bcAdmin 4.0 - Manual

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1. Introduction

bcAdmin will make working with batcorder recordings as well as other bat call files a lot easier. It takes away most of the organizing and supports you when analyzing. It is fine tuned to work with the batcorder and presents an elementary part of the batcorder-system. It is the database that stores information and does intelligent analysis.

The applications is primarily focused on the management of recordings and their meta information as well as the output of data compilations based on the raw data. In addition it automatically searches your recordings for bat calls, and takes measures of all found calls so batIdent can identify bat species. The meta information belonging to recordings are stored in a database-like file and can be filtered and otherwise manipulated.

bcAdmin was growing tied to the batcorder from its first release more than 10 years ago. It had to be able to cope with ever new arising tasks. bcAdmin4 is definitely the most powerful version we released and contains many new functions that were shaped from your input.

2. Installation

System requirements for running bcAdmin4 are an Apple Mac with Intel-CPU running Mac OS 10.15 or newer. We do recommend macOS 12 or newer and it may become mandatory in future.

We recommend at least 4GB of memory. After downloading the application zip archive, extract it into your Applications folder. If you are already using an older version of bcAdmin, we recommend you first rename the old version. To use the automatic identification you'll need batIdent and its components.

bcAdmin4 features an update process and will inform you if updates are available on our server. It can download the updates. To install the updates you have to quit bcAdmin 4 and copy the downloaded file to the applications folder (or where your bcAdmin copy resists). You can overwrite the existing version, the data is stored apart from the application file.

3. Overview of bcAdmin4

3.1. What does bcAdmin?

bcAdmin is designed to manage and analyse your bat call recordings. It combines a database with a sound analysis tool and creates tables and graphs for your reports. It works together well with batIdent and thus can obtain automatic species identification through it. That way you quickly get per species activity patterns and reports. In short: no need to switch between sound analysis app and spreadsheet app - it‘s all within bcAdmin.

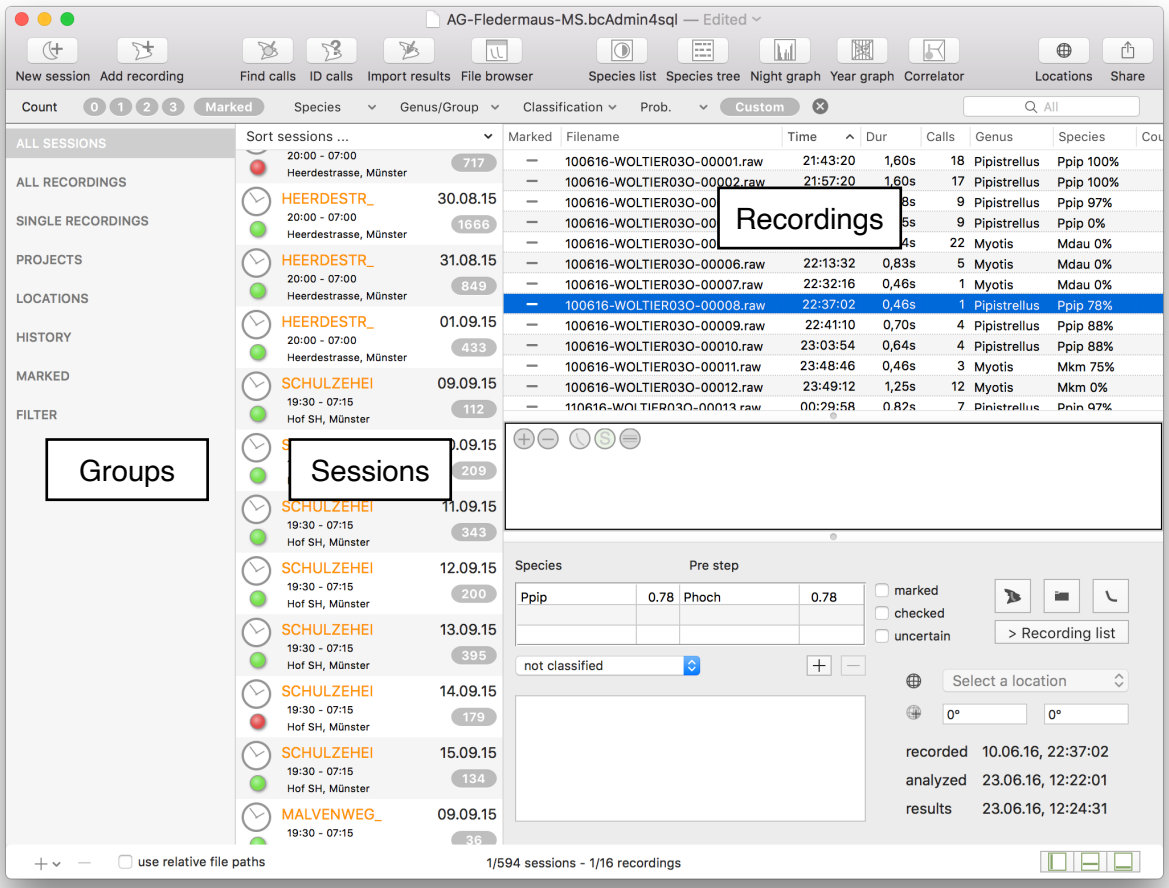
Since many steps in the analysis process are automated within bcAdmin, working with large datasets as created by passive recording systems is at least possible in a meaningful way. Only due to the objective call measurement and identification a basis for comparison of locations and nights is possible. Wether you‘re doing acoustic monitoring, comparison of activity for consulting or diversity indices - bcAdmin is the optimal tool for your work.

While the app is optimized for batcorder recordings, it works well with files of other systems as well. Nevertheless, many devices produce recordings with echoes or otherwise low sound quality. For these taking of automatic measurements may give less viable results or none at all. Note that some features of bcAdmin require special form of data only produced by the batcorder. Thus, some features may not work or only work partially with other recordings.

3.2. Short functional overview

Recordings are connected in bcAdmin to meta information regarding the sampling efforts (sessions) and location. Sessions and recordings may be filtered or grouped based on this data. Analysis of calls is done using an unique and lightning-fast algorithm. It works in batch-mode, finds every call matching your settings and takes measurements for each call. All calls can also been displayed on a per file basis and you can manually correct calls misclassified by batIdent (working for European bat species only). Per recording a maximum of three species entries is possible.

The comparison of data is possible due to the objective approach of call and species identification. Using these results calculations of activity based on recording count, recording duration or other activity groupings can be done. Different functions also visualise your data. Complex graphs can easily be created by a few clicks. In addition you can export data, graphs and do further calculations in any other application you like.



3.3. Data structures

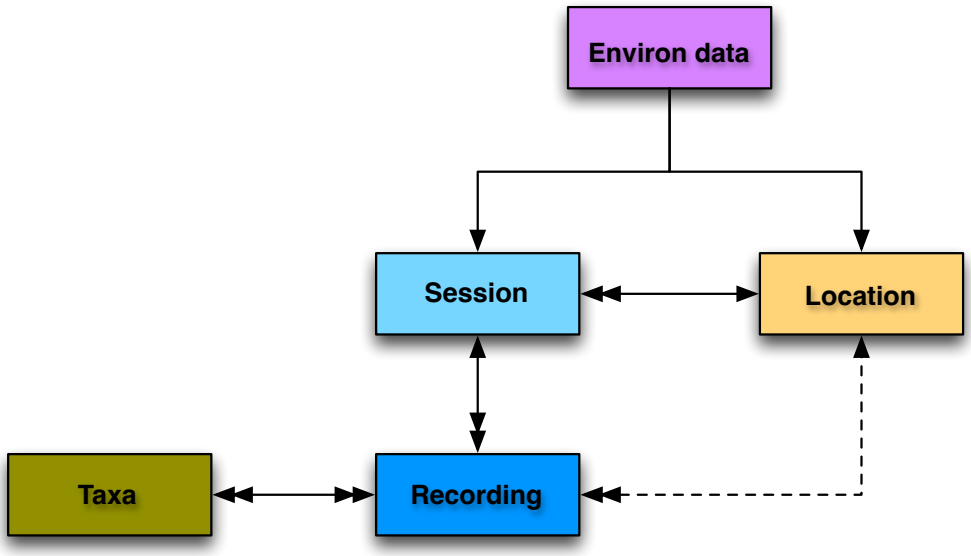
Before working with bcAdmin it is important to understand its concept of data management. The basic unit in bcAdmin is the **Session**. It includes the recordings of **one device and one night**. This data container is used throughout the program for calculations of activity and all data should be organized that way. You can group sessions in Projects for getting a better overview. Within a Session recordings are collected. To keep the database performant, the recordings themselves are not stored in the database, only meta-information and a link to the file is included. **The recording files are kept outside the database on your hard disc**. The same accounts for the measurement files (.bcCalls, .csv and .res after batIdent was run), these are stored also on disc, parallel to the recording files in the same folder.

So **after importing recordings into bcAdmin, you should not delete the files**. Each session keeps a link to the path of the recordings. This **file location** can be changed if files are moved for example from internal to an external disk. We chose this system, since then you can easily backup files and other applications like bcAnalyze can easily access the recordings and related files.

After importing and analysing the recordings you could delete the recording files to save disk space. While that is tempting, we recommend to not delete these files, but maybe first back them up. bcAdmin offers to archive the files of If later new tools allow better analysis you can re-analyze your data. In addition to Sessions and Recordings other objects like Locations and Projects are stored within the bcAdmin database. Sessions can be connected to these objects and thus be grouped.

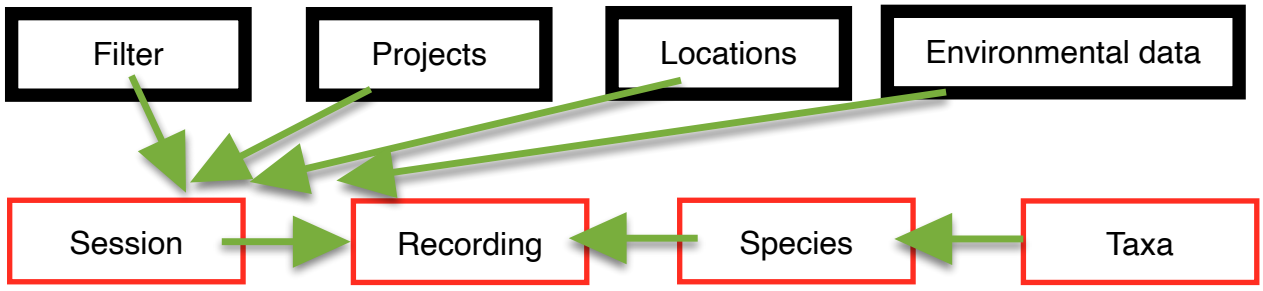
To import results bcAdmin holds a list of all species results of batIdent. A complete overview is given in the Taxon-Editor of bcAdmin. There you can also change display colors for selected species.

Apart from recording relevant entries (session, recording) additional objects can be created and stored. These are projects, taxa, location and environmental data (including for example wind measures and temperatures).



4. Creating database entries

As mentioned above, information is organised in Session, Project and Location objects within bcAdmin. When importing recordings and thus creating a new session, the addition of a project or location is not necessary. It can be done later on as well. Nevertheless, to utilise some functions, locations are necessary. We thus recommend to not be too lazy, but keep your database up to date. Sessions can be connected to locations and projects any time. The following chapters will shed some more light on the data structures and show how to import data easily.



4.1. Locations

If the batcorder is used for a single or multiple nights for passive, stationary monitoring information for this location can be stored within bcAdmin. Note that bcAdmin is primarily designed for working with data from one location per night, and thus not optimized for transect data. Yet as explained in a later chapter, it can be used for mobile sampled data as well.

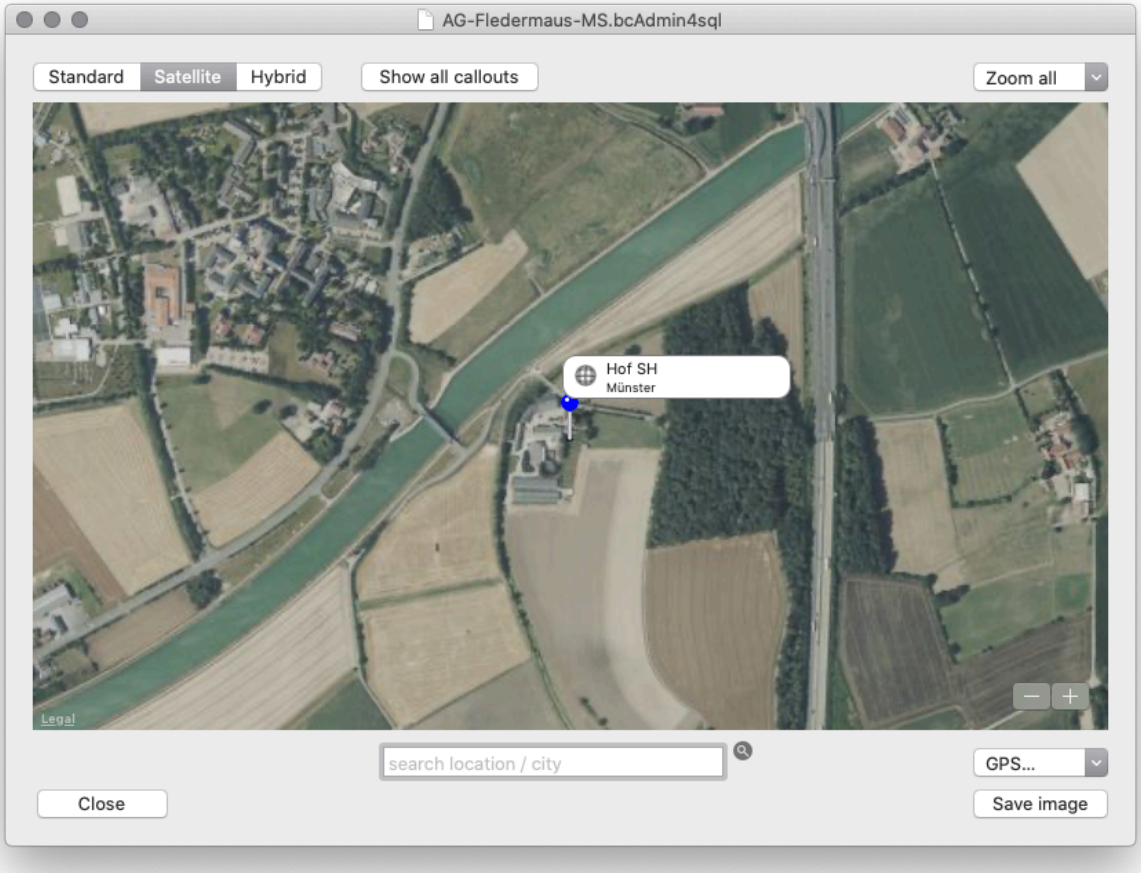
Usually a location is connected to a session. To create new locations or modify existing ones choose **Window -> Locations** and a window opens. There you get a list of all available locations. In addition you can filter locations and edit selected locations. For referencing a location throughout bcAdmin it needs a name and entry for closest city. You can copy and paste locations using the standard shortcut cmd+c and cmd+v.

Coordinates

Coordinates can be added in decimal degrees (WGS84). Using these coordinates bcAdmin can calculate for example sunset and sunrise times. They can also be acquired from the map. Choose „Set coordinates from map“ and then mark the location by right clicking within the map. Next save the coordinates and proceed as usual.

Show sun times

This function gives a graph showing sunset and sunrise times. It may be useful in planning batcorder timer setup in advance. It needs coordinates to be set for the location.



Central store

bcAdmin 4 has a new feature. It creates a central database per Mac user and uses information on location and taxa stored there as default when creating new databases. To add locations to the central store you can select one or multiple in the location editor and copy them to the central store. You also can import from the central store. To view the central store choose from Window menu the command **Shared locations**.

4.2. Projects

Projects offer the possibility to organise your sessions similar to your work projects. Projects are shown and maintained in the leftmost column of the document window. Per right-click or with the **+**-button (window bottom) projects and groups can be created.

Next to each project a number indicates the number of sessions contained within the project. After you have selected a project, the session table will reload and only sessions belonging to the project will get displayed. You can add folders for organising your projects. Sessions can be assigned only to projects and not to folders.

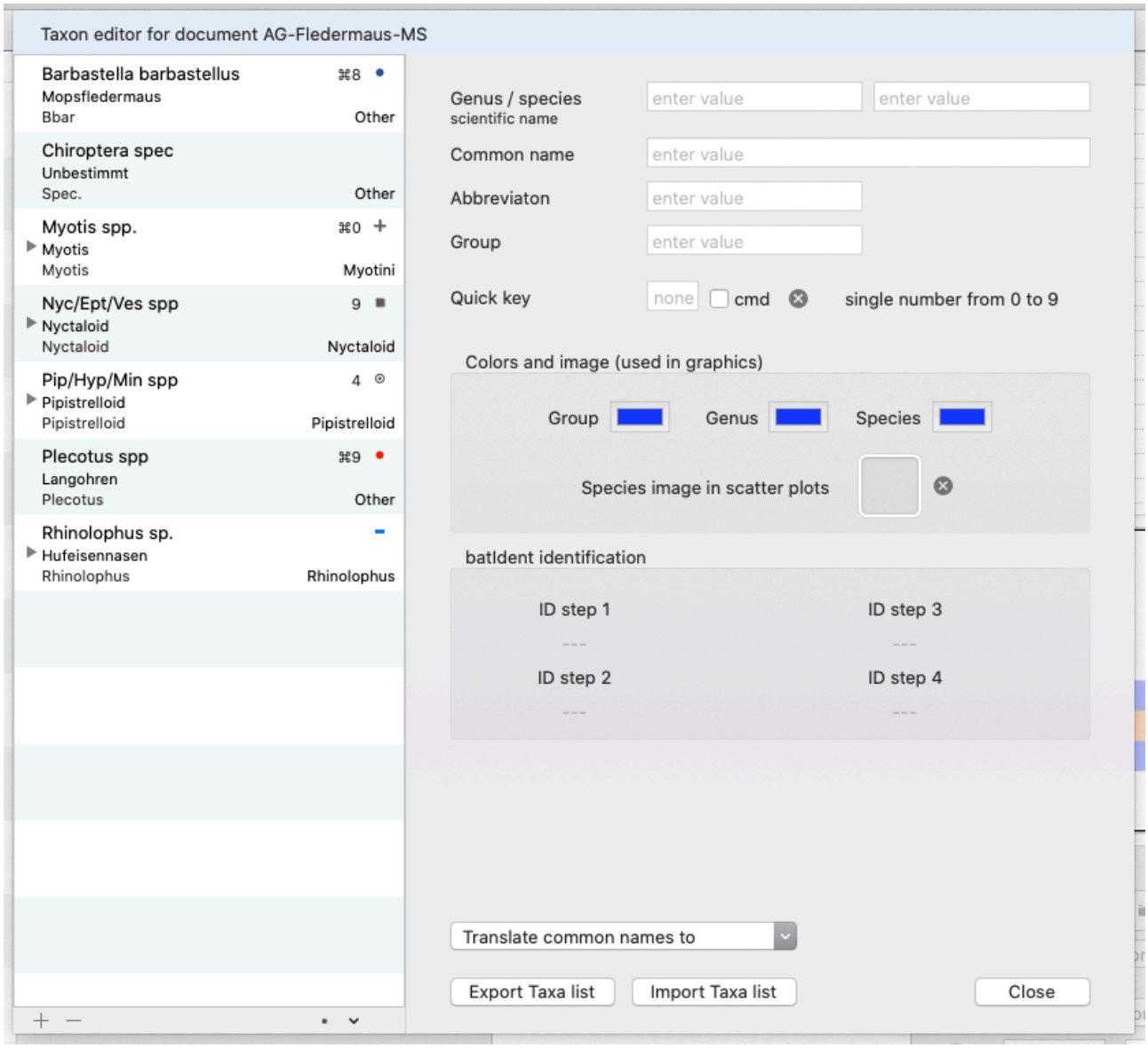
Projects can create subgroups either dynamically or manually. These subgroups are a list of all locations and flag states of sessions within this project. The default setting is that you

have to manually initiate the subgroup creation via the context-menu of a project. You can also set bcAdmin to automatically create these groups whenever the project groups is opened. The subgroups will be used best for projects with either many locations or many different flag states.

4.3. Taxon-Editor

The Taxon-Editor gives an overview of all species integrated into bcAdmin and their tree like organization. It is taken directly from batIdent and resembles the id process. For each taxon entry colors as well as the group can be chosen freely.

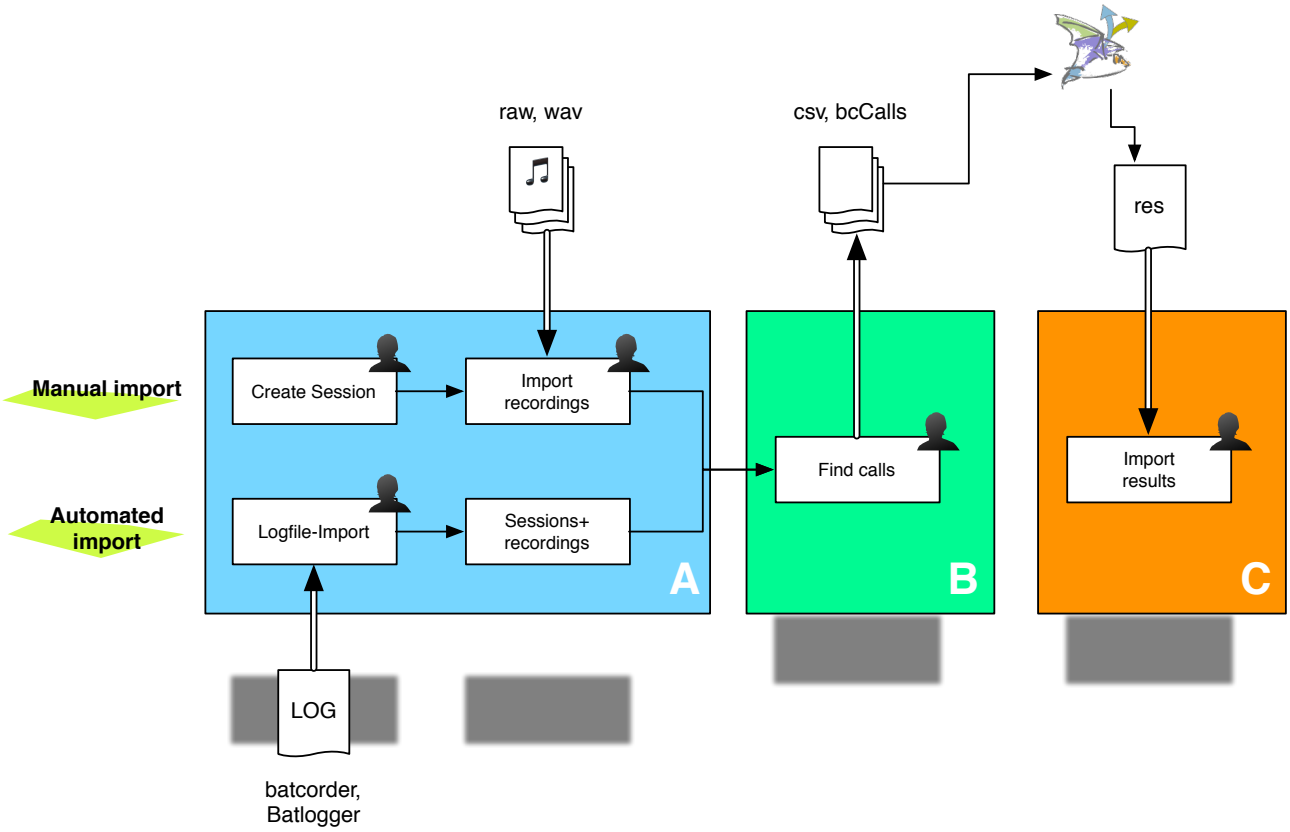
Taxa are stored per database and can be independently edited for each database. The taxa list can be imported from a .plist file or exported to a .plist file. The central taxon editor can be accessed from **Window** menu using **Shared taxa**.



