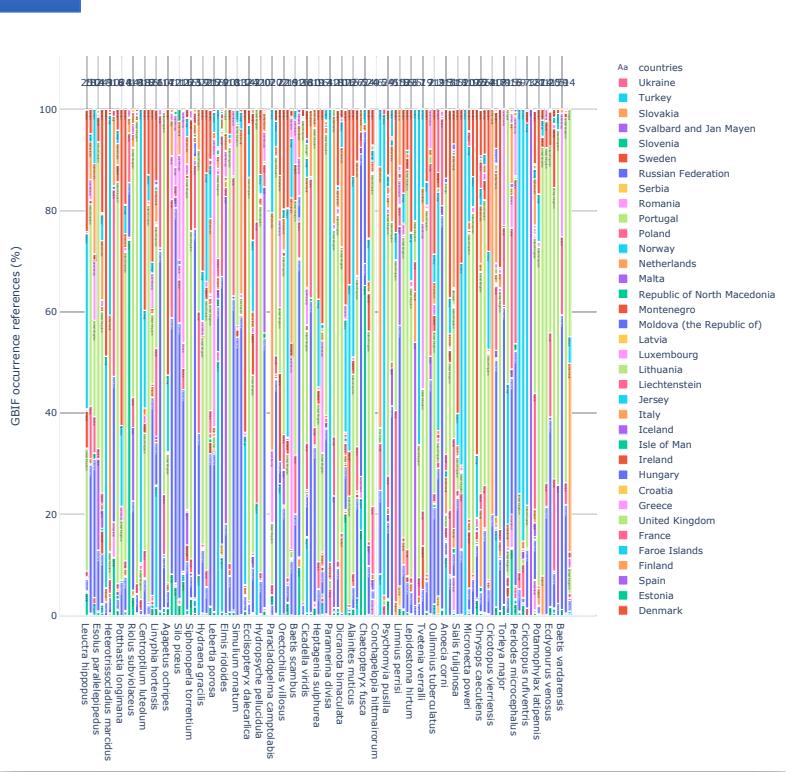
- Load the latest TaXon table (*TTT_cons_derep_arthropods_no_NC_gbif.xlsx*)
- Run the GBIF occurrence analysis
- Check mark Europe for this example
- This will roughly take 17 minutes
- The relative number of species reference in the GBIF database is plotted
- This allows to quickly assess the dataset for the species distributions
- Furthermore, potential bias can be quickly detected when species do not occur in the sampled region



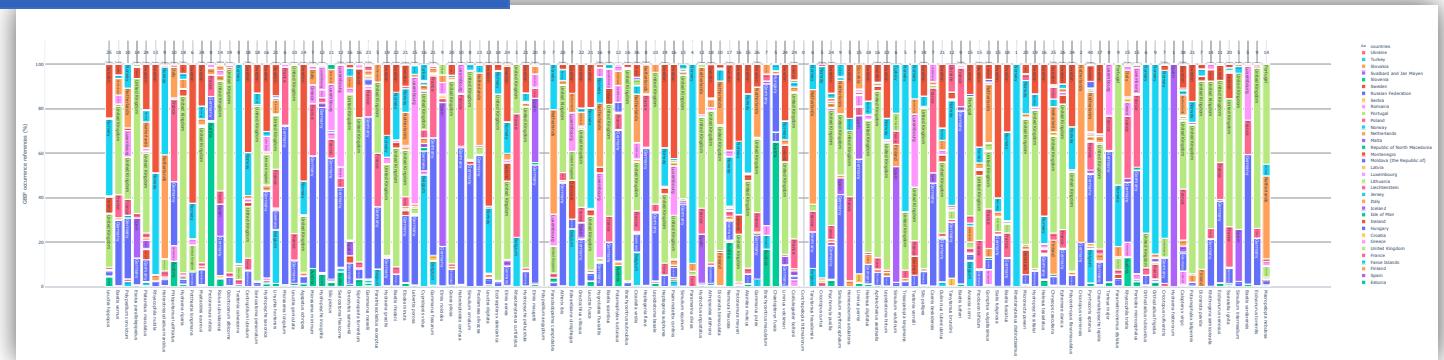
GBIF species occurrence

Use the plot function to plot the occurrence data again, with adjusted width and height!