5. Typical workflow

5.1. Workflow overview

The following scheme displays the typical steps when working with bcAdmin:



- A: Creation of Session and recordings. This can be done manually or, as recommended, automatically via the batcorder logfile.
- B: Finding calls and creating measurement files.
- C: Statistical species identification using batIdent. Import of identification results in bcAdmin as well as control of results. Data summarisation as well as raw data can be exported in various formats. This step is only necessary, if you do not use the new CoreML based identification tool built into bcAdmin4

bcAdmin manages and saves all entries and results for sessions and recordings in a database file with the extension bca4sql. When creating sessions, adding recordings and running their analysis it will read/write additional files:

- **recordings**; audio files from your recorder
- **LOGFILE.TXT**; batcorder logfile with runtime informations logged by the batcorder
- **call files .bcCalls**; time-frequency measurements of all calls of a recording
- **measurements .csv**; measurements taken for batIdent id process
- **result files .res**; batIdent result files

The logfile is used for automatic import of recordings and their organisation in sessions. The recording files are read when the call finder is started as well as when time stamps and recording lengths are read in. If you store files on a slow medium or on a network drive, the access will be slower than if stored locally or directly connected hard disk.

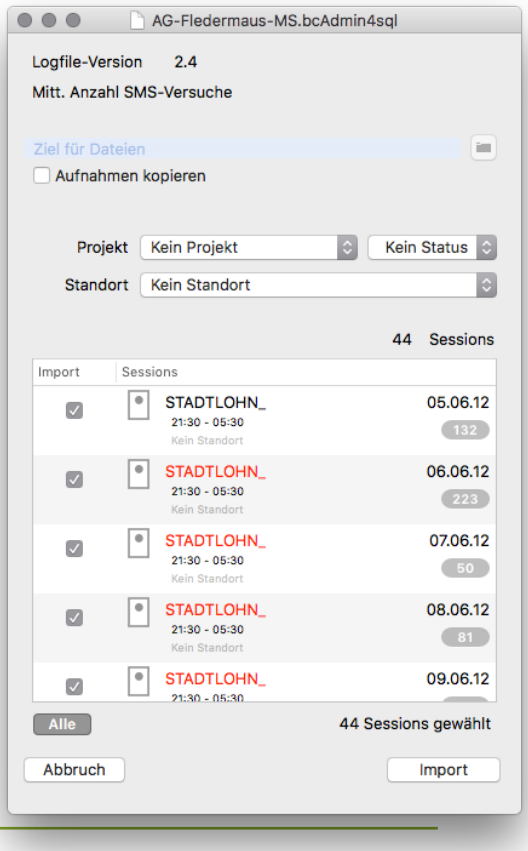
The call files are used to display the call preview in the File Browser and thus read whenever a call display is required. Measurements are used by batIdent which creates the .res files for results import into bcAdmin. The best approach is to organise all files belonging to a single session within their own unique folder.

5.2. Import from logfile

For creation of sessions and import of recordings the best approach is to utilise the import from logfile feature of bcAdmin. That way recordings are copied (if necessary) from SDHC card, sessions are created and recordings added. All available information from the logfile is automatically entered into the database. This means you get start and stoptime as well as batcorder settings created within bcAdmin automatically.

The following entries of a session are created automatically when importing from logfile:

- Session-identifier: batcorder filecode is used
- Sample date: start/stoptime and sampling time are taken as recorded by the batcorder
- filelocation: filelocation is set to the folder the recordings are imported from or copied to (if logfile resides on the sdhc card)
- batcorder-settings: the settings threshold, posttrigger, quality and critical frequency are set



Import of files from SDHC-card

Whenever a batcorder SDHC-card is inserted in the computer, bcAdmin recognises it and activates the SDHC toolbar item in the upper right of the window. Using this button you can import files or format the SDHC-card. Optionally choose the appropriate import command from the menu Sessions. When starting the import the logfile is read and analyzed and the results are displayed. For box or wind turbine kits the average GSM quality is indicated (the number of tries for sending an SMS are counted). There are various errors within a logfile that are ignored here, yet important information like sd card defect are in-

dicated in the import process. The import dialog list all extracted sessions in a table. For each session available information are shown. In addition a symbol indicates the usage mode of the batcorder and gives hints if the sd card is out of memory or the battery empty:


AUTO mode


wind turbine kit


AUTO+TIMER mode


box extension


logfile problem

If a logfile problem was indicated for some sessions not all recordings may get copied. You should check manually, if the recordings were copied completely. If such error occur regularly, please exchange the SDHC card.

The dialog allows to select which sessions to import. You can additionally already set project and/or location for all sessions. Since the files reside on SDHC-card, you have to set a folder the files should be copied to before importing them. Check each session you want to import using these settings and start the import. That may take some time, depending on the number of files that have to be copied to disc. If you have the files already copied to disk before starting the logfile import, you can op out of copying the files. Make sure, you do not opt out when import from sd card. Otherwise the files will not be accessible after ejecting the sd card.

Import from logfile on hard disc

If you have already copied your recordings to hard disc, you still can use the logfile import. Note that the logfile and the recordings have to be located in the same way they were found on card. If you introduced subfolders, the logfile import may not be able to find the recording files.

You can start the import via **Sessions -> Import from logfile**. Next a file chooser dialog appears and you have to select the logfile you want to use for import.

The procedure to import files is as described above. The only difference is, that you'll not need to set a filelocation for copying files to. If you want bcAdmin to organise the file structure, you nevertheless can activate file copy.

When recordings get imported that way, their timestamp is set from the file creation date. If files were copied to hard disc, they may have received a new timestamp. If that is the case, you can later extract the correct timestamp from logfile.

Import per drag&drop

Starting with bcAdmin 4 1.0.50 you can drag files from a Finder window and drop them on a session. This will import the files if filelocation is not already set for the session or the filelocation is the same as where the recordings reside on disc.

Folder import

You also have the possibility to import multiple logfiles from within a folder tree. This proves useful if you have collected data over a season from multiple devices and have them stored on your hard disk already. This way you choose the parent folder within which the various logfiles and recordings are located. bcAdmin will collect all logfiles int he folder tree and show an import panel per logfile automatically. The folder tree must be similar to this:

Parent folder ->
SD-card1 ->
Logfile.txtx
Recording folders (created by the batcorder)
SD-card2 ->
Logfile.txtx
Recording folders (created by the batcorder)
SD-card3 ->
Logfile.txtx
Recording folders (created by the batcorder)

Import of Batlogger recordings

While you can add Batlogger wave files manually there also exists an import analogue to the log file import. Select folders with Batlogger recordings, created per night. You may have to change the Batlogger settings to create a folder per night. bcAdmin will read the Batrec.log in the root folder of these nightly folders and automatically create sessions for each sampling night. The according recordings are automatically imported. bcAdmin will always try to evaluate the batlogger .xml files created per recording. These usually contain temperature and coordinates.

Note that a previous import of files to BatExplorer 2.0 will change the folder structure. A regular import to bcAdmin 4 is then not easily possible.

5.3. Import of folder structures

The command **Sessions -> Folder import** allows importing any existing folder structure from your hard disk. If bcAdmin 4 finds a Logfile.txt in the progress it will ask if to use it. Otherwise all selected folders are checked for recordings and if any are found, a session for import is created. Note that the folder import **does not deep traverse** through your

folder tree. Using the folder import you can import the selected folders at one level. Settings for the newly created sessions can be chosen.

5.4. Manual creation of sessions and recordings

There may be situations when you can‘t use the automatic import of sessions and recordings. For example if you have a collection of non-related files or if you are using another recording device that doesn‘t create a logfile. We recommend you setup a session with necessary information and add recordings to it manually. That way you can use all or most of bcAdmin features with these recordings.

Create a session

Either press the create session toolbar item (the batcorder symbol) or choose **Sessions -> Add** to create a new session entry. Also note that you can duplicate existing sessions to get a starting point. It will have most of the source sessions details filled in already.

Note: Duplicating a session will neither duplicate the files nor the filelocation.

Next set a correct filecode or identifier and set the correct sample date. Also make sure start- and stoptime are set. If necessary adjust the batcorder settings so they resemble the actual settings of your batcorder.

Add recordings

After you created a new session it should be already selected in the table of sessions. You can then add recordings either via the toolbar item or via the **Session** or **Recording** menu, or by dragging files from a Finder window onto the session entry in the middle table. If there is already a filelocation set for the session that differs from the filelocation of the added recordings you‘ll get a warning and the process is stopped. Please first set the session filelocation to the folder the new recordings are located at. bcAdmin supports only raw and wav files.

When importing recordings the timestamp in the database for each recording is taken from the file creation date. This may have been changed due to emailing, copying or uploading files. If you still have a logfile at hand, bcAdmin will be able to reset the timestamp from there. For some wav recordings you will be able to extract recording time from the filename.

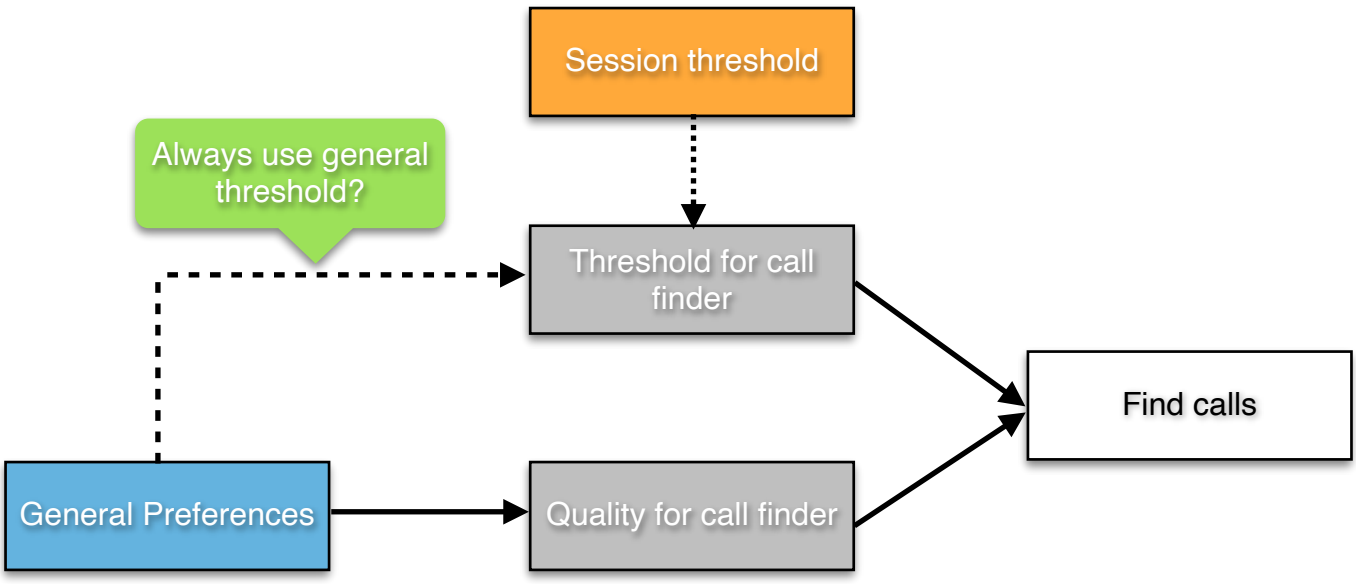
5.5. Finding calls

After adding recordings initially the recording stable list only a few entries, but no information on count of calls or species. Only after you initiated the search for calls, you will get a number of calls found, if any were found. Also you‘re able to see calls in the File Browser now. The call finder works on all selected recordings.

Tip: Select all displayed recordings by pressing cmd/⌘ and A.

The algorithm to find calls and extract measurements is lightning fast, and unique. Most settings for this algorithm are set to an optimum value, optimised for batcorder recordings. Still, as user you can and should change the threshold according to your recordings, which equals the sensitivity. The threshold, thus call finding sensitivity, can be set at various places. Note the value is given as damping value in dB. Thus a value of -27 dB is less sensitive than a value of -30 dB. 0 dB resembles a full strength signal.

The basic setting for threshold is preset to a per session value, so when accessing the threshold bcAdmin uses the value set in the session details. All files of a single session will thus be analyzed with the same threshold value. You can also set a general application wide value. That is used only, if you choose to ignore the session value. This can be set in the application preferences. There you can also choose to use adaptive call intervals. This feature allows to improve call measuring when echos and calls overlap. Often this happens with Nyctaloid calls and pipistrelloid social calls are detected. Setting an adaptive call interval of factor 3 to 5 allows to solve this situation quite often giving better identification results. At the same settings panel in preferences you can also choose a parallel call finder which is quicker than the serial call finding algorithm. You may adjust the number of simultaneous operations there. Note that depending on the recording storage too many parallel calculations may slow down due to limited bandwidth for disk access. In addition you can choose to search for calls in background, thus you can continue working in the open database. We do only recommend this for advanced users.



5.6. Influence call finder

The threshold setting as well as the adaptive call finder algorithm is in the first step of the call finding process. Thus these two options will eliminate calls at the level of finding calls. There are other advanced options that make use of plausibility controls and will eliminate

calls not being plausible only after the full measurements are taken. They are explained in a later chapter together with the other advanced / expert settings.

5.7. Results-Import

Starting with bcAdmin4 1.4.2 you do not need batIdent for classification anymore. bcAdmin4 comes then with a built in classifier based on CoreML using updated reference calls. You once have to activate CoreML usage within application preferences. The option is located in the Call finder sheet. The following paragraphs are only valid if you want to use batIdent.

After a successful call search species identification using batIdent can be started. You need to have installed and setup batIdent for this.

Either navigate from batIdent to the folder containing the corresponding recordings or right-click on the selected recordings and choose **Identify bat** from the menu. For this batIdent has to be activated as service via the System Preferences of Mac OS X.

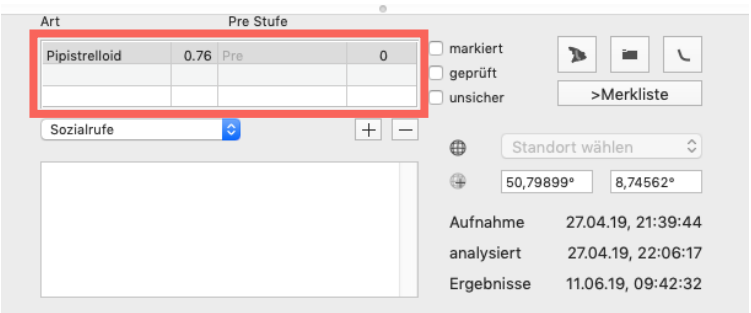
batident will create a res file for each recording and also add per call results to the bcCalls file. That way you‘re able to see per call id results in the FileBrowser. To display the results in the recording table, you‘ll have to import results for the selected files.

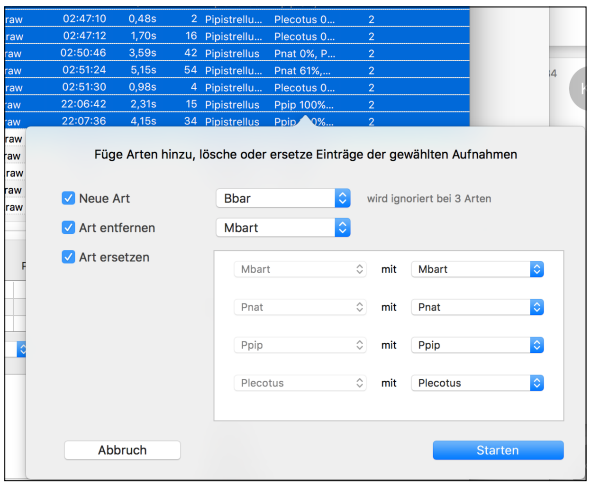
Another word on activating the service **Identify bats**:

To go directly to the system preference that maintains the list of services, choose within **bcAdmin -> Services** and there choose **Settings**. A dialog opens displaying a list of available services in the right column. Scroll down and check **identify bats**. Now bcAdmin should be able to communicate directly with batIdent.

5.8.Edit species entries

In the recording details view various information for the selected recording are displayed. A table shows the species identified with CoreML or batIdent. You also see the probability as well as the previous step in the id process. Using the **+** button you can manually add a





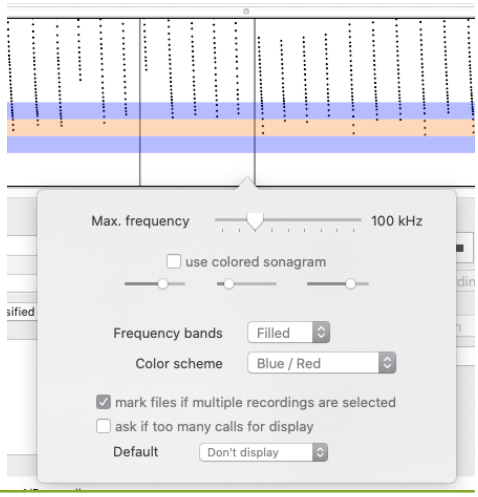
new or replace an existing entry. Manually added entries get a probability of 0% so they can be identified again easily.

Using **Recordings -> Batch replace** species entries for a range of selected species can be removed, added or exchanged automatically.

We highly recommend to use the following option when editing species entries. It is the fastest and most streamlined way of doing it. Species can be set using the **number keys** (1 to 0) as well as the **number keys + cmd-key**. The corresponding species for each number can be set in the taxa editor. The key assignments can also be displayed in the file browser by pressing the **k key**. By pressing the number key either in file browser or in the main window the existing species entry for the recording is written over. If you want to add a species, you have to hold the **alt key** . Using the key combination **ctrl + 0 deletes any species entry** in the selected recording. These key commands give you the possibility to correct identification results for multiple recordings very quickly.

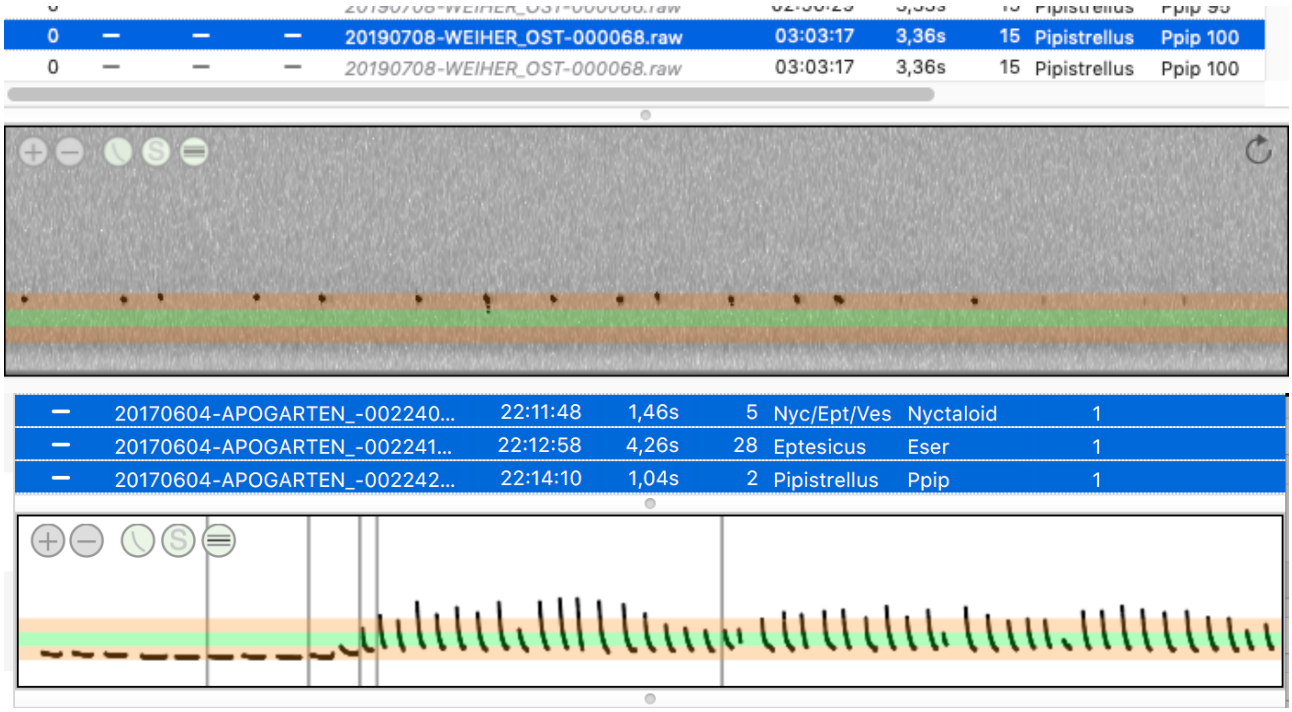
5.9. Call display and File Browser

One of the new features of bcAdmin4 is a direct call display integrated into the main interface. You can thus quickly see a sonagram and measured calls when browsing the table of recordings. If multiple recordings are selected only calls are shown and the sonagram is hidden. With multiple recordings you can click on one of the recordings and select this one for detailed analysis. A small circled arrow in the top right of the call preview allows you to switch back to the last selection. Holding down the **shift key** while clicking a recording in the call preview will deselect this recording. That way you can quickly assign new species based on calls of multiple recordings and can exclude single recordings within the selection beforehand.



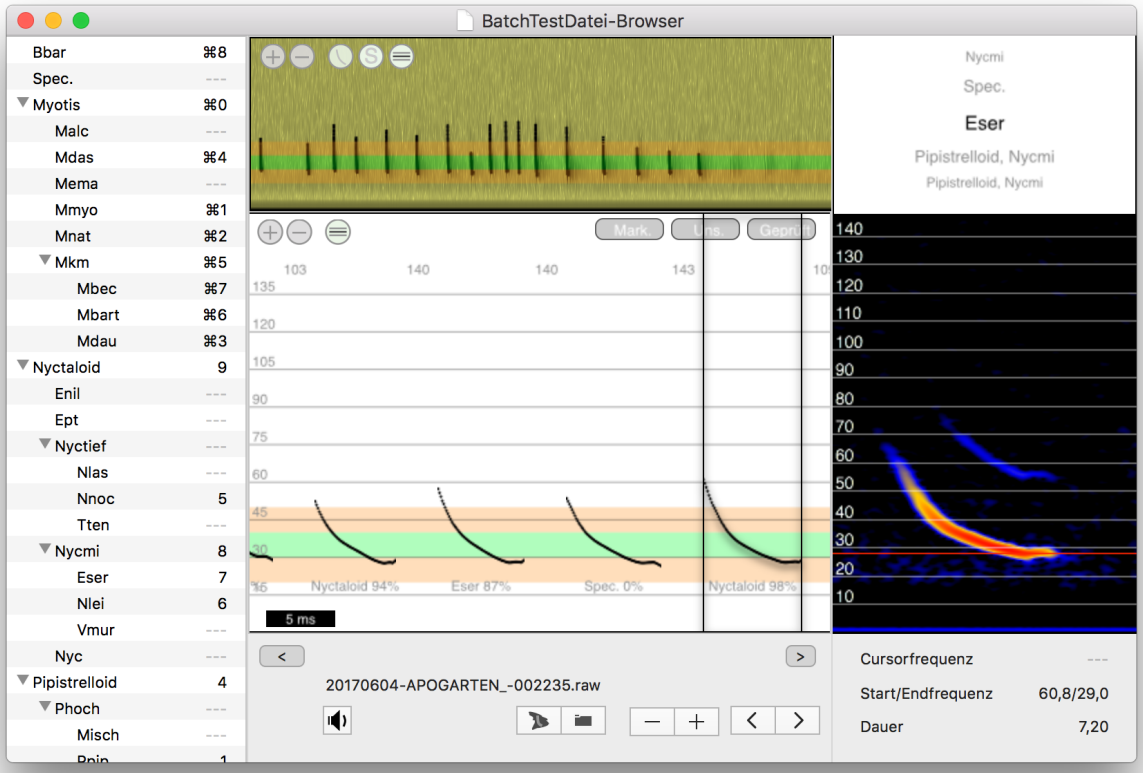
A right click on the call preview allows to adjust settings like maximum frequency in display, style of frequency bands apart other from settings. You can also define bcAdmin behaviour when more than 300 calls are selected for display. It can be set to not display call numbers of 300 or more to speed up working with multiple selections.

Using the File Browser you can quickly display calls and an overview sonagram of selected recordings as



well as a sonagram of single selected calls. Open the file browser using the corresponding toolbar item or the command **Recordings -> File browser**. After selecting a recording in the main window the **Enter key** will also open the file browser.

In the newly opened window you see a display showing the measurements per call (frequency over time; call intervals are cut-out) as well as an overview sonagram (upper graph). This displays up to four seconds of sound (see preferences). Using the arrow keys

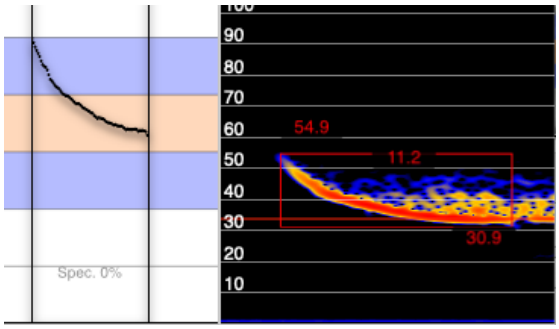


on your keyboard you can move up and down the recordings table and quickly scan your recordings. If batIdent already identified species, you can see below each call an entry displaying species and probability for this single call. Additionally the sounds are displayed as sonagram above the calls. Intervals are shown as well in the sonagram. The sonagram is always stretched to fill the window width.

Note: The results should be read as per call results and not be interpreted as the id result for the file. The results of each single call are accumulated and an overall result is calculated. What you see for the per call results is typical for statistical noise, thus species showing up that you may not have expected.

Navigation through recordings is possible using the arrow buttons as well as the arrow keys on your keyboard. This allows you to screen a large number of recordings very quickly. It helps to control the quality of identification and find sequences with social calls or feeding buzzes. By clicking the play or speaker button below the call display you can playback either in ten-time delayed mode or with a virtual heterodyne detector (also by pressing **p**).

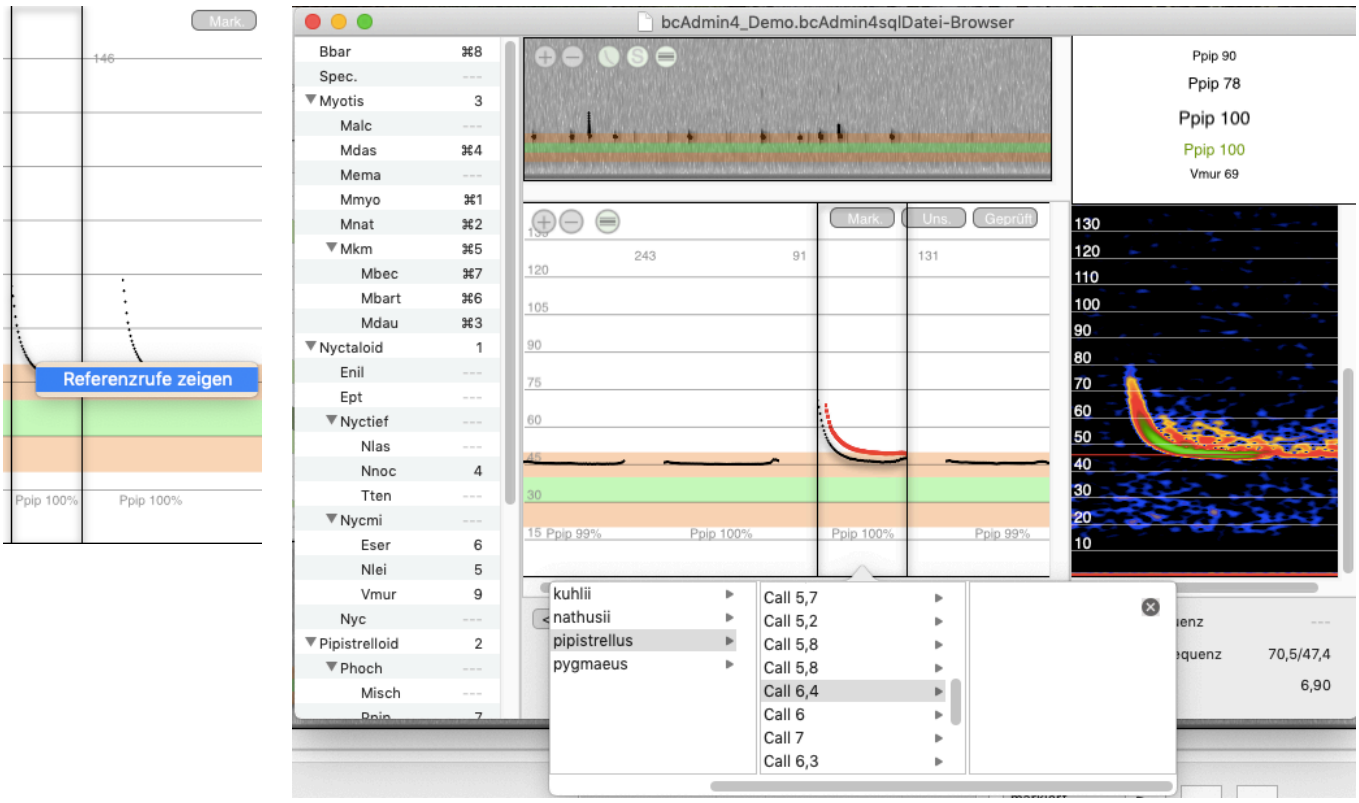
To the lower right a sonagram of the selected call is displayed. The red line indicates the frequency with most spectral power. Sonagram parameters are chosen based on call length and are fixed. By right clicking on the preview call sonagramm you can change the colors of the sonagram. Using a mouse left click and hold you can drag a measurement display to manually measure call values.



Starting with bcAdmin 1.0.40 you can display reference calls. After right clicking on the call display choose reference calls display.

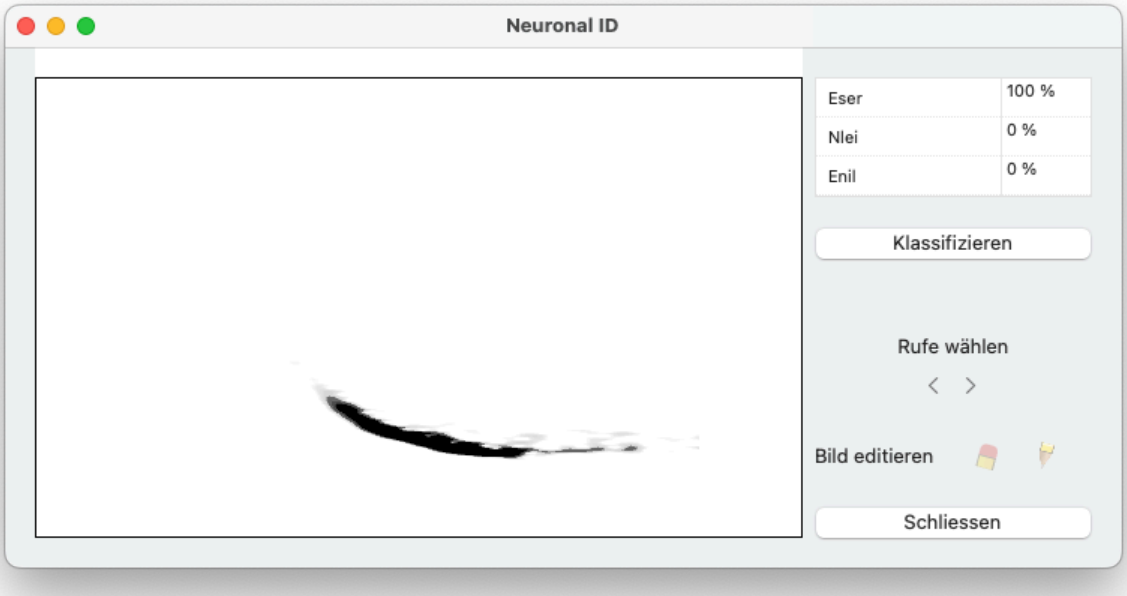
Key shortcuts

For quickly changing or setting a species for the selected recording, they keys **1 to 0** and **cmd+1 to 0** can be set to a species. That way, when manually identifying a species using the **file browser** (or **while working in the recording table**!), you can quickly set its species entry. If you want to add a species to the existing entry, you can press the **alt** key and the corresponding number. The maximum number of three species per recording can not be circumvented that way. In addition the key combinations **m, c** and **u** toggle the **marked, checked and unsure state** of the selected recordings. All key combinations can be displayed by pressing the k key. The taxa keys can be assigned per document in the taxa editor.



Neuronal network for species id

In bcAdmin4 1.2.4 a preliminary tool Neuronal id was added to use the sonagram of a call for species identification. This is a rather preliminary tool that currently only supports the group Nyctaloid. It can be started using the respective button (bat+question mark). An improved tool is available already in bcAnalyze 4 Pro.

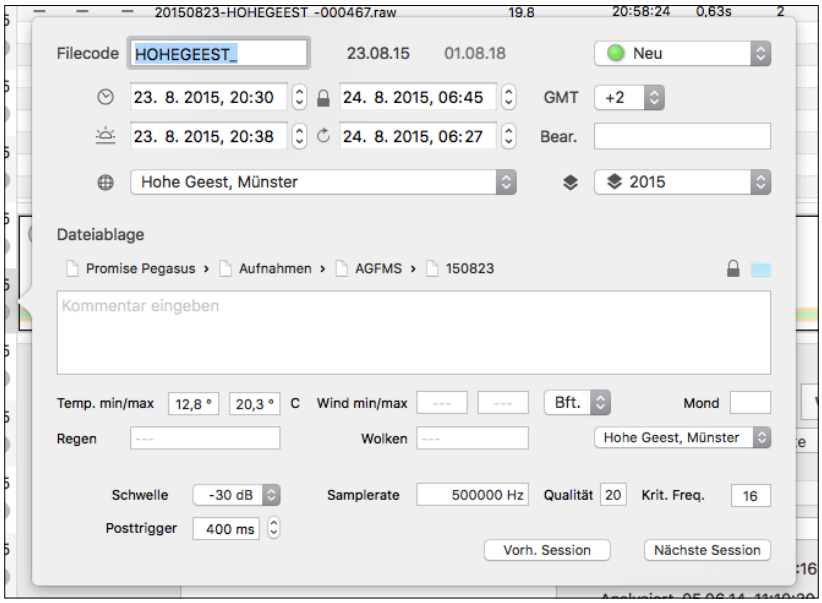


6. Sessions

To allow a quick and simple working with the application, most data can be accessed and changed easily. All session details are accessible easily after double-clicking a session entry in the session table. A popup displays all session details and allows editing all information. More elaborate functions let you access the logfile, delete or add recordings and remove location or project connections. These are accessible via the **Session** menu.

6.1. Editing Sessions

In a previous chapter detailed instructions were given on how to import sessions manually or from logfile. Since not all settings for a session may be available at its creation time, it may be necessary to add details later:



Filecode: This acts as name of the session and forms a unique identifier together with the date. Usually this set to the same value as on the batcorder. If you use other recording devices, you can code a location or project here.

Date: The date the sampling began. Acts as sample date throughout the application.

Project: Sessions can be grouped in projects.

Status: Sessions can be marked with a status or flag.

Sampling from / to: Timestamp for start and end of sampling. Is used by some functions for calculating activity indexes.

Editor: You can add the person responsible for data collection here.

Filelocation: At this folder all recordings and related files are searched for. By unlocking this field you can change the filelocation, for example after the recording files have moved.

Furthermore these details can be set per session:

Location: This dropdown gives a list of available locations to connect the session to. If you have already chosen a project for this session, only locations already connected to sessions of this project are shown. You can show all locations.

Sunset/-rise: Timestamp for sunset and sunrise. These are used for some graphs as well as for some calculations and should be filled in after best knowledge. If a location with coordinates was set these values can be calculated.

Rain, Temperature: Both types of values have no special input format and are currently not used by other functions. They are more for your own reference. Since the batcorder 3 does automatic logging of temperature while recording bats, the values get extracted automatically when importing recordings via logfile. You can get a graph showing the temperatures over night. If temperature data is available a small icon with a thermometer is displayed. This acts as button to open the temperature graph.

Environmental data: If environmental data is connected to a session, this is indicated here. You can also choose a different set of environmental data. The setting is used for the correlation tools to give default data to each session. The environmental data object is generated automatically when importing data from logfile and if the logfile contains batcorder temperature measurements.

Comment: Any comment for this session can be added.

batcorder-settings: If you‘re working with the batcorder, your settings should be added here. For other recording devices or file formats, the corresponding samplerate should be set. Depending on the recording quality, you may adjust threshold and quality settings.

6.2. Managing sessions

Selected sessions can be edited per double-click. Selection of multiple selection is possible by holding down **cmd key** when selecting. If you want to select a whole continuum of sessions, select the first, then hold **shift key** and select the last one. If more than one session is selected, most actions operate on the multiple selected sessions.

After some time of batcorder usage you may find your list of sessions grown a lot. Thus, finding sessions may get painful. bcAdmin offers some ways to speed up finding sessions.

Sorting

Sessions can be sorted according to various criteria. Click the session column header and select the sort parameter you want.

Filter

You can quickly filter sessions by type of session (auto, timer, ...) using the drop-down above the session column. More complex filters can be activated in the left sidebar. You create filters analogue to projects, thus by using the buttons below the sidebar. Filters act dynamically, thus whenever activated by clicking, they perform their filter and filter from all sessions those that fit their predicate. After creating new sessions you will have to reactivate/reselect the filter to see changes.

When creating a filter you should give it a label first. Then you can choose from a variety of fields that can be used for the actual filter process. An explanation of what you can use as filter criteria for various field types follows:

Date entries: You can use filters with daily accuracy.

Strings: Most fields contain string values. Various criteria for filtering strings are available including equality, difference, starting with, ending on etc.

Boole values: They can be set to wither Yes or NO, or 1 and 0 respectively.Fields like marked or audited belong to this type.

Numbers: All values that resemble numbers can be tested for equality or smaller than, larger than, ...

For some fields special ranges of values account:

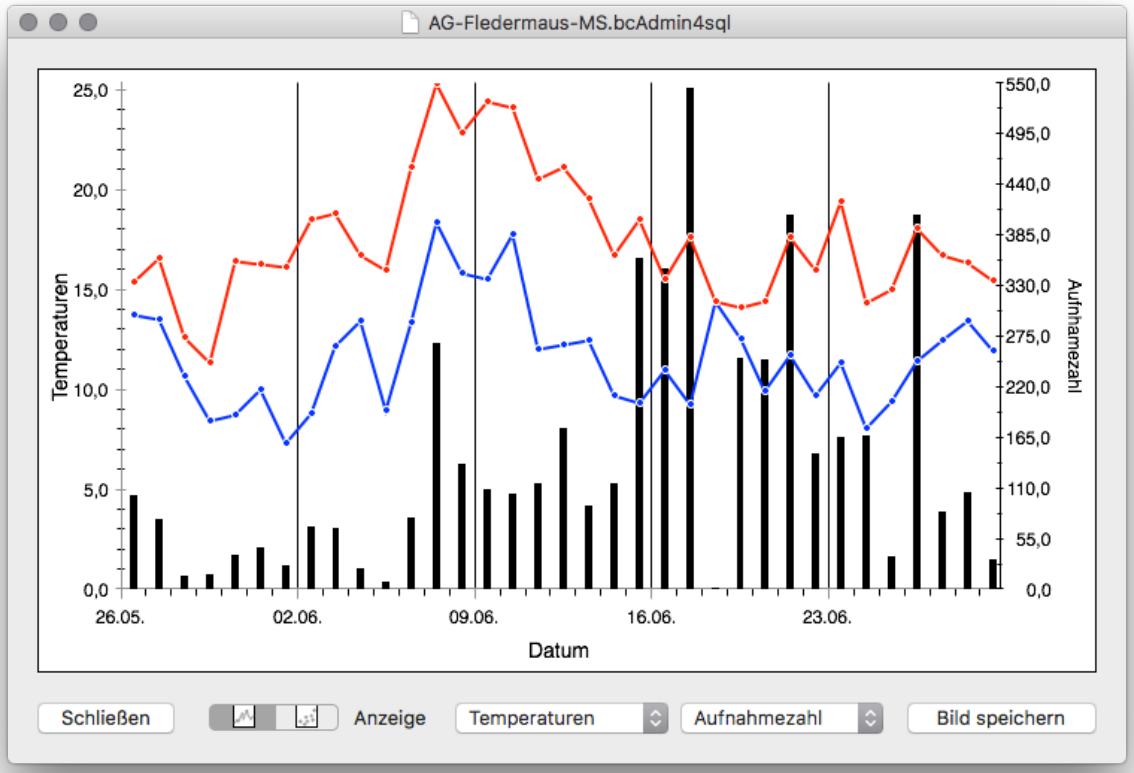
Details: moon: The value for moon is listed as percentage in the session details. It is thus stored as value ranging from 0 to 1.

Recordings: classification: Recordings can be classified according to four different types. Standard is 0 = no classification. Other values are 1 = normal calls, 2 = social calls and 3 = feeding buzz. Please enter the respective number when filtering sessions that include such recordings.

Above the filter criteria you can in addition choose how criteria are combined and used.

6.3. Temperature data

If the same environmental data is connected to all selected sessions you can display a temperature history. In addition file numbers or seconds of sound recording are displayed as bar chart.



The red line indicates daily maximum while the blue line shows the daily minimum temperature.

6.4. Archive sessions

A new feature of bcAdmin 4 is to archive sessions. This will create a zip of the session file-location and is useful to save space on hard disk. It only works well if per session a single folder exists and the files are not used by another session as well. You can archive the selected sessions using the menu **Sessions** - > **Archive session files**. Archived sessions are displayed with blue color in the session table. If the zip file stays at the location where it was created bcAdmin can still extract sound files and call values from the archived files for display. Only changes that create new files are not possible anymore.

6.5. Filtering sessions

While you can use projects to manage sessions according for example to your field work projects, you can also use filters to dynamically filter all sessions in your database. That way you can quickly create a subset of sessions according to a large number of filter criteria. Filters are created with the same button that projects or project folders can be created. This button is found in the lower left corner of the main window.

Upon creating a filter a dialog is shown allowing you to choose from a long list of parameters for filtering the sessions. You first can choose if all criteria must be met or of any of the criteria should be met (ALL/ANY). Next you choose the parameters and set the filter criterion. This is rather intuitiv and can be changed later again when double clicking a filter.

If you have created a filter that produces an error, for example due to changed data, bcAdmin may crash. For such situations we have added a feature that allows selection of filters without starting the criteria This can be done by holding alt/option key when selecting such a crashing filter.

6.6. Changing the filelocation

The correct filelocation is important to find the files belonging to a session. They are needed when searching calls as well as when displaying call displays. Sessions with a missing filelocation or an invalid filelocation are shown in red in the session table. When you are moving a folder with recordings, the sessions pointing there will be drawn in red. You then have to adjust the filelocation, otherwise the files can‘t be accessed from bcAdmin. If you have to adjust the path for multiple sessions, bcAdmin will help you as much as it can. It will first determine the common path of all sessions. As long as you have stored and moved recordings in a parallel way, so not randomly, this should be good enough. bcAdmin will allow you to exchange the common old path with the new filepath the sessions have in common.

An example:

Sessions with FILECODE_A, FILECODE_B and FILECODE_C store their recordings in:

/Volumes/Macintosh HD/User/batcorder/Recordings/130601

/Volumes/Macintosh HD/User/batcorder/Recordings/130605

/Volumes/Macintosh HD/User/batcorder/Recordings/130610

The common path thus is:

/Volumes/Macintosh HD/User/batcorder/Recordings

If you move these folders to an external hard drive as follows

/Volumes/EXTERN/Recordings2013/130601

/Volumes/EXTERN/Recordings2013/130605

/Volumes/EXTERN/Recordings2013/130610

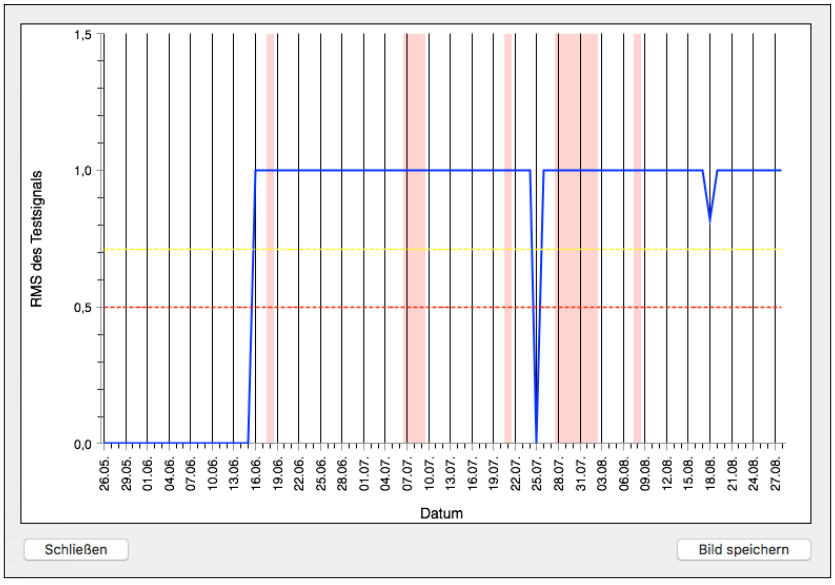
That way the old common path from above will be exchanged with:

/Volumes/EXTERN/Recordings2013

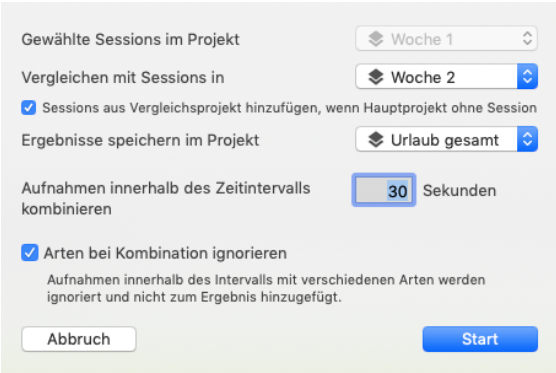
This method of path replacement is always possible, if multiple sessions are selected when the session details are opened.