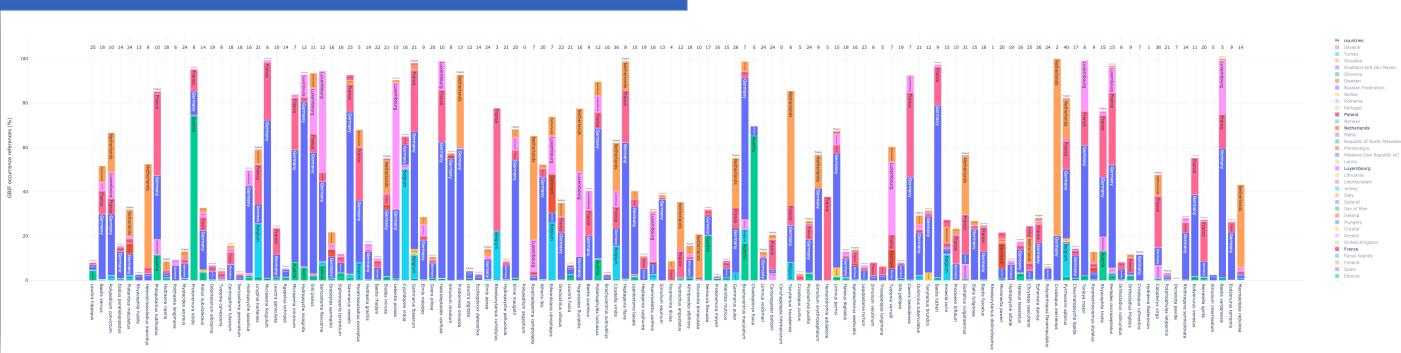
Raw



Re-plotted with adjusted size



Only Germany and surrounding countries



GBIF species occurrence

Both the absolute and relative occurrence reference numbers are written to an excel sheet