6.7. TSL-evaluation

The microphone test recordings of box and wind turbine extensions as well as the GSM-batcorder can be analyzed to check for correct microphone sensitivity. For this test the recordings have to been imported using logfile import from SDHC card. That way the microphone test signals are specifically labelled and can be accessed automatically from bcAdmin. The plotted graph shows the results of RMS measurements within the test signal. Since the reference value taken when implementing the batcorder in the field is not known to bcAdmin, you have to read the graph by looking at the average RMS. From the average two lines showing- 3 dB and- 6 dB are plotted in yellow and red. Values outside the -6 dB range indicate mic problems.

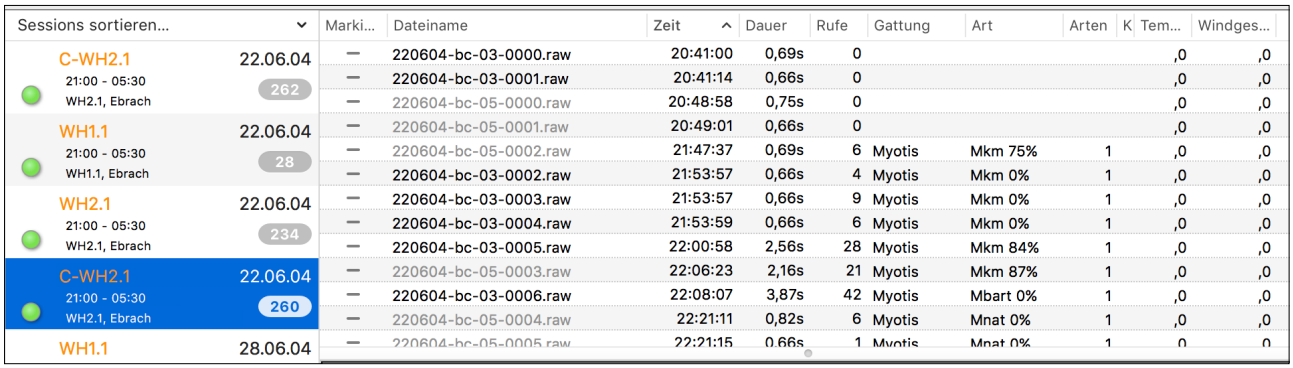


6.8. Combining sessions



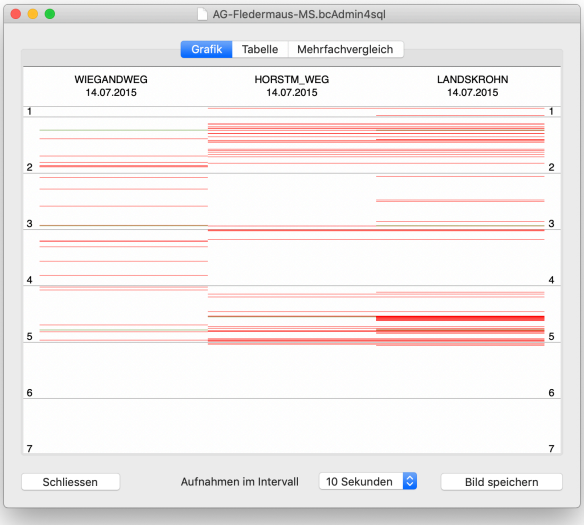
This feature allows to combine two session in such a way, that duplicate recordings (based on time stamp) are removed in the resulting combined session. This for example is useful when you have recorded at two similar and close locations and want a combined dataset of bat activity. Usually this feature is used with a selection of multiple sessions. These must reside in one project. The other set of sessions, mirroring the first set by days, must be inside another project. The combination dialog after selecting the first set of sessions then allows to choose the project with the second set. You can also choose the time interval allowed between two recordings to still count as one pair.

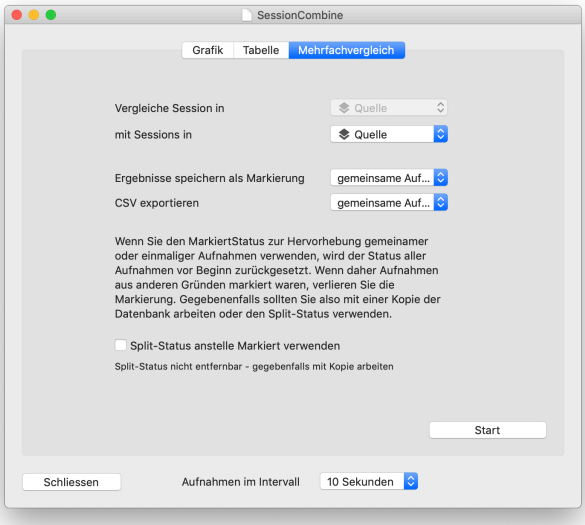
For running the combination process you best have a third empty project for adding the newly created sessions to. The newly created sessions are marked by a C- in front of the original filecode. Virtual recordings, that mean those added from the second session set, are displayed in italic.



6.9. Comparing sessions

Another feature for working with larger datasets is the session comparison tool. It works with two up to four single sessions as well as a batch mode for sessions organized in projects. It allows to visualize activity identical as well as different in time between various sessions.





7. Recordings

There are many methods in bcAdmin making management of your data easier. While most information is stored within the database for fast access, the raw recording files and all derived files are saved at the sessions filelocation. Some of the following functions need access to the files to work properly. Others can work on the database alone.

7.1. Recordings table

The main interaction with recordings is done using the recording table in the main window. It displays apart from filename and recording time many other meta information for each recording. Using the application wide preferences you can choose visual display of marked, unsafe or audited recordings. In addition the preferences allow to colorize all recordings belonging to a single time period defined by a choosable time interval. Apart from activating this feature in the preferences the table has to be sorted by recording time.

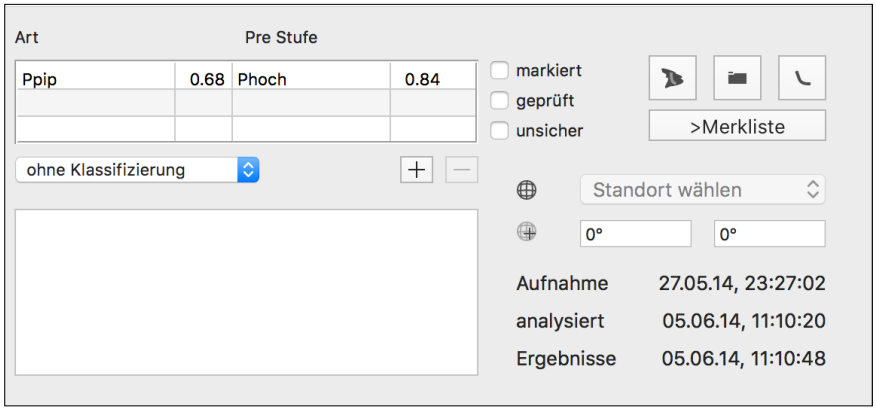
Cla...	Marked	Audited	Uncert...	Filename	Time	Dur	Calls	Genus	Species	Tem...	Count	Wind...	Comment
0	–	–	–	20200731-SUNNENBARG-000359.wav	21:58:46	1,79s	15	Barbastell...	Nyctaloid 70, Bba...		2		
0	–	–	–	20200731-SUNNENBARG-000360.wav	22:02:28	1,65s	12	Pipistrellus	Ppip 100, Pnat 0		2		
0	–	–	–	20200731-SUNNENBARG-000361.wav	22:04:06	2,40s	14	Nyc/Ept/Ves	Nyctaloid 86		1		
0	–	–	–	20200731-SUNNENBARG-000362.wav	22:04:44	1,61s	13	Eptesicus	Enil 65		1		
0	–	–	–	20200731-SUNNENBARG-000363.wav	22:04:56	2,98s	17	Nyc/Ept/Ves	Nyctaloid 69		1		
0	–	–	–	20200731-SUNNENBARG-000379.wav	22:17:24	1,31s	9	Pipistrellus	Ppip 100		1		
0	✓	–	–	**20200731-SUNNENBARG-000384.wav**	22:25:28	3,16s	27	Myotis	Mdau 51		1		
0	–	✓	–	20200731-SUNNENBARG-000385.wav	22:25:40	0,67s	1	Chiroptera	**Spec. 0**		1		
0	–	–	✓	20200731-SUNNENBARG-000386.wav	22:25:48	1,29s	10	Chiroptera	Spec. 0		1		
2	–	–	–	20200731-SUNNENBARG-000388.wav	22:26:20	1,17s	6	Pip/Hyp/Min	Pipistrelloid 29		1		
0	–	–	–	20200731-SUNNENBARG-000389.wav	22:26:36	0,67s	1	Chiroptera	Spec. 0		1		
0	–	–	–	20200731-SUNNENBARG-000390.wav	22:27:12	0,78s	3	Chiroptera	Spec. 0		1		
0	–	–	–	20200731-SUNNENBARG-000393.wav	22:28:36	0,99s	4	Chiroptera	Spec. 0		1		
2	–	–	–	20200731-SUNNENBARG-000394.wav	22:28:58	1,40s	11	Pip/Hyp/Min	Pipistrelloid 33		1		
0	–	–	–	20200731-SUNNENBARG-000395.wav	22:29:00	0,91s	2	Chiroptera	Spec. 0		1		

On right clicking the column headers you can select or deselect columns to alter the table display.

A new feature of bcAdmin 4 is the display of a call and sonagram display for the selected recordings. The calls are displayed if calls were found and saved as bcCalls file. If you selected multiple recordings all calls are shown. You can set a preference to explicitly only show up to 300 calls since rendering too many calls may slow down the app. Sonagram is only shown if a single recording is selected.

7.2. Recording details

The recording details allow to set details for each recording entry in the database. You can open the detail view by by clicking the small buttons in the lower right of the recording table. Each recording entry can be classified as normal sequence, social calls or feeding buzz. Apart from social calls of pipistrelle this will not be done automatically, but can only be checked manually. The comment field can be used for any kind of comment like for example your own guess regarding species.

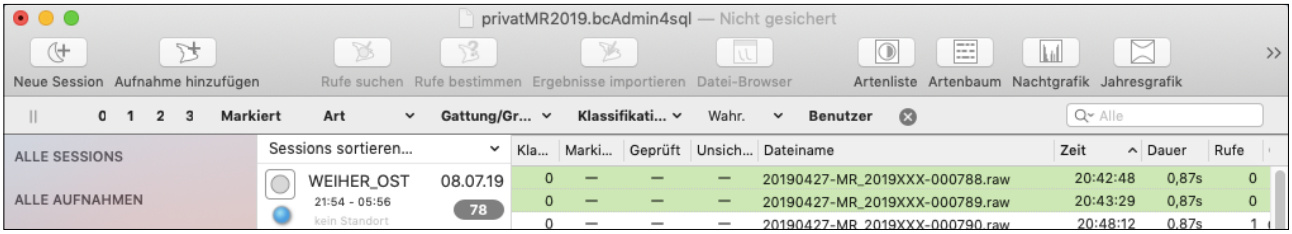


Note: classification and comment can be set only for the whole recording entry, not for a single species entry.

Using the mark checkbox you can mark a recording to find it easier again. A checkmark for audited means, the recording result was manually controlled. There also exist buttons to open a file in Finder, with a sound tool like bcAnalyze or in the call preview of the file browser.

7.3. Filtering recordings

By clicking the columns headers the whole table can be sorted using the according column. In addition you have the possibility to filter using a couple of criteria listed above the recordings table:



Mark.: only marked (see recording details) recordings are shown, the control switches to Unsafe, Audited and negation of these with consecutive clicks. Holding shift while clicking quickly disables this filter again.

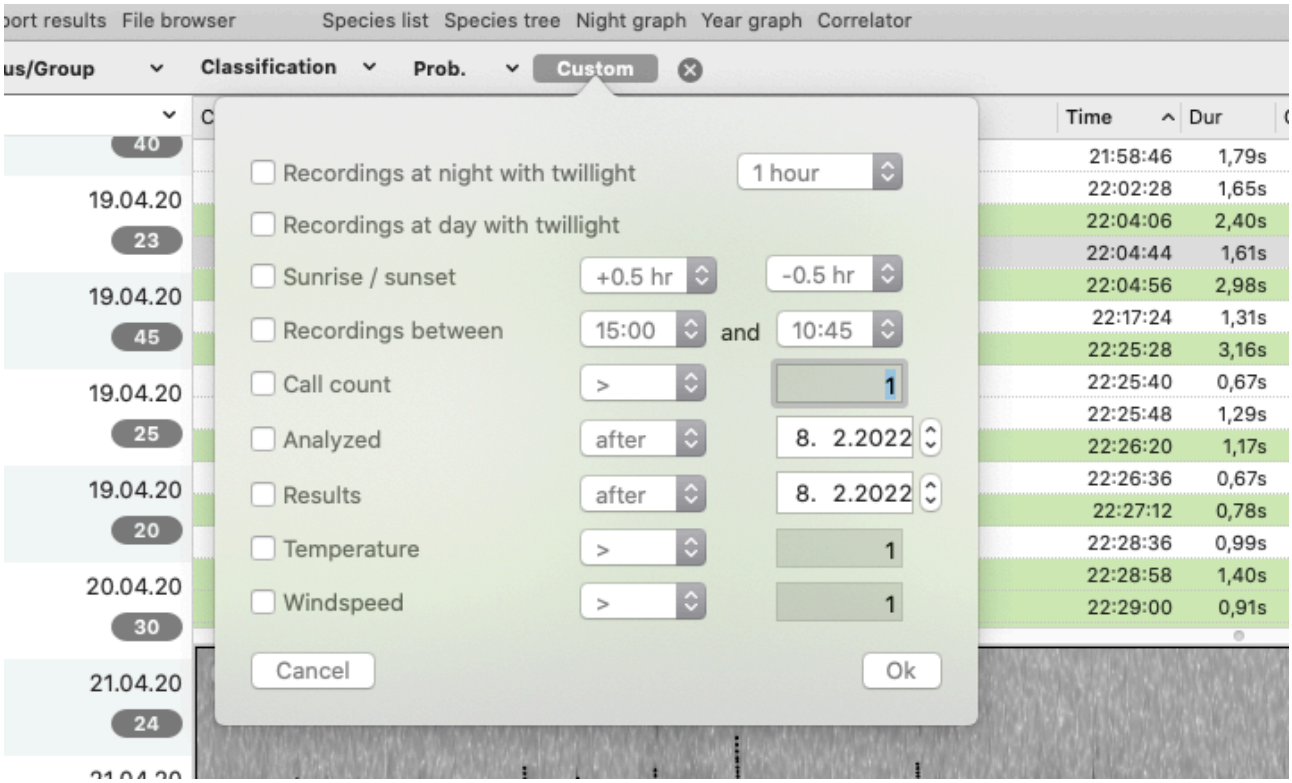
Count 1 / 2 / 3: only recordings with the according number of species are shown

Species: Only recordings with the selected species are shown. When holding shift while selecting a species, the species is filtered out.

Group: Only recordings with the selected group entry are shown. When holding shift while selecting a group, the group is filtered out.

Class: only recordings with the corresponding classification are shown

Prob: only recordings with the corresponding probability are shown

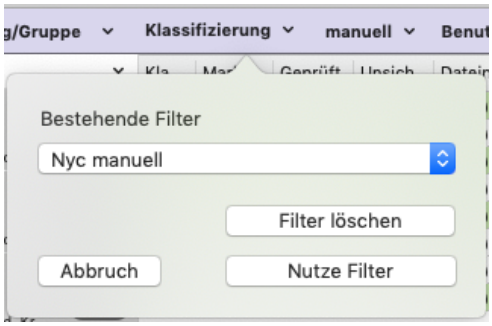


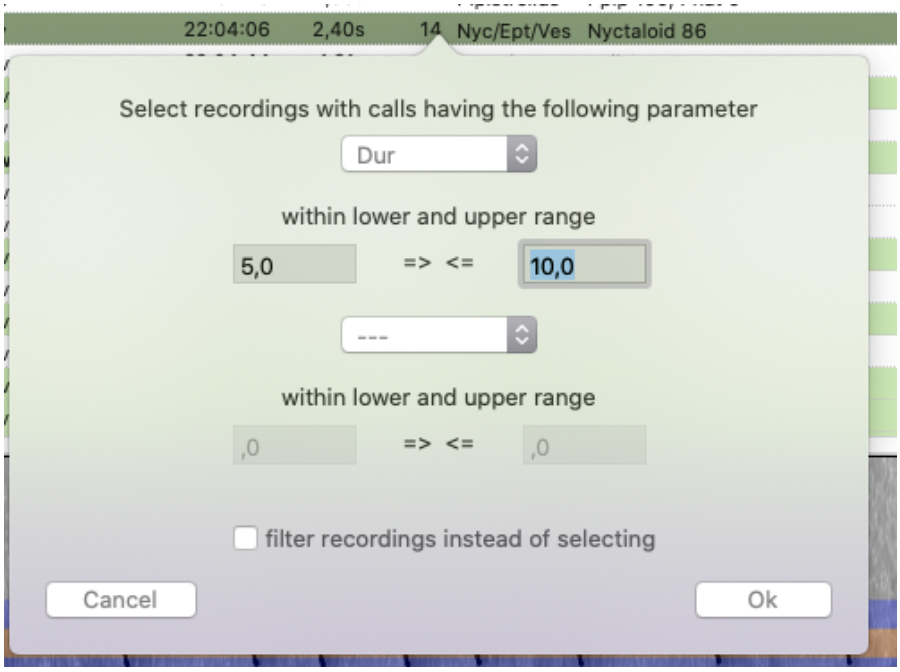
Custom: custom filters allowing to filter by recording time and other values

Note that the filter stays active even when you select an other session or dataset. Active filters are indicated by a red background of the filter bar. You can remove all filters using the **x** button on the right end of the filter bar.

The filters can be saved by right clicking on the colored filter bar and choosing to save the current filter. Saved filters are available throughout all databases and can be deleted again by choosing to manage the filters.

The additional custom filters are available by clicking on **Custom** in the filterbar. These allow certain filters based on recording time. For some the sessions need to have set correct sunset and sunrise time entries. These extra filters are useful when dealing with large datasets from long term monitoring as for example from wind turbine assessments.





Another new filter is based on measurements of each call. For this filter the recordings must be available on disk as files and measurements have to be created by the call finder. To activate the call measurement filters, you need to double click any entry in the **Calls column**. In addition the filters can be activated from the menu **Recordings -> Select call parameters**. Another filter in the recordings menu will filter a random number of recordings.

7.4. Managing recordings

Copying and deleting original files

You can delete recording files displayed in bcAdmin directly via the according menu items in the **Recordings** menu. Deleted files are moved to the system trash and can be restored from there again.

Managing database entries

Using **Sessions->Add recordings or Recordings -> Add recordings** new recording files can be added to bcAdmin. They will be added to the current selected session. You can‘t add recordings from different filelocations to one sessions, though.

7.5.Feeding-buzz detector

We do not believe that feeding buzzes are a reliable marker for hunting behaviour - or the absence of feeding buzzes for no hunting behaviour. Yet bcAdmin 4 features a detector for feeding buzzes in selected recordings. It is available from the **Recordings** menu.

7.6.Find trigger events

Sometimes you have recordings covered by a lot of artificial noise or bushcrickets. In such situations the call finder may not be able to find all calls. Using the trigger finder may allow to find some more recordings with positive trigger events that were not good enough for the call finder.

7.7.Parasite detector

Starting with version 1.3.5 bcAdmin 4 includes a parasite noise detector. After call search and batIdent/CoreML identification at some locations you end up with many Spec or Pipistrelloid recordings that are actually noise. The process of checking these can be cumbersome. We have included an automatic tool based on machine learning. Select the relevant recordings and choose from the menu Recordings the option Detect parasites. Each recording will be classified as Bat or „Störung“ (German for noise) and the result is written to the comment field.

If you have recorded noise/parasite that the supplied method does not recognize as noise you can learn an adapted model. For this select the relevant recordings first. Make sure, they do not contain bat calls apart from parasite noise. From the Recordings menu choose to Export parasite (requires macOS 12). Using the application CreateCallsModel (download on our homepage), you can create a custom parasite detector including our data as well as your noise data. The resulting model-file can now be used as an alternative to the built in classifier model. To use your own mode hold the shift key when starting the parasite detector from the recording menu. You are then asked to choose your model file which is used for the parasite detection then.

7.8.Automatic species identification using CoreML

In bcAdmin4 1.4.0 we have introduced a new species identification tool which will replace batIdent this year. The first version is preliminary and does for now store its results in the recording comment. That way you can easily compare batIdent results and CoreML results.

The classifier is found in the recordings menu and you can either classify on genus/group level (only the first classification step) or on species level. The command takes the selected recordings and is doing an analysis. The process is ca. 5 times faster than the batIdent process, with higher speeds on the optimized Apple computers with M processors.

For optimal results of the new CoreML classifiers we recommend to adjust the call finder to eliminate such calls deviating from the regular calls. This can be activated in the application Preferences -> Expert settings. Choose to filter noise using statistical analysis and allowing only such calls with a median as criterium within 100% bandwidth.

Since version 1.4.1 a new feature was added. In Preferences -> CoreML you can set individual probability thresholds for genus/species which must be met to add a call to results and output a final result. For a better understanding of these thresholds we explain in short, how the classification process is working and where these probabilities are effectively used.

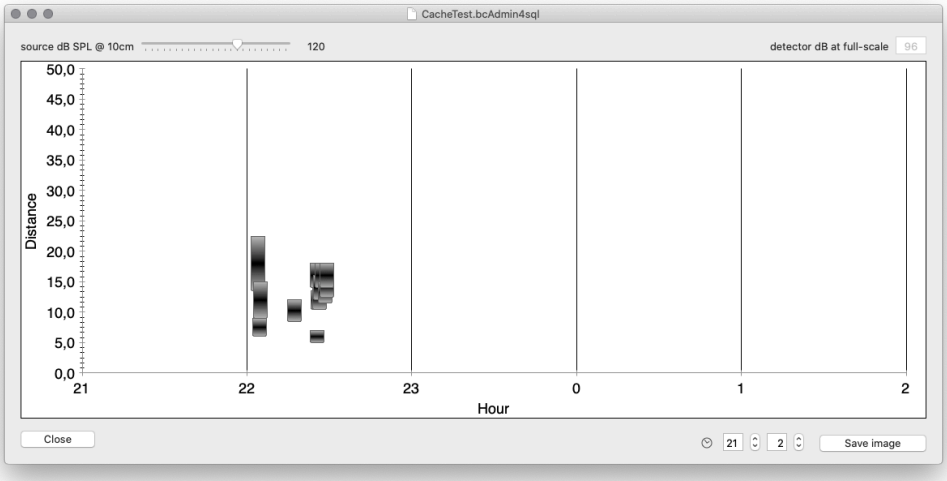
1. **Classification on genus/groups level**: In a first step for each call the genus (group for nyctaloid calls) is evaluated. The classifier gives a result and a probability. If the probability reaches at least the threshold set for the result (standard 0,8 = 80%) the result is stored for this call. If the criterium is not met, unspecified Spec is stored.
2. **Classification on species level**: The next step classifies the call on species level. The classifier again gives a result and a probability. If the probability reaches at least the threshold set for the result (standard 0,8 = 80%) the result again is stored for this call. If the threshold is not reached, the last result (genus/group) is kept.
3. **Final result for recording**: The results of all calls are combined per genus/species are sorted by probability and count. For each result the probability must reach the threshold to qualify as final result for the recording. These results are then reported.