	Country	<i>Idytes sannitopycus</i>	<i>slimis maugaeus</i>	<i>stenia verrutorus</i>	<i>torrifera</i>	<i>drena riparia</i>	<i>greteticis</i>	<i>scambus</i>	<i>ranota pavo</i>	<i>tochilus vilius</i>	<i>voeltzkovii</i>	<i>rhodinus</i>	<i>tuberigena</i>	<i>semidicaphila</i>	<i>nubecula</i>	<i>pellis</i>	<i>risoiloatus</i>	<i>sus disti</i>	<i>parallelepipedopteryx</i>	<i>limis annae</i>	<i>annularis pulena</i>	<i>fosterorum</i>		
1	Austria	0.19	0.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00			
2	Bosnia and Herzegovina	0.00	0.00	0.53	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00			
3	Belgium	0.89	0.03	0.07	0.00	0.00	0.30	0.12	0.00	0.00	0.00	0.03	0.02	2.11	0.05	0.00	0.00	0.00	0.00	0.03	0.02	0.00		
4	Bulgaria	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00			
5	Belarus	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00			
6	Switzerland	0.02	0.01	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.02	0.00	0.02	0.01	0.00	0.09	0.00	0.00	0.00	0.00	0.00			
7	Czechia	0.00	0.00	0.00	0.05	0.00	0.13	0.02	0.01	0.00	0.01	0.05	0.00	0.04	0.01	0.00	0.01	0.00	0.20	0.00	0.21	0.00		
8	Germany	9.57	7.02	53.18	5.17	21.40	2.05	12.36	20.06	0.00	20.99	9.52	5.22	19.07	21.20	2.67	6.39	17.72	0.00	12.03	4.35	8.69	19.82	0.00
9	Denmark	3.30	0.04	0.00	8.62	0.00	0.00	0.25	0.00	0.12	0.30	0.04	0.03	0.01	0.00	0.01	0.07	0.00	0.00	0.00	0.02	0.77	0.00	
10	Estonia	0.00	0.00	1.05	0.00	0.00	0.71	0.11	0.00	0.00	0.26	0.06	0.01	0.54	0.00	0.01	0.01	0.00	0.00	0.03	0.02	0.00		
11	Spain	6.47	0.03	28.87	0.00	0.00	0.81	0.03	0.00	0.00	6.89	3.96	0.06	0.25	0.15	0.00	0.01	64.66	0.00	18.03	0.00	2.39	0.02	100.00
12	Finland	0.32	0.39	0.00	0.00	0.00	0.00	0.45	0.29	0.00	7.74	0.13	0.06	0.00	0.35	0.00	2.67	0.42	0.00	0.00	0.13	0.55	0.00	
13	France	0.24	0.38	4.45	0.00	4.33	1.05	0.56	1.00	0.00	6.00	0.71	3.24	0.00	0.00	0.00	1.19	1.87	0.00	2.01	0.00	0.47	8.74	0.00
14	United Kingdom	56.45	71.33	40.00	24.14	72.16	79.39	46.05	50.23	38.84	33.25	41.57	53.28	32.02	66.02	0.00	72.45	0.00	60.61	0.00	35.12	33.12	0.00	
15	Greece	0.00	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
16	Croatia	0.00	0.00	0.01	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
17	Hungary	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
18	Ireland	0.64	0.02	0.00	0.00	0.95	3.22	0.32	7.18	2.08	0.75	7.42	2.46	3.24	5.13	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
19	Isle of Man	0.00	0.08	0.00	0.00	0.00	0.02	0.04	0.00	0.00	0.03	0.00	0.01	0.02	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
20	Italy	0.05	0.00	0.38	0.00	0.00	0.00	0.00	0.00	0.13	0.04	0.04	0.01	0.20	0.01	1.56	0	1	0	30	45	104	1	
21	Liechtenstein	0.00	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
22	Lithuania	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
23	Luxembourg	2.14	1.08	5.86	32.76	0.52	0.12	2.85	8.81	0.00	0.27	0.34	1.12	2.10	2.17	0.00	0.39	5	5	0	0	0	0	
24	Latvia	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
25	Montenegro	0.00	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
26	Netherlands	5.42	0.06	3.57	6.90	0.13	4.17	0.05	0.08	0.12	6.25	2.03	0.04	4.31	0.01	0.07	0.37	3	8	0	0	1	8	
27	North Macedonia	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
28	Norway	3.70	5.93	0.00	15.52	0.00	2.65	0.82	1.84	3.23	1.75	8.40	21.37	5.55	0.00	45.74	3.83	9	0	207	15	0	0	
29	Poland	0.00	0.00	0.02	0.00	0.00	0.02	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
30	Portugal	0.08	0.02	0.29	0.00	0.00	0.00	0.00	0.00	0.09	0.13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4	1	44	0		
31	Romania	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1206	0	0		
32	Serbia	0.00	0.00	0.12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
33	Russian Federation	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	14	242	186		
34	Sweden	1.61	13.26	0.00	0.00	0.00	4.08	31.93	0.11	2.08	19.66	25.42	12.58	28.60	0.00	48.73	12.85	0	409	29844	3331	4630	1913	
35	Svalbard and Jan Mayen	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
36	Slovakia	0.00	0.00	0.00	0.36	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
37	Turkey	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
38																								
	Country	<i>Idytes sannitopycus</i>	<i>slimis maugaeus</i>	<i>stenia verrutorus</i>	<i>torrifera</i>	<i>drena riparia</i>	<i>greteticis</i>	<i>scambus</i>	<i>ranota pavo</i>	<i>tochilus vilius</i>	<i>voeltzkovii</i>	<i>rhodinus</i>	<i>tuberigena</i>	<i>semidicaphila</i>	<i>nubecula</i>	<i>pellis</i>	<i>risoiloatus</i>	<i>sus disti</i>	<i>parallelepipedopteryx</i>	<i>limis annae</i>	<i>annularis pulena</i>	<i>fosterorum</i>		
1	Austria	12	37	40	0	2	42	42	1	0	9	30	35	14	15	0	64	4	0	30	45	104	1	
2	Bosnia and Herzegovina	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
3	Belgium	56	14	3	0	0	8	14	0	0	12	6	16	232	4	0	27	0	0	3	0	12	736	
4	Bulgaria	0	0	0	0	0	0	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
5	Belarus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
6	Switzerland	1	6	0	0	0	0	0	1	0	0	0	0	0	0	0	0	4	2	0	0	0	0	
7	Czechia	0	0	0	2	0	3	1	1	0	0	1	0	1	4	0	0	2	0	0	10	65	1	
8	Germany	600	2936	2222	3	495	86	1401	763	0	1559	1915	4814	2100	1810	764	1871	171	0	603	3	2701	4318	
9	Denmark	207	15	0	5	0	0	28	0	1	22	9	28	1	0	3	20	0	0	0	0	5	167	
10	Estonia	0	1	44	0	0	30	12	0	0	19	13	6	60	0	4	3	0	0	0	8	4	0	
11	Spain	406	14	1206	0	0	34	3	0	0	512	796	58	27	13	0	4	624	0	904	0	744	4	39
12	Finland	20	165	0	0	0	0	0	0	19	33	0	67	10	12	2	38	0	764	0	122	0	0	
13	France	15	242	186	4	100	44	442	0	0	512	143	2989	175	391	0	350	18	0	101	0	145	1904	0
14	United Kingdom																							

TTT log file

TTT tracks each module that was run and writes the users history to a log file

- Based on the log table a log network can be created to visualise the usage history