The preference window gives two fields per genus/species holding the single call threshold in the first and the overall threshold in the second field.

In bcAdmin4 1.4.2 the results can now be directly used instead of batIdent results. You only have to activate this option once in preferences -> call finder. There you can opt-in to still produce the csv-files used by batIdent. The new CoreML classifier works without the csv files as well.

7.9.Recording distance

If your detector has a known sensitivity you can calculate the distance the calling bat had to your detector by assuming a call amplitude for the bat. Using this tool will not give exact



distances to the calling bat, but it will help to estimate the range you were recording the bats at. You start the distance finder from the **Recordings menu** using **Plot distance**.

For the batcorder you can assume 96 dB full scale at 40 kHz when properly calibrated. If your detector of another brand is calibrated, you should have a value for full scale as well. Bats can be expected to use sound pressure levels of 90 dB (whispering bats) up to 130 dB SPL.

7.10. Changing timestamps and durations

Changing timestamps

The timestamp for each recording is extracted from the file creation timestamp when the files are imported to bcAdmin. This timestamp may not be correct if the files were copied, sent by email or otherwise moved between different media. Thus it may be necessary to change the timestamp to the correct one. Various commands exist for this task. You can use **Recordings - Adjust recording** time to add or subtract a certain amount of hours, minutes and seconds to the current timestamps. With **Recordings -> Adjust time from logfile** the logfile is read and timestamps are extracted from there for each recording. Furthermore a feature exists for SM2Bat and Avisoft recordings that store the recording timestamp in the filename.

7.11. Simulate batcorder

You have the possibility to simulate a batcorder with different settings based on the selected recordings. This enables you to switch parameters if you have mistakenly used different settings when recording. Note that only some simulations are possible:

$Posttrigger_{original} >= Posttrigger_{simulation}$ e.g. 600ms batcorder vs. 200ms simulation

$Threshold_{original} =< Threshold_{simulation}$ e.g. -36 dB batcorder vs. -27 dB simulation

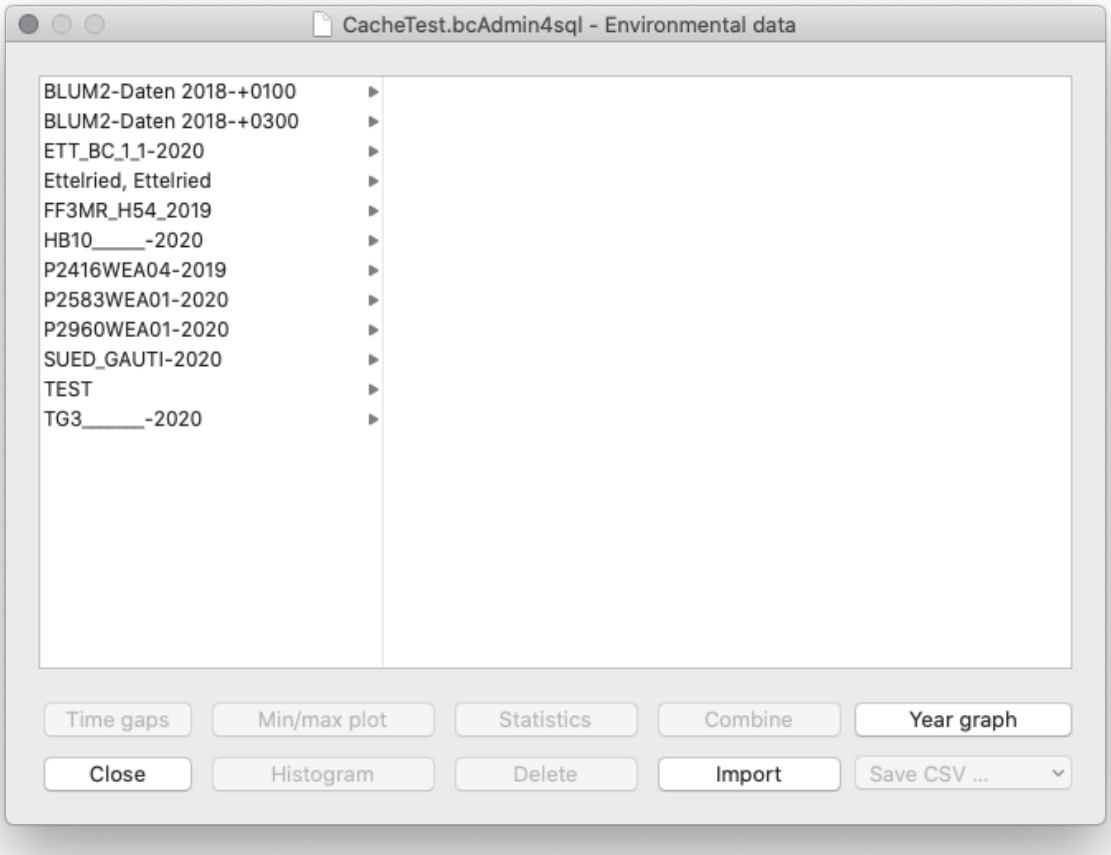
The results are stored using virtual recordings in your session indicated by italic print of file name. All other aspects like duration, species etc. are copied from the original recording.

7.12. Export as wave file

Selected recordings can be exported as wave files using **Recordings -> Save as Wave**. This may be useful if batcorder files have to be sent to someone not being able to open raw recordings. The exported files get the timestamp of the database entry.

8. Managing environmental data

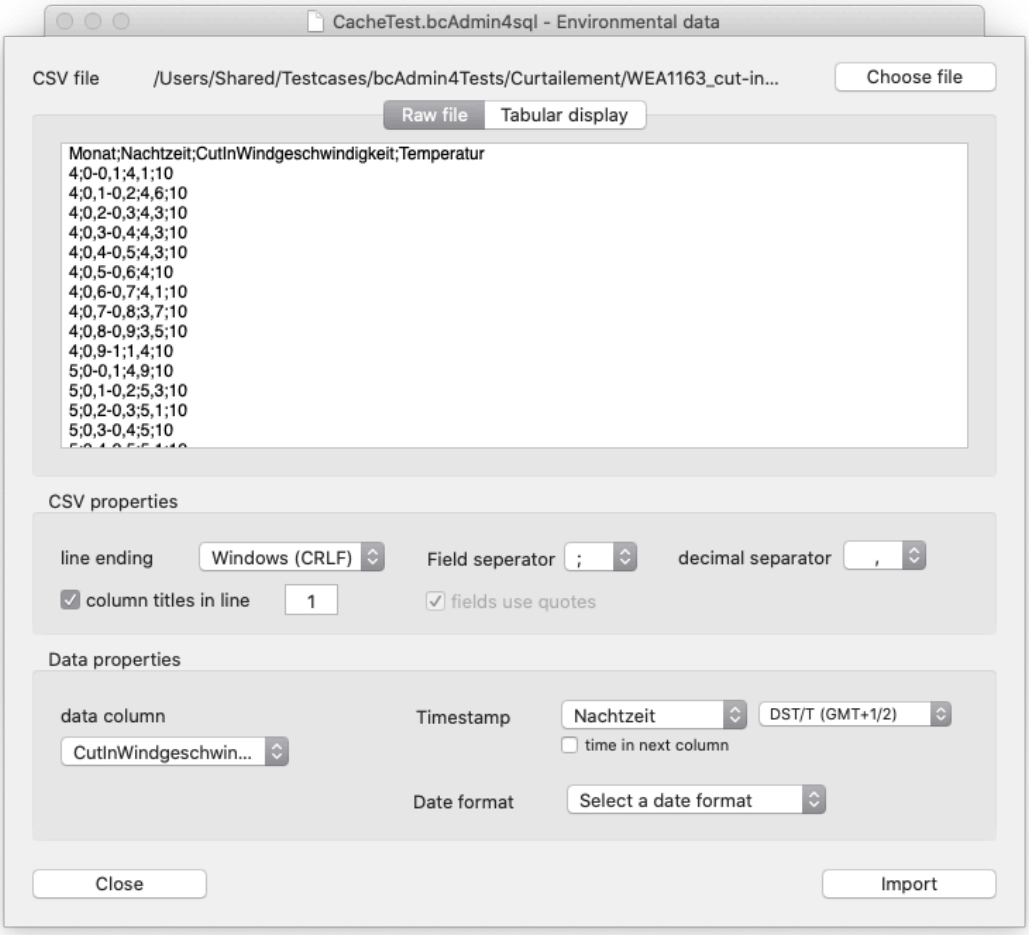
When analysing bat activity environmental parameters like temperature or windspeed influencing the activity are often of interest. In bcAdmin4 these can be imported and stored in the database as extra objects and then be used for various analyses. You can open the editor from the Window menu using **Environ data**.



Administrate and import environmental data from there and store windspeed, temperature, rainfall, energy and coordinates within a single dataset. Coordinates are managed from the maps view where they can be used for geo referencing. When importing from logfile, the stored temperatures from the batcorder are imported as environmental data and stored with the according FILECODE. Simple analysis allow to see time gaps in data as well as various statistics.

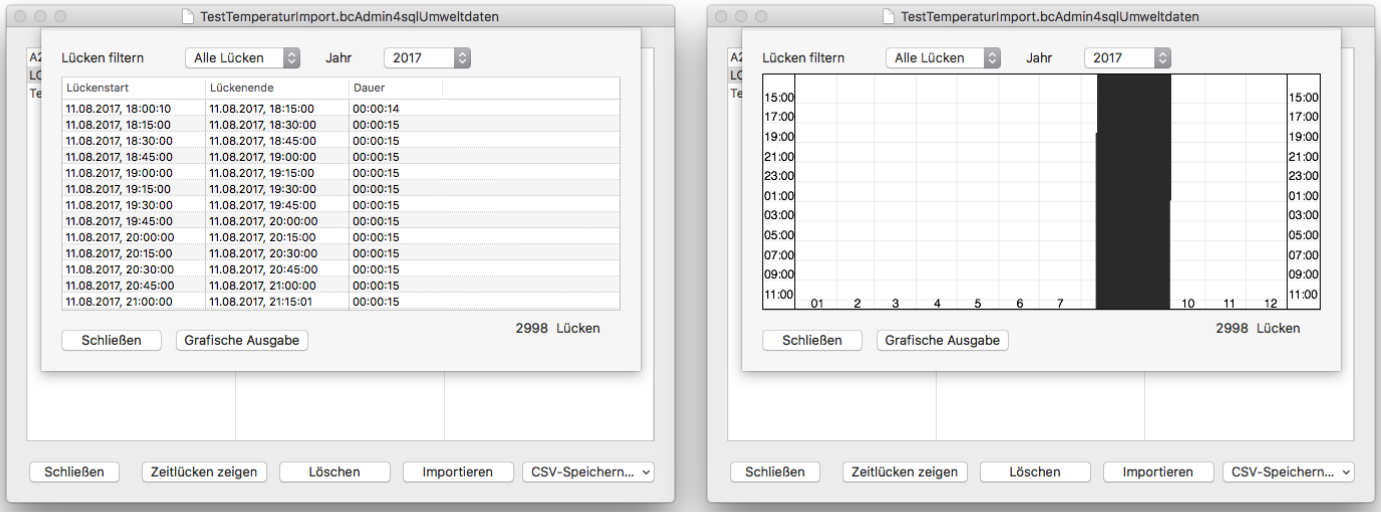
The import of CSV files is one of the main tasks of the environmental data editor. If you want to add data to an existing dataset, choose the main dataset in the first column, then use **Import**. Otherwise a new main entry is created. After choosing the csv file for import next choose the appropriate settings to import single columns and timestamps from the CSV file. Display of either raw data or a table is possible indicating by bold text the

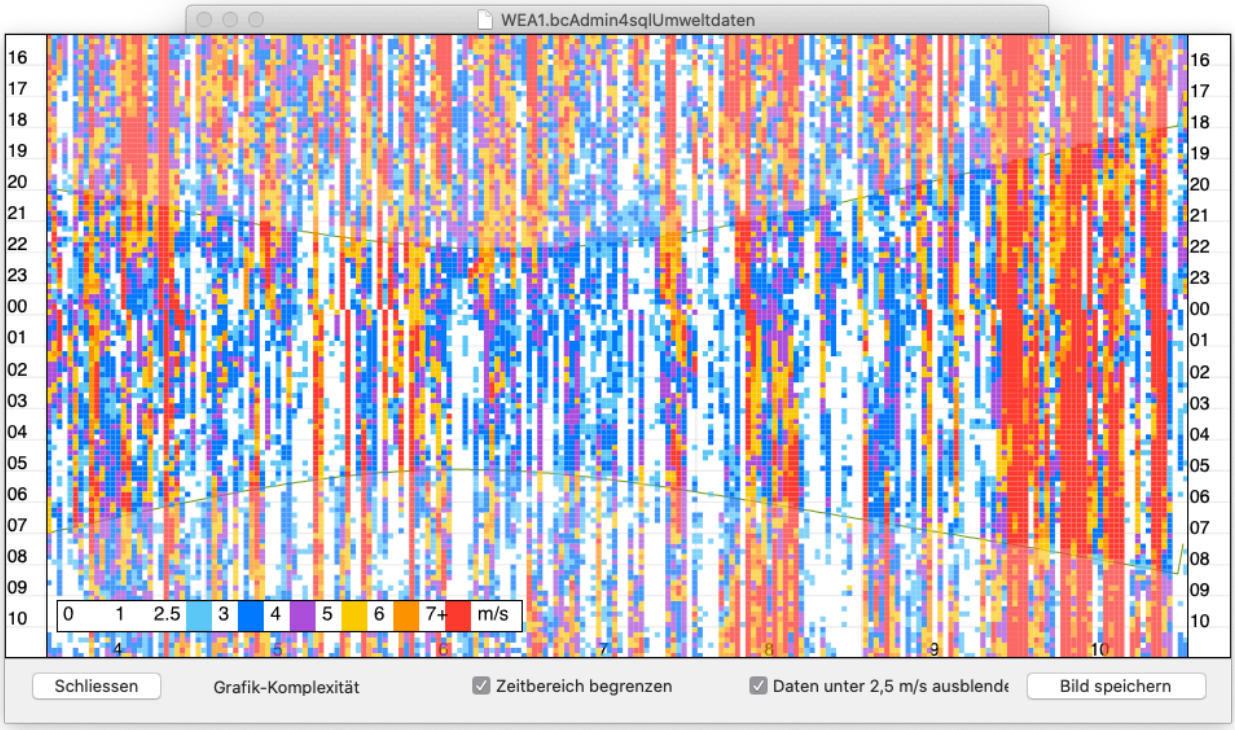
imported data. Note the correct time format as well as the deviation of GMT for the data is needed.



Timestamps can sometimes be a bit tricky. The optimal solution is that date and time are stored in a single column. Otherwise check the box that time is stored in the next column. Choose from the presets the format that describes exactly the given timestamp format in your csv file. Make sure, all rows feature exactly the same timestamp format. While bcAdmin will recognise most formatting errors itself, there can be situations when you get wrong timestamps returned. You later can adjust the time base (GMT offset, timezone) after selecting any of the contained datasets (temperature, windspeed, …).

You can examine various properties of the data like time gaps, minimum and maximum as well as the distribution of data by using the various buttons. A new analysis gives a graph/ heatmap for temperature or windspeed throughout the year with various options to customise the display.





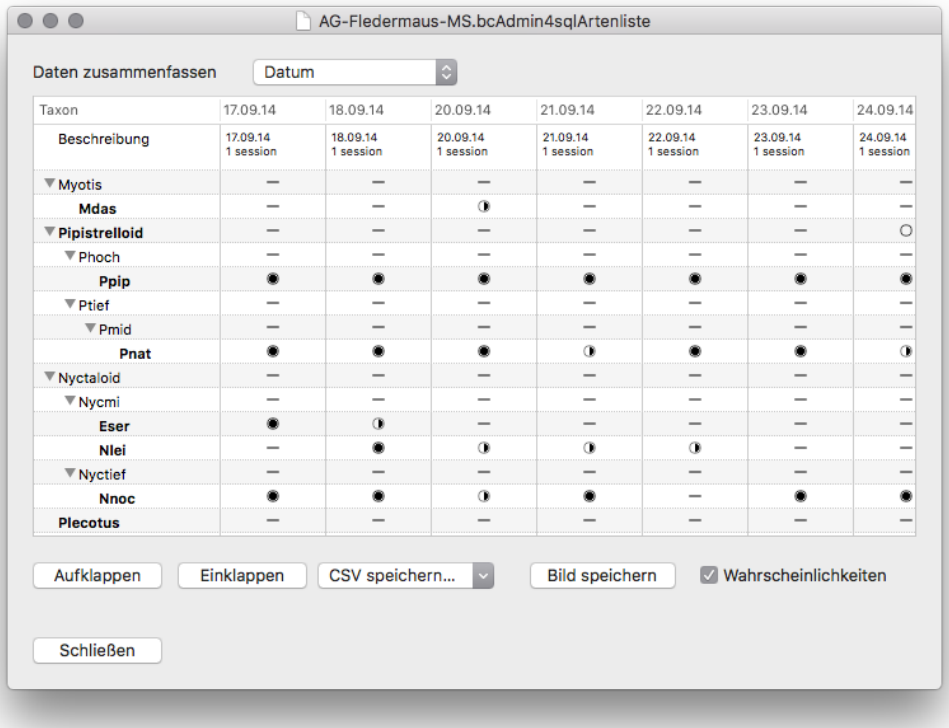
Environmental datasets can be connected to either sessions or locations and then be used in correlation of activity with weather conditions.

9. Data analysis

bcAdmin contains various tools to analyse your data for different goals. You are able to create meaningful activity summaries and graphs for your reports. Usually the following tools work on data of the selected sessions.

9.1. Species list

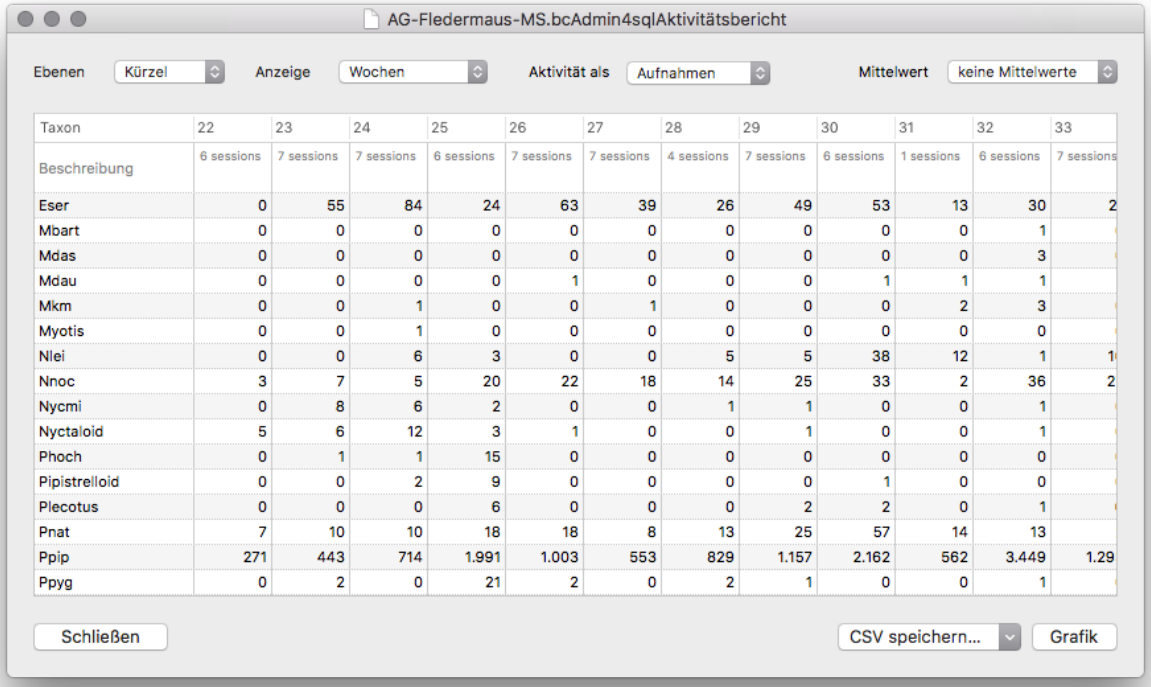
This feature gives a list of all species encountered at the selected sessions. Additionally sessions can be summarised based on various parameters like project, location or various date parameters. Based on averaged probabilities bcAdmin creates a probability for each species/group entry and indicates this with different symbols (filled circle high probability, empty circle Lowes probability). For this a weighted average over all species entries is calculated. Species with only a few entries may thus be more easily classified as of lower probability. The result can be saved as image or CSV file.



9.2. Activity report

The activity report is a powerful tool for comparing the data of various sessions or sample efforts. You create an activity report using **Analysis -> Activity report** . The report lists after its initial run for each selected session a column and a row per species/group entry. Sessions can be grouped using date, project or location entries. Data can be summarised in form of count of sequences, recording durations in seconds as well as activity in one-minute classes. Some entries can be normalised based on sampling or night duration.

Choose to display species abbreviations, scientific names or groups for the species row. bcAdmin calculates the relevant entries in the table based on this selection. Next choose which data should be combined. You can show data for each session, for each date, for a week, month or decade as well as a mix of these with locations or projects.



Taxon	22	23	24	25	26	27	28	29	30	31	32	33
Beschreibung	6 sessions	7 sessions	7 sessions	6 sessions	7 sessions	7 sessions	4 sessions	7 sessions	6 sessions	1 sessions	6 sessions	7 sessions
Eser	0	55	84	24	63	39	26	49	53	13	30	2
Mbart	0	0	0	0	0	0	0	0	0	0	1	
Mdas	0	0	0	0	0	0	0	0	0	0	3	
Mdau	0	0	0	0	1	0	0	0	1	1	1	
Mkm	0	0	1	0	0	1	0	0	0	2	3	
Myotis	0	0	1	0	0	0	0	0	0	0	0	
Nlei	0	0	6	3	0	0	5	5	38	12	1	1
Nnoc	3	7	5	20	22	18	14	25	33	2	36	2
Nycmi	0	8	6	2	0	0	1	1	0	0	1	
Nyctaloid	5	6	12	3	1	0	0	1	0	0	1	
Phoch	0	1	1	15	0	0	0	0	0	0	0	
Pipistrelloid	0	0	2	9	0	0	0	0	1	0	0	
Plecotus	0	0	0	6	0	0	0	2	2	0	1	
Pnat	7	10	10	18	18	8	13	25	57	14	13	
Ppip	271	443	714	1.991	1.003	553	829	1.157	2.162	562	3.449	1.29
Ppyg	0	2	0	21	2	0	2	1	0	0	1	

The following activity indices are implemented:

- Seconds: The activity of each species per second (recording duration) is calculated
- Sequences: The number of sequences
- 1-minute classes: for each minute of sampling time with activity the minute count is increased. Thus, all sequences of the same species recorded within a minute count as one. Sequences that have a timestamp outside the sampling time are ignored. Thus check that session settings are correct before using this function.
- Free time class: You set in preferences your time interval for combining recordings
- Continuity: If multiple sessions or locations are combined (for example monthly activity), the continuity gives a measure of how regular activity occurs. It ranges from 0% (none) to 100% (every session).

I addition all calculations can be averaged based on hours of sampling, nights, etc. using the popup button in the upper right.

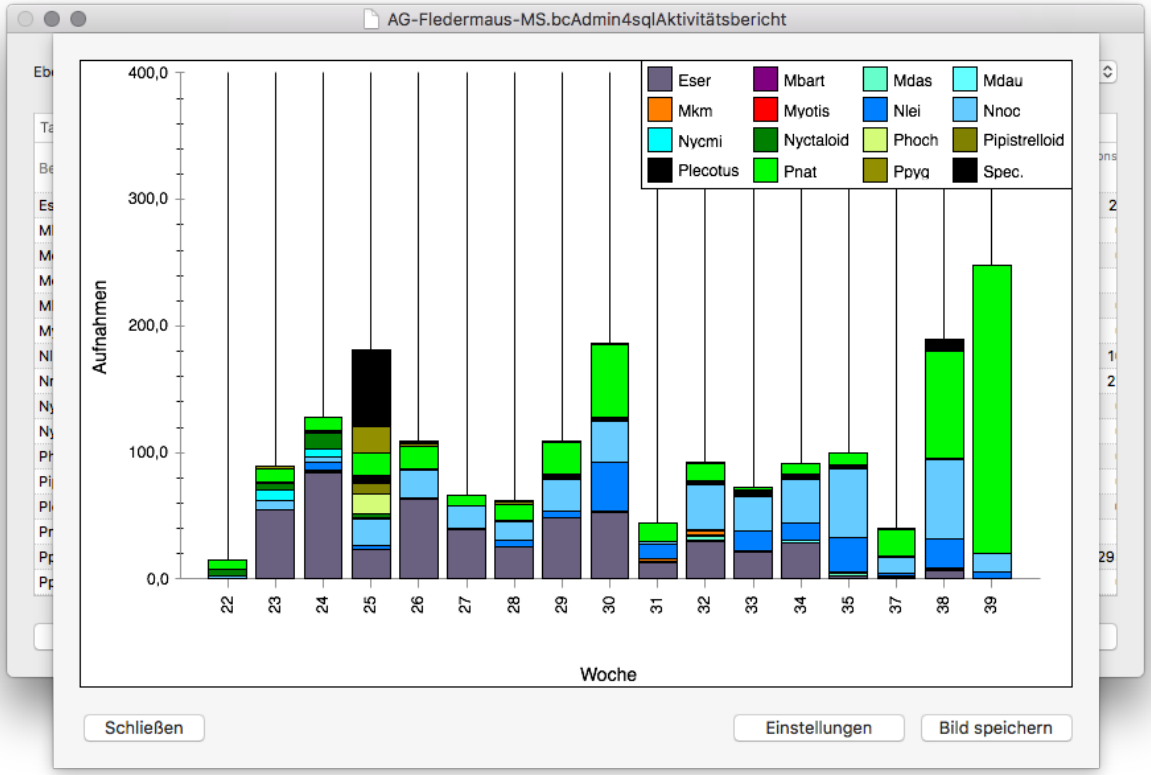
For some of the above calculations suntimes and sampling times from the session entries are used. Make sure these are set correctly, otherwise you may receive wrong results.

Export to CSV

The displayed results can be exported to a CSV file for import to graphing apps or other databases. The standard setting is that the table will get transposed for export, but you can switch that off in the app preferences.

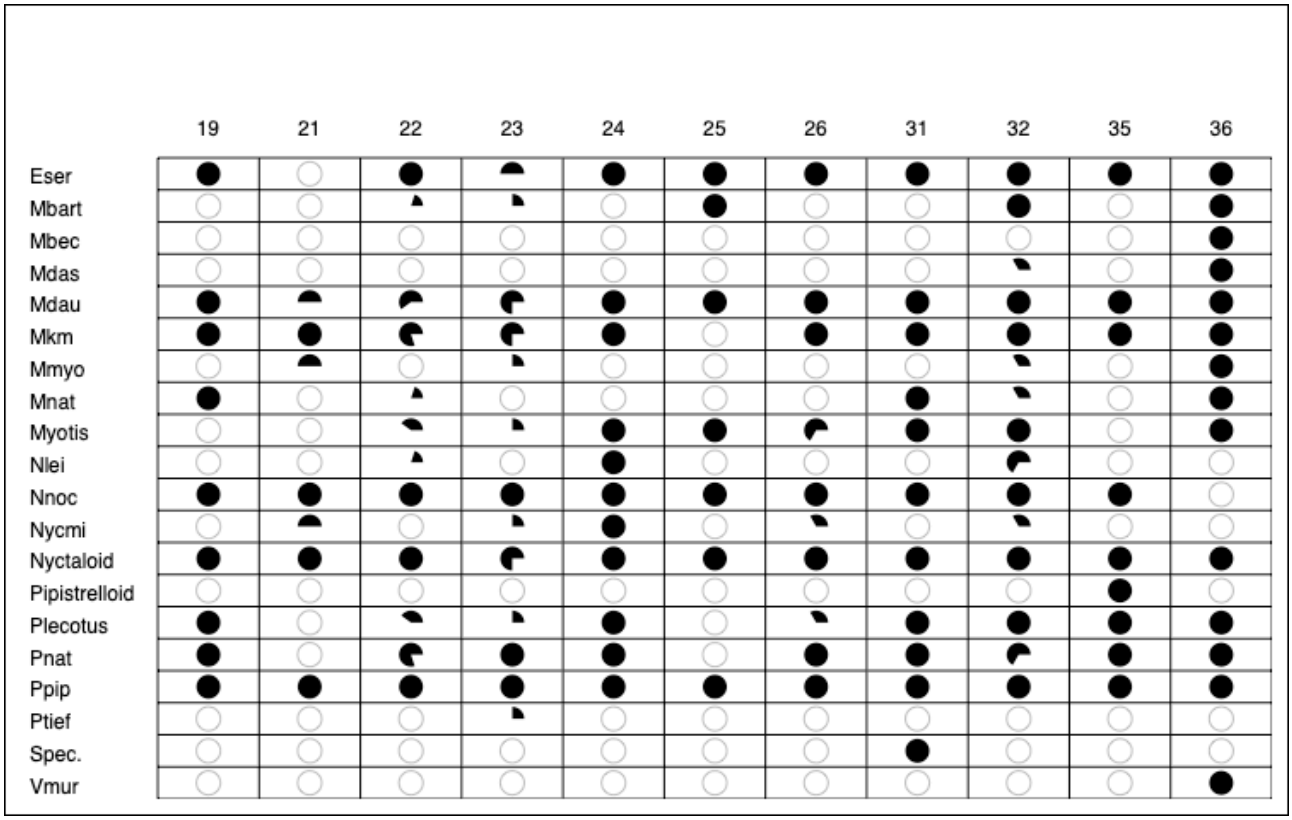
Graphical display

After selecting the report options a simple bar chart can be opened using the button **Show graph**. Clicking on **settings** opens a dialog that gives options like species selection, axis labels or user defined maxima for the y axis. That way you can select certain species for display in the graph.



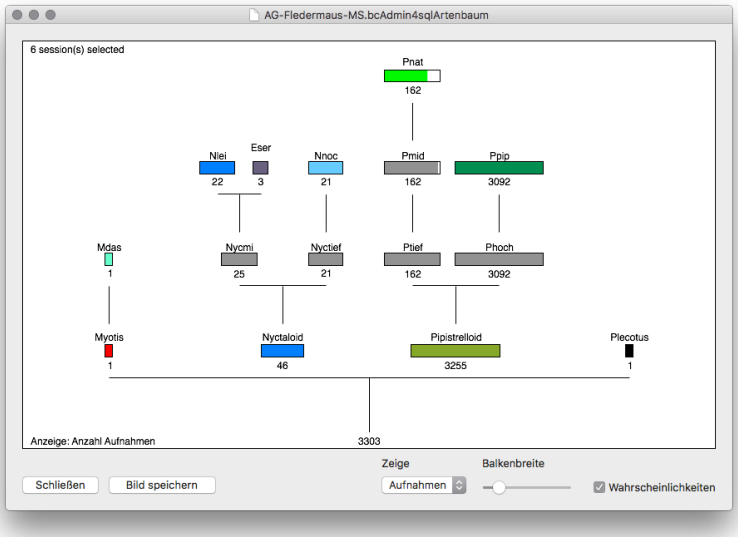
The species colors are taken from the values set in the taxon-editor. If you want or need other colors, change them there for the whole database.

A special plot is possible to create if you have selected continuity as displayed parameter. In this case a matrix is created giving circles for each species/group for each displayed time base (day, week, month, …). That way you can quickly see activity patterns of species over the year.



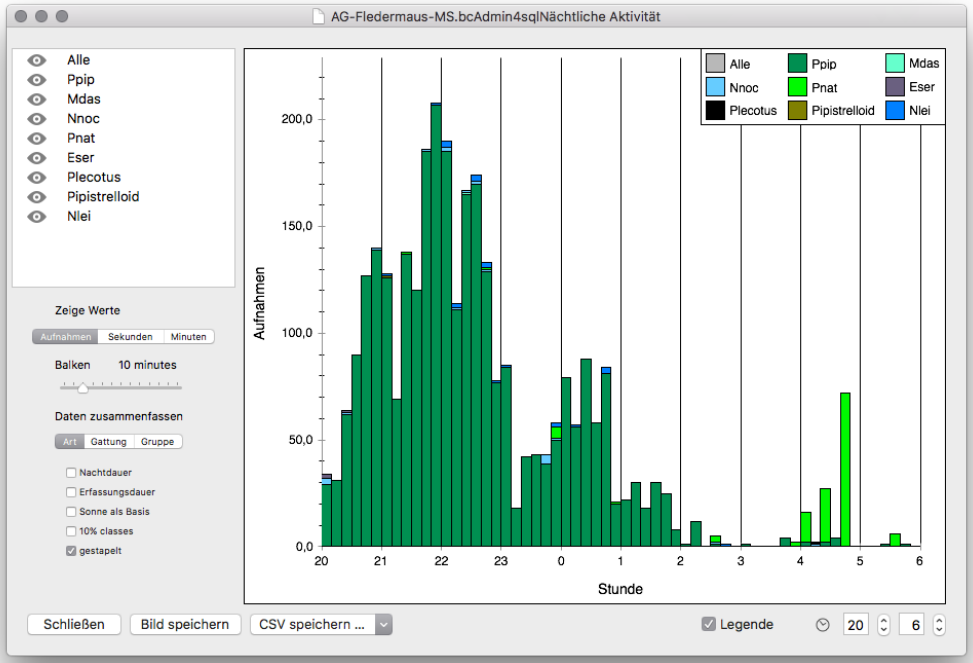
9.3. Species tree

The species tree displays the distribution of species identification for the selected sessions. It resembles the steps batIdent went through to find species for the recordings. You can opt to display number, seconds or minutes of activity per tree element. The numbers are also coded using either small bars or pie charts, you can chose between those two displays. In addition the average probability for each tree element can be plotted. The graph works well for showing diversity as well as for finding identification errors by looking at the numbers shared between similar calling species or groups.



9.4. Nocturnal activity

For various reasons it may be helpful to examine activity at a location throughout one night. Emerging patterns may indicate roosts, or other bat relevant structures. For single as well as multiple sessions bcAdmin offers the display of nocturnal activity. It can be accessed via **Analysis -> Nocturnal activity** after the relevant sessions were selected.

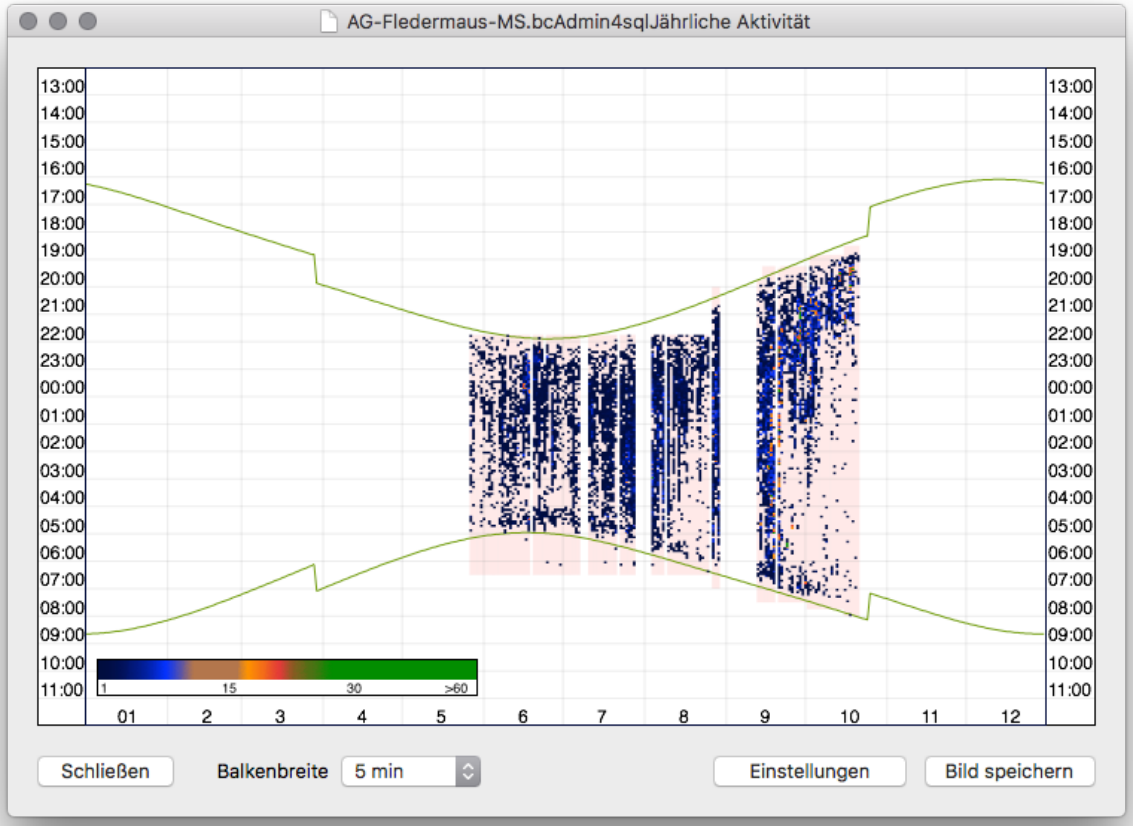


Activity is displayed as bars in a histogram like way. The bats can either represent number of sequences or seconds of activity per bin. You can adjust the bin width from 5 to 60 minutes. The background can be filled to indicate night or sampling duration. To allow better comparisons of different nights, you can also set the displayed time frame. Single species can be plotted as sub-bars by clicking the eye symbol next to their name in the left column. Finally the display of either species, genera or groups can be toggled. For export a legend can be toggled using the small legend icon in the upper right (only visible if species are coloured). A right click on the graph shows a context menu with options to set a maximum y-axis value as well as graph subscription.

A new feature allows to batch export graphs for each session shown in the session table. To use it, select the first session, that should be saved as graph. Adjust the settings to your liking and then click on **Save image while holding the alt/option key**. Next choose a folder to save a image for each sessions nightly activity distribution.

9.5. Yearly activity

If you are doing long-term monitoring your interest often lies in the activity pattern throughout the year. This feature allows you to take a closer look at bat activity distribution split into daily and nightly patterns within one graph. It works for the selected recordings, thus you can easily display graphs for single species or all recordings. It is not meant as a graph to read accurate maxima and minima, but to give an overall impression of activity patterns. To draw the graph select **Analysis -> Yearly activity** after you have selected sessions and recordings. For better understanding of patterns the batcorder runtimes can be displayed in the background. They are taken from the session settings. Based on the coordinates sunset and sunrise are drawn as lines. If no location with coordinates was given to the sessions, a standard mid Germany location is assumed.

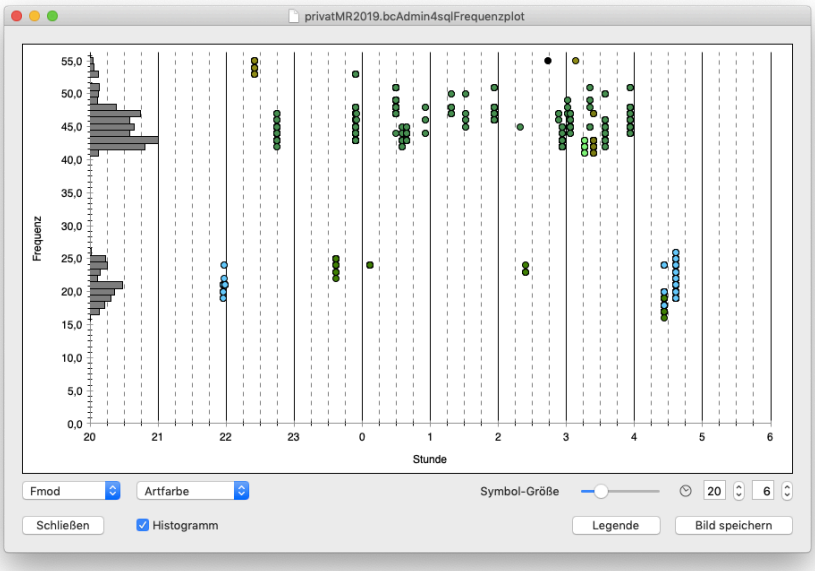


The sliders below the graph allow to change the color fill similar to a sonagram. To resemble a sonagram even more, you can activate a sonagram-like display as well. Export to an image file for adding the graph to reports is possible as well.

9.6. Frequency and probability plot

These two plots show the distribution of activity over night. One displays the batIdent probabilities for each recording, the other shows a selected frequency parameter for the selected recordings within the night. Both graphs help to identify possible misclassifications and overall give an impression of identification sturdiness.

The graphs can be manipulated in various ways. When holding cmd-key you can select recordings by drawing a selection rectangle around measurements and zoom them full screen. By double-clicking while holding down cmd-key the graph is unzoomed again. When selecting measurements by a selection rectangle while holding alt-key, the recordings get selected in the recording table of the main window.

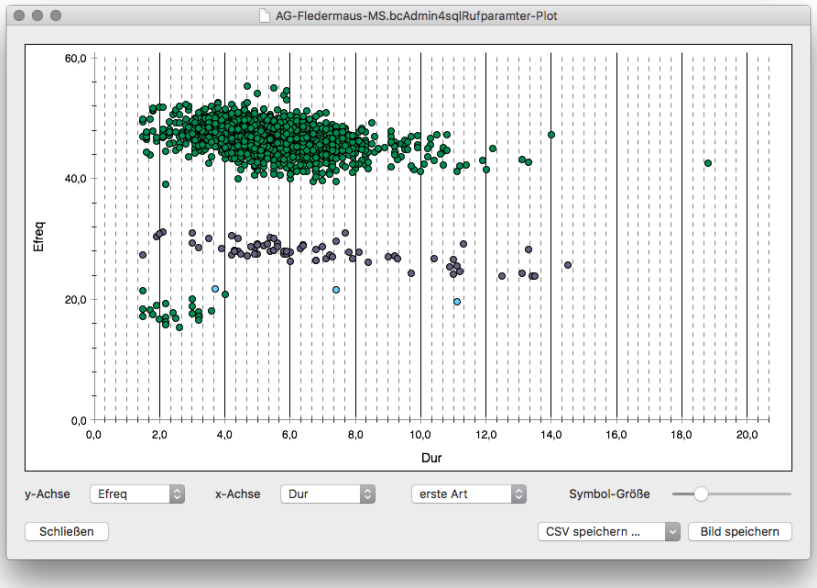


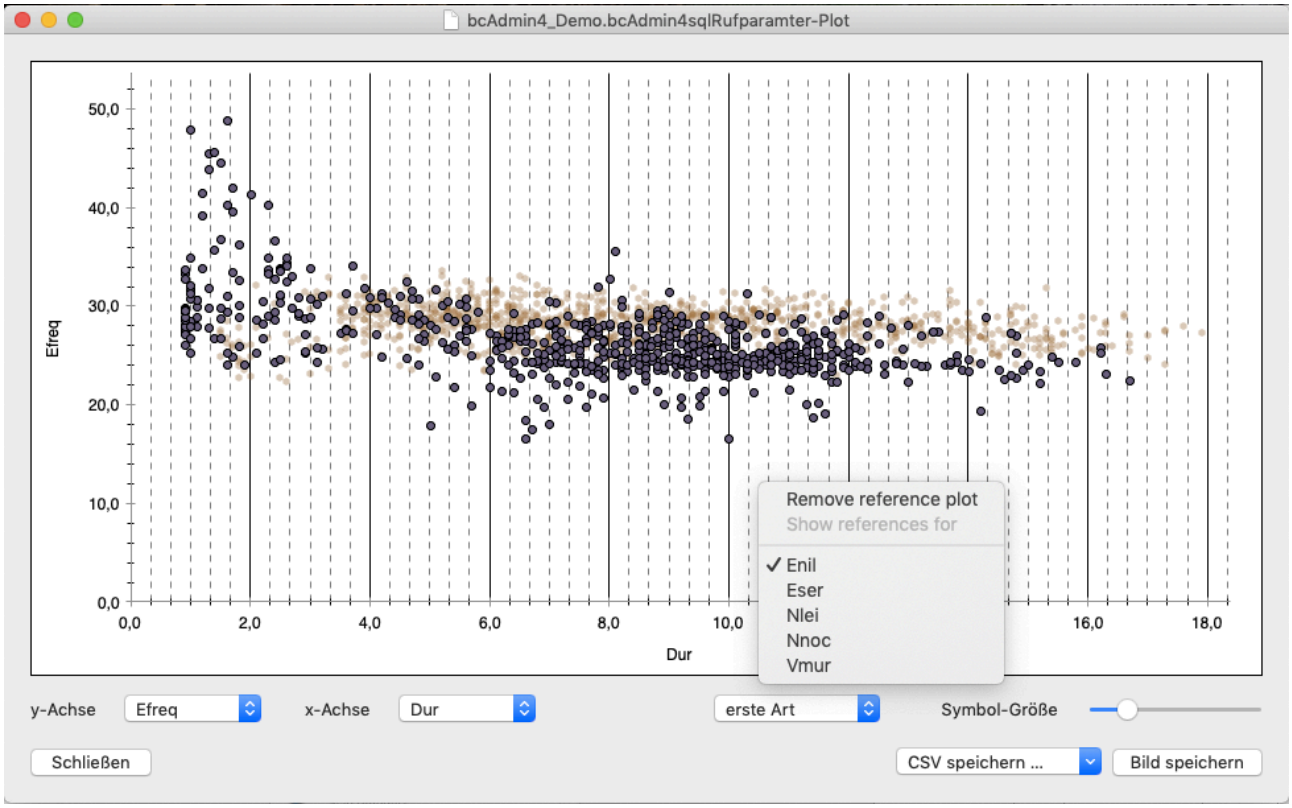
9.7. Call parameter plot

Another powerful tool to help identify misclassifications as well as to classifiy species your self without looking at all single calls is the call parameter plot. In form of a classic scatterplot you can choose to display two measurements, each on an axis. Typical pairings are duration and Fmod (which translates roughly to mean frequency) or duration and Fend (end frequency). Using the mouse while holding down cmd you can draw a selection rectangle to zoom in. Zooming back to normal is done by cmd+ double click. A right click on the graph allows to display some reference measurements of a limited list of species.

Using the clockwork symbol in the lower right you can activate a filter to eliminate calls in the display. If a filter is active this is indicated by red label below the plot. Furthermore point size and colors can be chosen. You can add a second reference species by clicking activating it while holding down the shift key. That way you can compare your calls to two

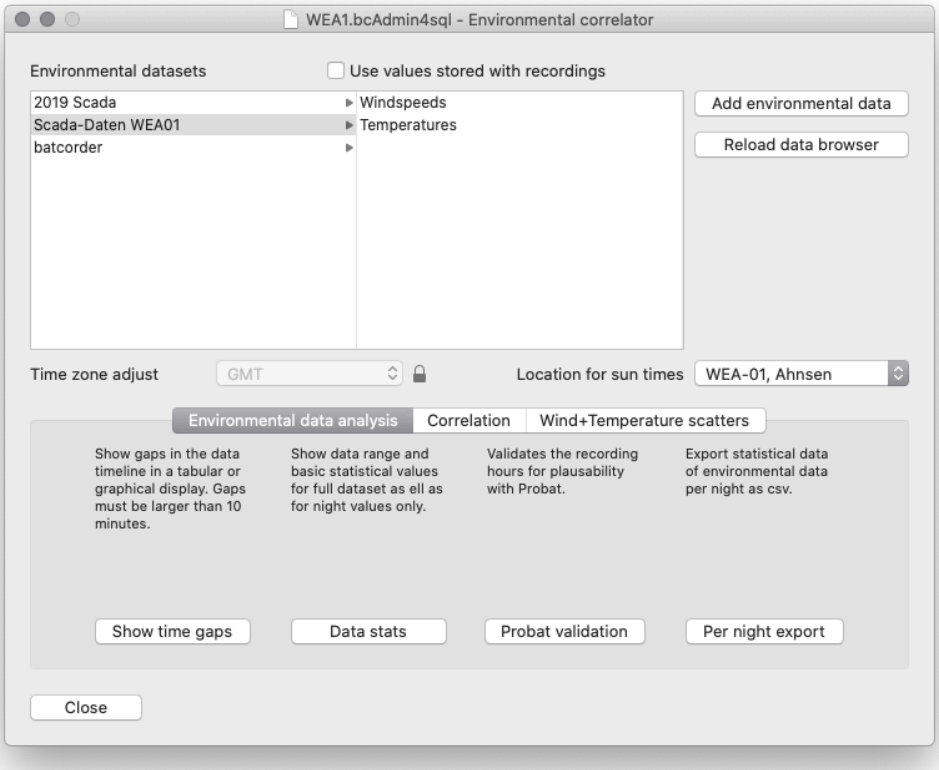
species at the same time. This often helps to sort out the species the calls you have recorded belong to.





9.8. Environmental correlation

One of the most complex features implemented in bcAdmin is the correlation of activity data with environmental parameters, mainly wind speed. This tool was developed to understand activity in relation to wind speed better and support the bat-friendly running of wind turbines.

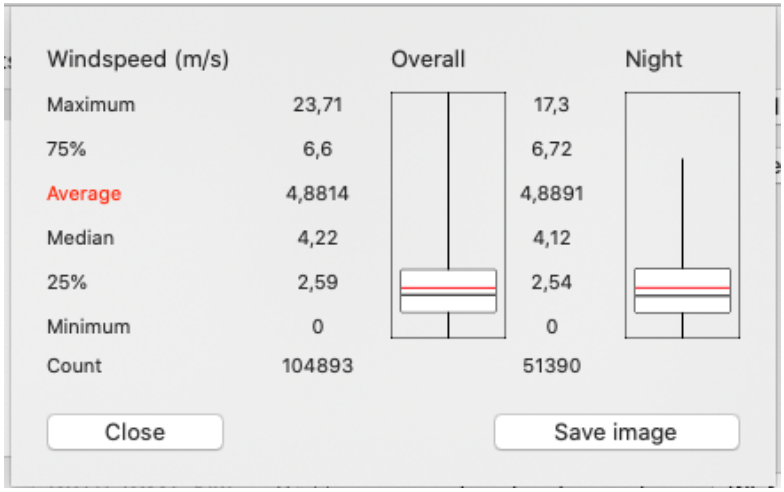


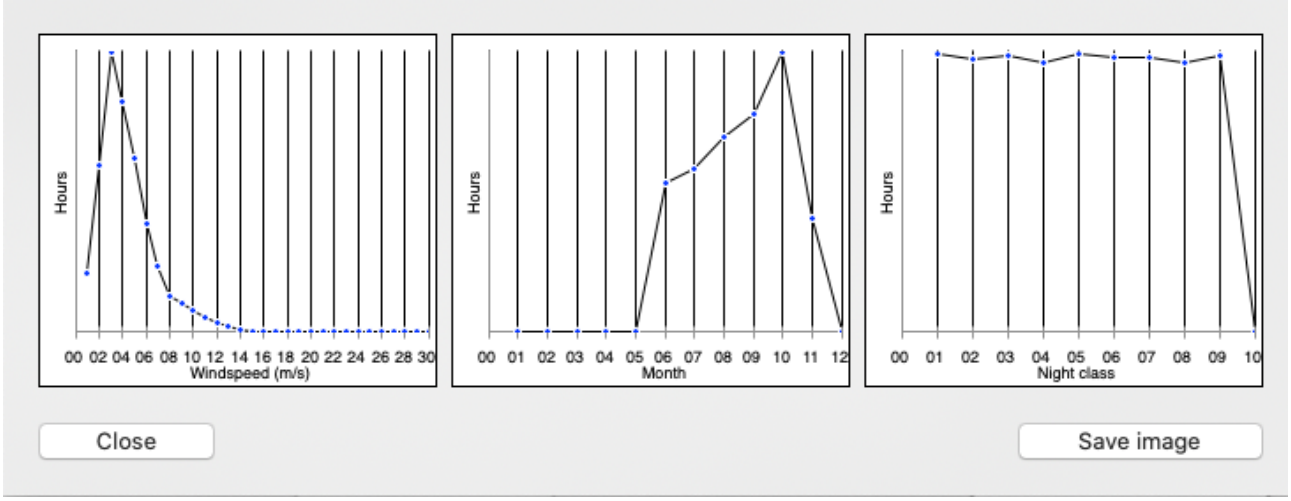
Input data

The calculations are based on the selected recordings, thus, first select the recordings you want to run a correlation for. That way you can select recordings of all bats or of certain species. If you select recordings without species entry, these will be correlated as well. Using the recording filter capabilities helps to select wanted recordings quickly.

Next you need to select the environmental dataset containing the data for correlation. If you don't have any imported yet, you can start the import here instead of in the environmental data editor. You can also opt-in to use data stored with recordings, for example after a successful correlation.

You can do some checks on the environmental data before running the correlation. For example can you check time gaps or see the statistics of one parameter. In addition if using ProBat you can do a data validation beforehand.





Correlation parameters

Last step before running the correlation is to select if results are given per species or per group level. Additionally select if a binary count (based on 10 minutes intervals) or the actual count of recordings is used for the correlation.

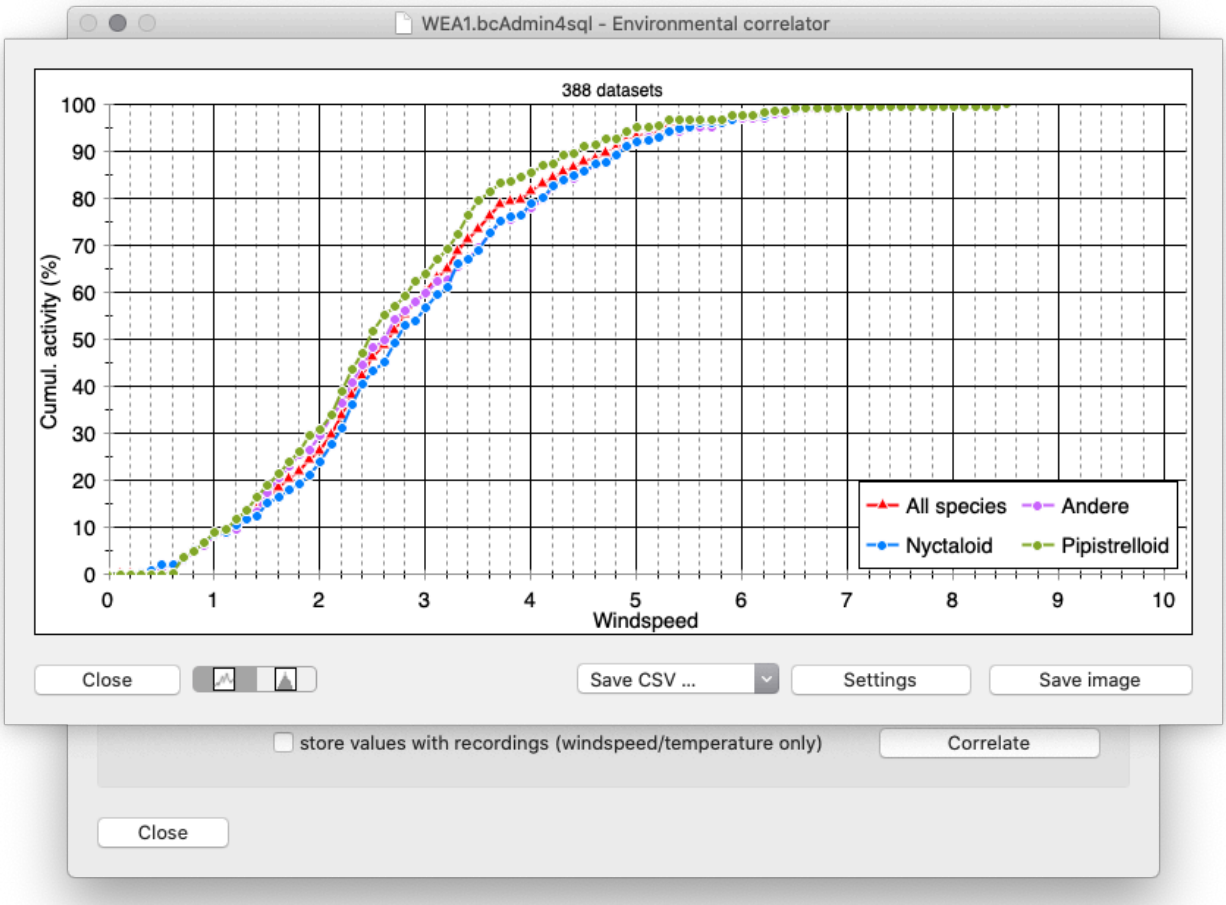
If you have already run a correlation before and have stored the environmental data with the recordings, a new correlation can be run using the stored values. This allows to create the graphs without choosing environmental datasets from the database.

Correlation background

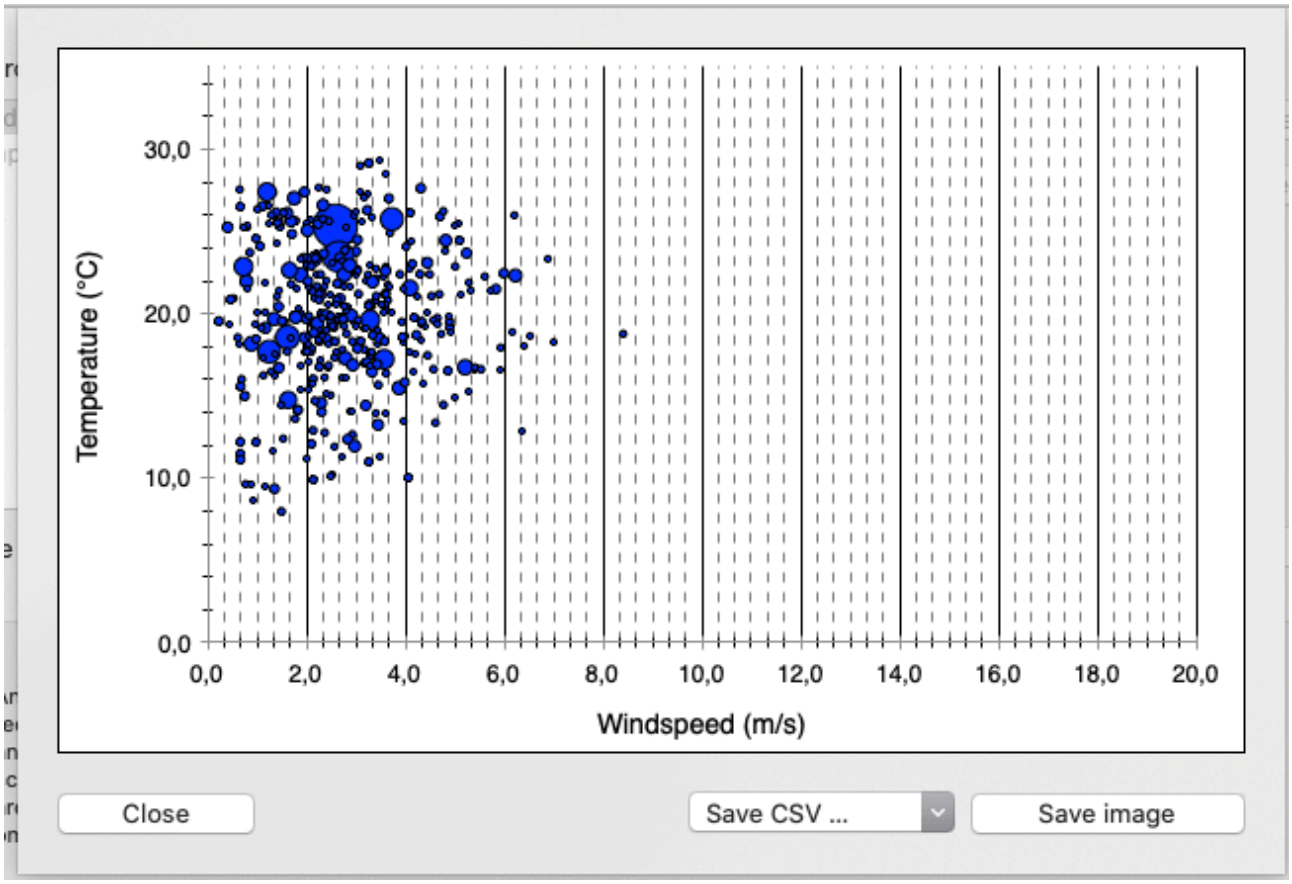
After extracting the data range of the environmental parameter it is distributed evenly over 60 bins (minimum to maximum). When correlating wind speed usually the range is set to 0 m/s to 30 m/s resulting in 0.1 m/s bin widths. The current bin width can be seen in the data stored in the clipboard after a successful correlation or from the filter button below the graph.

Graphs

The correlation results are shown as line or bar plot, raw data is saved to clipboard in addition and can be imported into other applications that way. The default line graph shows cumulated bat activity as percentage above the selected environmental parameter. For wind speeds 0.5 m/s classes are used, for temperatures 0,5° respectively. By either using the plots context menu (right-click) or the settings button various display parameters can be changed. When doing a left-click in the graph the area between the y-axis and the clicked point is filled with a different colour. That way you can for example click on the 95% of bat activity point and fill the part left of it indicating wind speeds that will be dangerous for bats. Finally you can switch between cumulative line display and a bar chart.



A new feature is to display a scatter plot with temperature and windspeed as axis values. You will need to correlate the recordings first with both these parameters and choose to save values. That way each recording gets a windspeed and a temperature assigned to. After activating the use of stored values of the recordings you can show the Wind+temperature scatter plots.

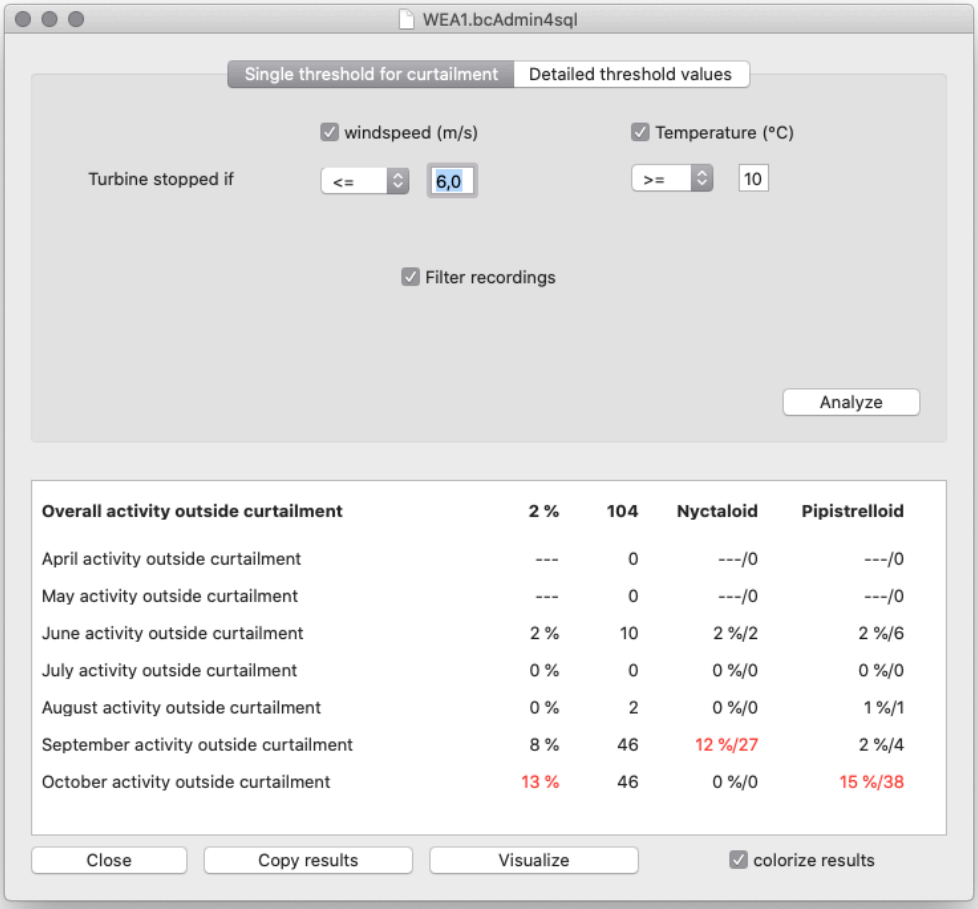


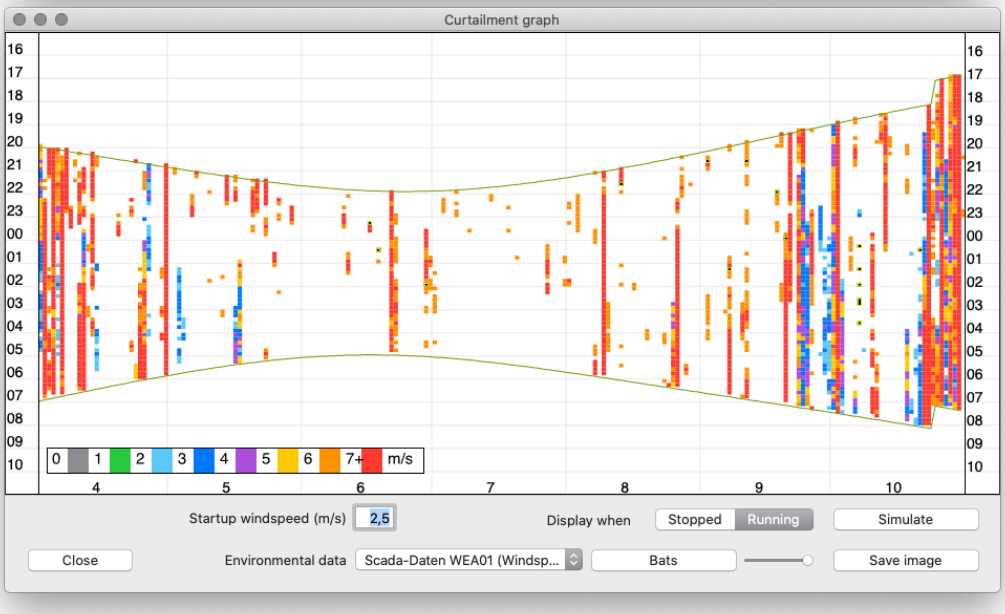
9.9. Curtailment analysis

Since 2022 a new feature to test curtailment algorithms for wind turbines was added to bcAdmin. This basically checks for selected sessions, if recordings are within or outside of a curtailement condition. These conditions can be either a rather simple form of either windspeed and/or temperature thresholds or detailed values per month or month and nighttenth.

The analysis will test for each recording if it is within our outside the curtailment and give results for the month of April to October. These are plotted in the display below the settings.

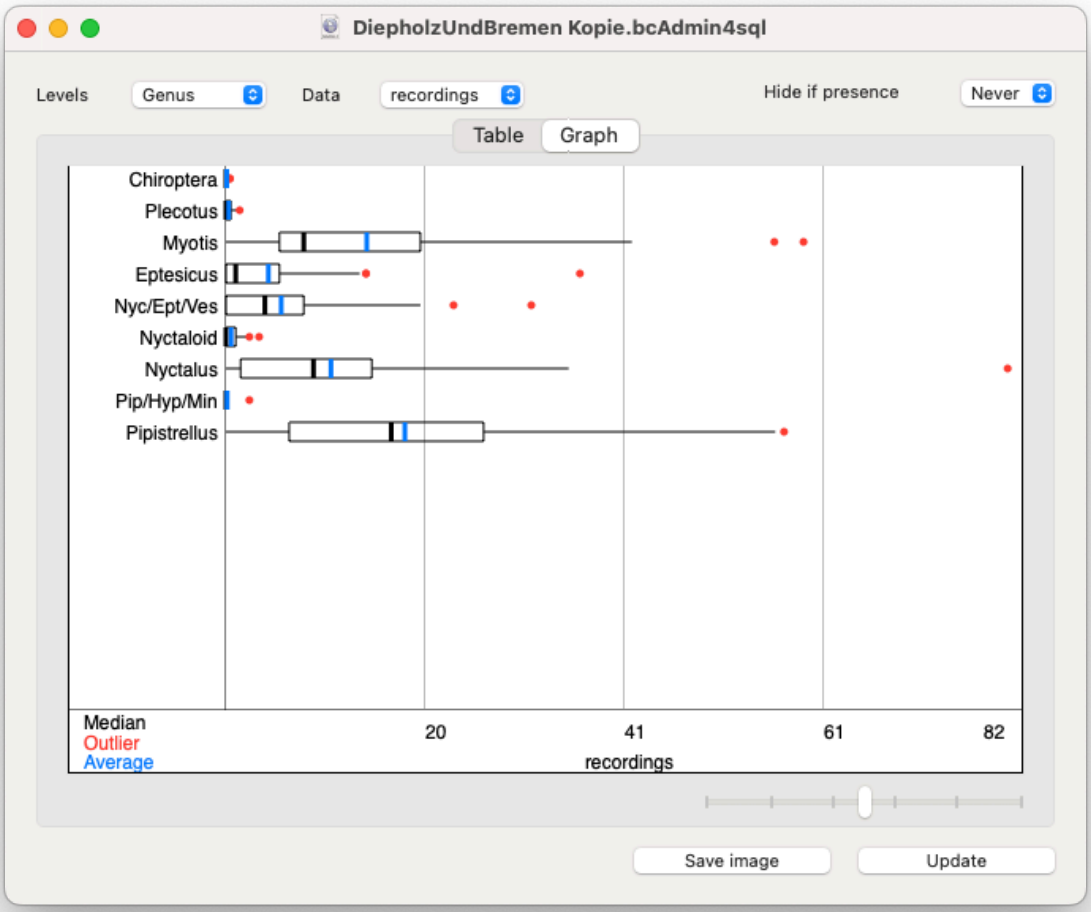
In addition you can plot the distribution of wind speeds for the year and optionally add the bat events:


WEA1.bcAdmin4sql
Single threshold for curtailment
Detailed threshold values
windspeed (m/s)
Temperature (°C)
Turbine stopped if
<=
6,0
>=
10
Filter recordings
Analyze
Overall activity outside curtailment
2 %
104
Nyctaloid
Pipistrelloid
April activity outside curtailment
--- 0 ---/0 ---/0
May activity outside curtailment
--- 0 ---/0 ---/0
June activity outside curtailment
2 % 10 2 %/2 2 %/6
July activity outside curtailment
0 % 0 0 %/0 0 %/0
August activity outside curtailment
0 % 2 0 %/0 1 %/1
September activity outside curtailment
8 % 46 12 %/27 2 %/4
October activity outside curtailment
13 % 46 0 %/0 15 %/38
Close
Copy results
Visualize
colorize results


Curtailment graph
16 17 18 19 20 21 22 23 00 01 02 03 04 05 06 07 08 09 10
0 1 2 3 4 5 6 7+ m/s
4 5 6 7 8 9 10
Startup windspeed (m/s)
2,5
Display when
Stopped
Running
Simulate
Close
Environmental data
Scada-Daten WEA01 (Windsp...
Bats
Save image

9.10. Data distribution analysis

With bcAdmin4 1.4.4 a new preliminary tool was introduced. The so-called **Statistical report** is located in the **Analyses** menu. After selecting at least ten sessions it will give the distribution of the parameters count of recordings, sum of seconds or minutes with activity in the form of a table with data for boxplots or as boxplots in an actual graph. You can filter out data for species occurring rarely and thus not allowing a proper calculation of distribution parameters.



This analysis is useful to understand how your activity is composed in terms of temporal distribution. If you have single nights with high activity and mostly low activity nights that does give not only a distinct boxplot but also tells you a lot of the bat activity. In comparison a single value like „average count of recordings“ may then be useless.

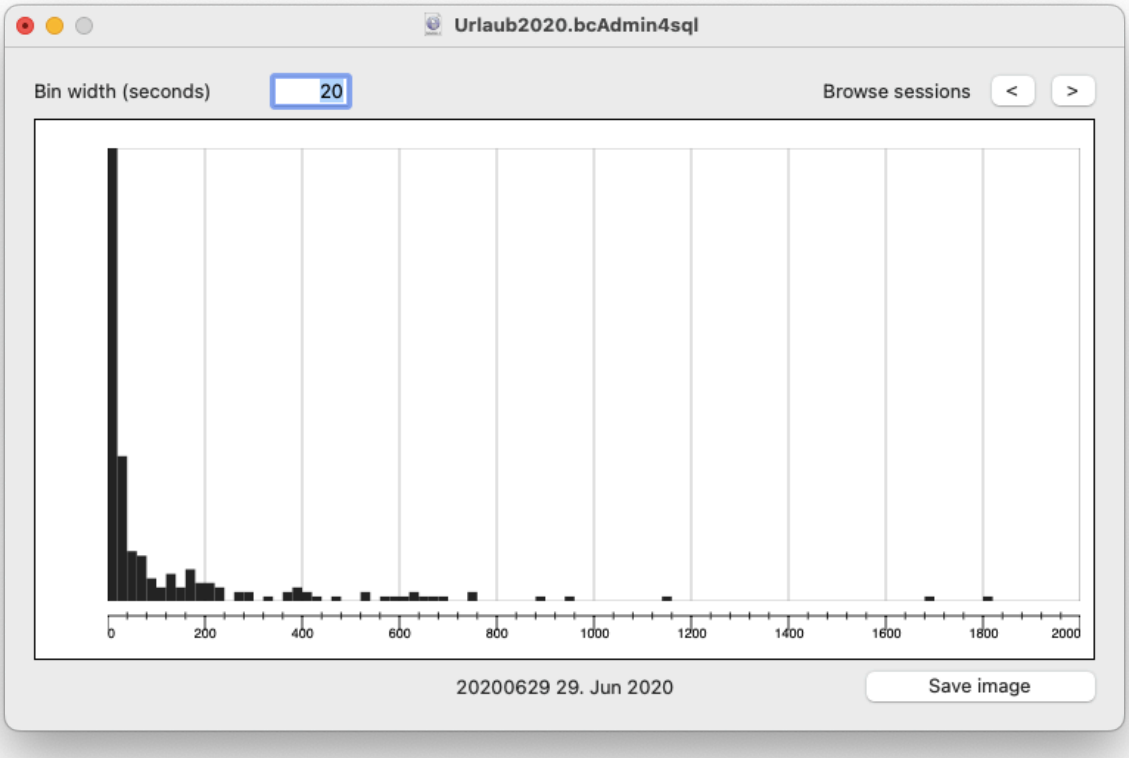
The graph can be exported to an image files as well as you can export the raw data displayed in the table.

We are currently investigating further features for this analysis tool to allow you to better describe bat activity in your projects.

9.11. Within night distribution analysis

A new features starting with bcAdmin4 1.4.4 is the analysis of the distribution of time intervals between recordings. A preliminary version can be tested and used already with the mentioned version. It can be found in the **Analyses** menu as item **Night distro**.

The basic idea is, that different patterns of bats occurrence relate to different types of activity. For example a bat hunting close to the microphone will produce series of recordings with short time intervals between these recordings. At a location with transfer flights



only, the recording will be more isolated in time. While the analysis may be show noise due to the night duration being much longer than the typical activity of a bat at one location, it should already give hints at least for some recording locations.

The tool creates a histogram with a selectable bin width. That means you select how many seconds of time interval between two recordings one histogram bin should include. The analysis is done based on the visible recordings, thus any active filter is taken into account. If you filter for example Pipistrellus pipistrellus only these recordings will be used for analysis.

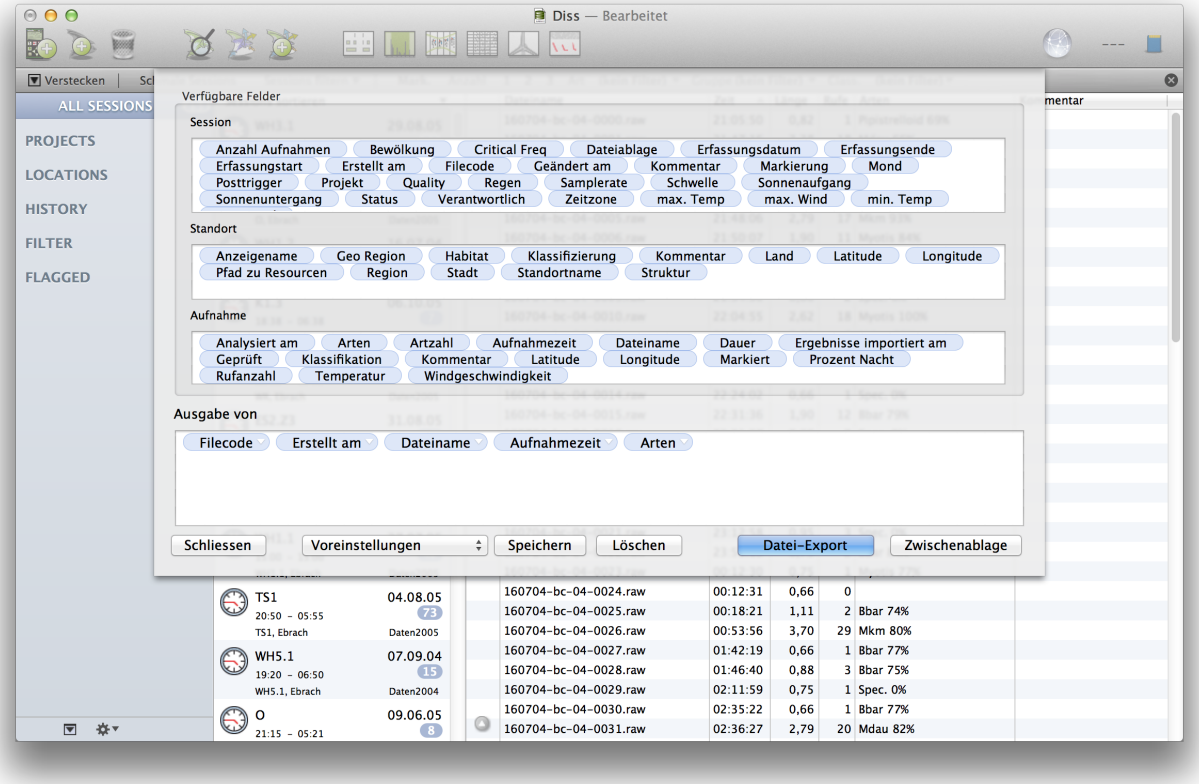
10. Data export and synchronisation

You often will need to use data generated in bcAdmin in other applications as well. May it be for reporting or creating more special graphs in tools like R. Most of the tools bcAdmin offers already have the possibility to export the data generated and used in the tool itself. But sometimes you have your own analysis tools and for this exports of various information are possible.

Exports are done to so called csv files. csv stands for character/comma-separated values. In such a file each dataset is stored in a row. The fields of the dataset are separated by a certain character - usually comma, semicolon or tab-stop. From application Prefererences you can adjust the default export options to csv format including field separator and timestamp format.

10.1. Raw data export to CSV

By using **File -> Export to CSV** you can export selected recordings and sessions to CSV in a very flexible way. The export dialog contains all fields that can be exported in the upper three groups of items. They are separated by session, location and recording. The fourth, lowest field acts as container for the actual export. Drag items from the above fields to the fourth to construct the export. You can save export selection and reload previously saved export configurations. Stored export configurations can also be set as default for



copy and paste from the session and recordings table. Thus, you can create a CSV string for the clipboard more quickly.

If you have selected **species** from the list of recording fields, you can chose if you want a new line for each species (if more than one is stored for a recording) or if all species should be within one line. The switch for this can be found in the applications preferences. This is a new feature of bcAdmin 3, in bcAdmin2 always a single line was written for each recording.

Note: Details regarding the CSV format can be all set in the application preferences via the Export display. There you can set column or field separator as well as line-ending.

10.2. Import of locations

Locations can be imported from csv files as well as from GPX-Trackfiles. Since a location always needs a unique name, when importing the data source already should feature a name for each location. Note the csv file must adhere to the following scheme:

4 columns with separator tab-stop, coordinates with . as decimal separator. The columns are

Date (optional), name, longitude, latitude

For example

```
019-06-22   Teststandort 1    9.515186221451565 48.74579048194715
2019-06-22  Teststandort 2    9.115186221451565 48.34579048194715
```

Date is optional and only used for sorting.

An example GPX file

```
<?xml version="1.0" encoding="UTF-8" standalone="no" ?><gpx xmlns="http://
www.topografix.com/GPX/1/1" xmlns:gpxx="http://www.garmin.com/xmlschemas/
GpxExtensions/v3" xmlns:wptx1="http://www.garmin.com/xmlschemas/
WaypointExtension/v1" xmlns:gpxtpx="http://www.garmin.com/xmlschemas/
TrackPointExtension/v1" creator="eTrex 20" version="1.1" xmlns:xsi="http://
www.w3.org/2001/XMLSchema-instance" xsi:schemaLocation="http://
www.topografix.com/GPX/1/1 http://www.topografix.com/GPX/1/1/gpx.xsd http://
www.garmin.com/xmlschemas/GpxExtensions/v3 http://www8.garmin.com/xmlschemas/
GpxExtensionsv3.xsd http://www.garmin.com/xmlschemas/WaypointExtension/v1
http://www8.garmin.com/xmlschemas/WaypointExtensionv1.xsd http://www.garmin.com/
xmlschemas/TrackPointExtension/v1 http://www.garmin.com/xmlschemas/
TrackPointExtensionv1.xsd"><metadata><link href="http://
www.garmin.com"><text>Garmin International</text></
link><time>2019-07-08T14:51:55Z</time></metadata><wpt lat="50.12345"
lon=„11.74522"><ele>350.170349</ele><time>2019-07-08T14:51:55Z</
time><name>Standortname</name></wpt></gpx>
```

10.3. Database synchronisation

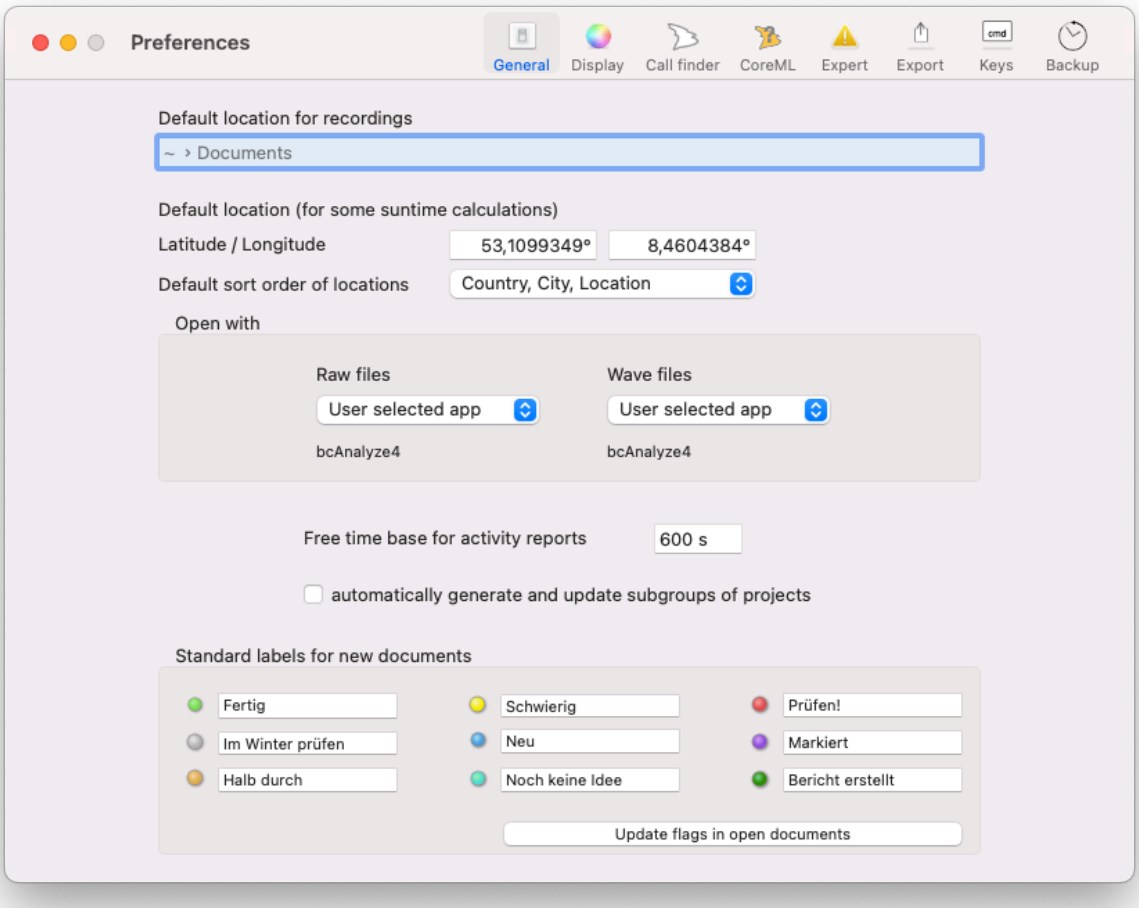
With this feature you can synchronize or share data between two bcAdmin4 databases. For example if you and colleague are working on two parts of a larger dataset, you can synchronize the data into one database after both have finished analysis. Synchronisation is possible on the level of projects, sessions or recordings.

11. Preferences

The behaviour of bcAdmin can be fine-tuned using various preferences settings. They influence the call finder, CSV export or colours used within the application.

11.1. General

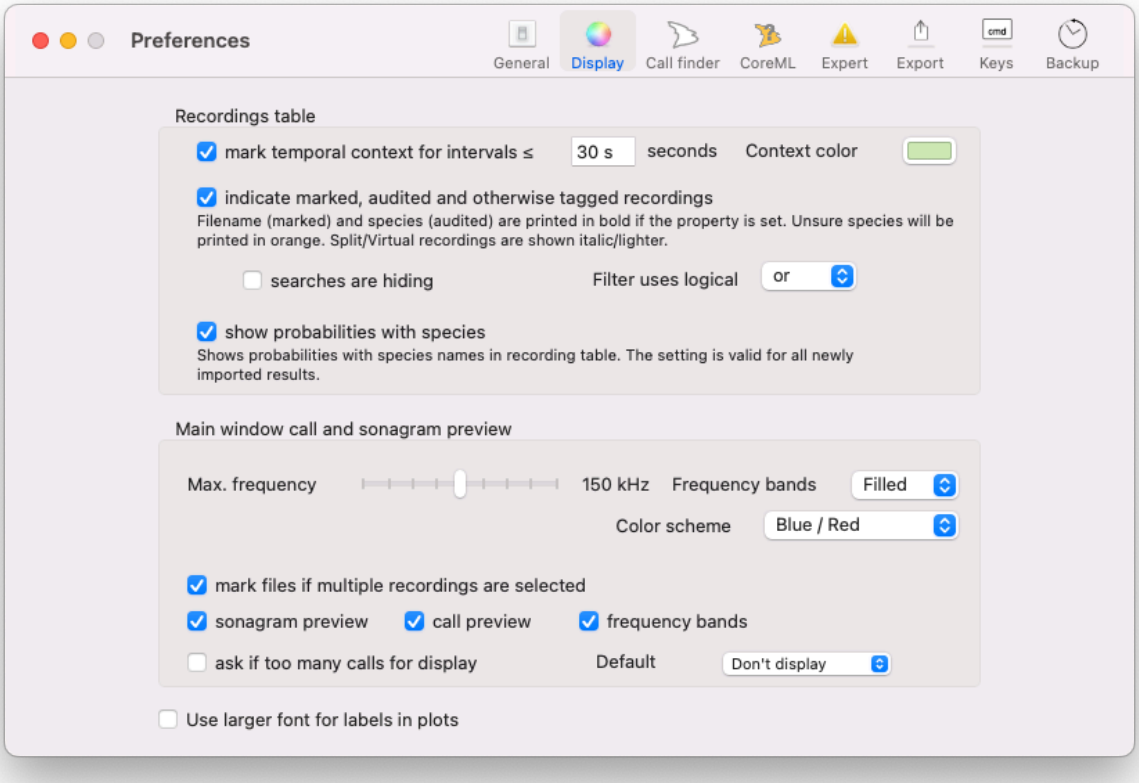
Choose the default folder for recordings and if project subgroups should be created automatically.



Furthermore you can select the standard application to open raw and wave files for manual analysis. In addition you can set the labels for session groups and some other details of how bcAdmin works in general.

11.2. Display

Activate colourisation of recordings within a temporal context if the table is sorted by recording time. Choose if the recordings table formats recordings based on marked/checked state as well as split recordings. Also activate or deactivate the display of species probabilities shown in the table. Furthermore you can choose sonogram preview parameters here as well.



For selections containing more than 300 calls you can opt-in to either hide or show the calls. If you are showing such amount of calls the display will get slowed down.

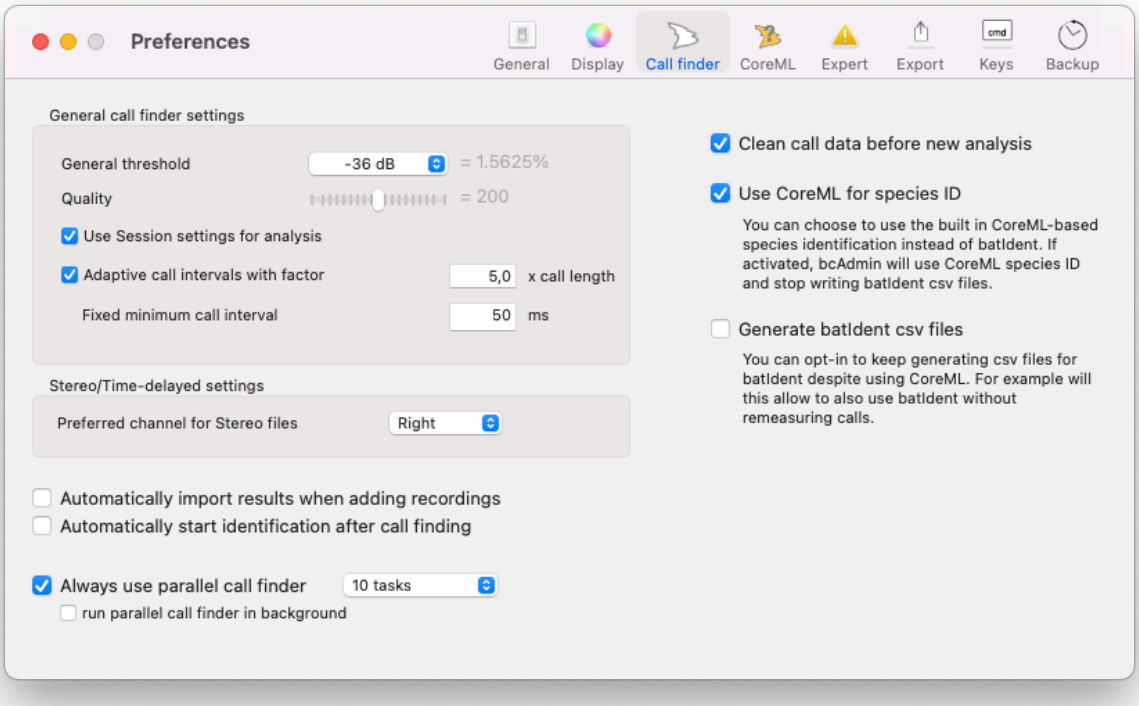
11.3. Call finder

The call finder preferences influence how the call finder works. You can set the general call finder threshold and if this value or the value per session will be used when analysing calls. Another feature for recordings with a lot of echoes or from long-term monitoring in the open space is the **adaptive call interval**. You set a factor and based on the call duration multiplied with that factor a part of the recording after the call is excluded from the call finder. That way echoes are not misinterpreted as calls so easily and in general species results should be improved. Good factors are 3.0 to 7.0.

If you want to gain speed, you may change the parallelisation options. We recommend to keep the lowest values, if problems occur. That should already be fast enough. If you have an unstable or very slow call finder, you may want to switch to serial call finding mode that also blocks all other parts of bcAdmin to avoid interruptions. By checking **run parallel call finder in background** the call finder does not block the interface at all but runs invisibly in the background. This is only recommended for pro users.

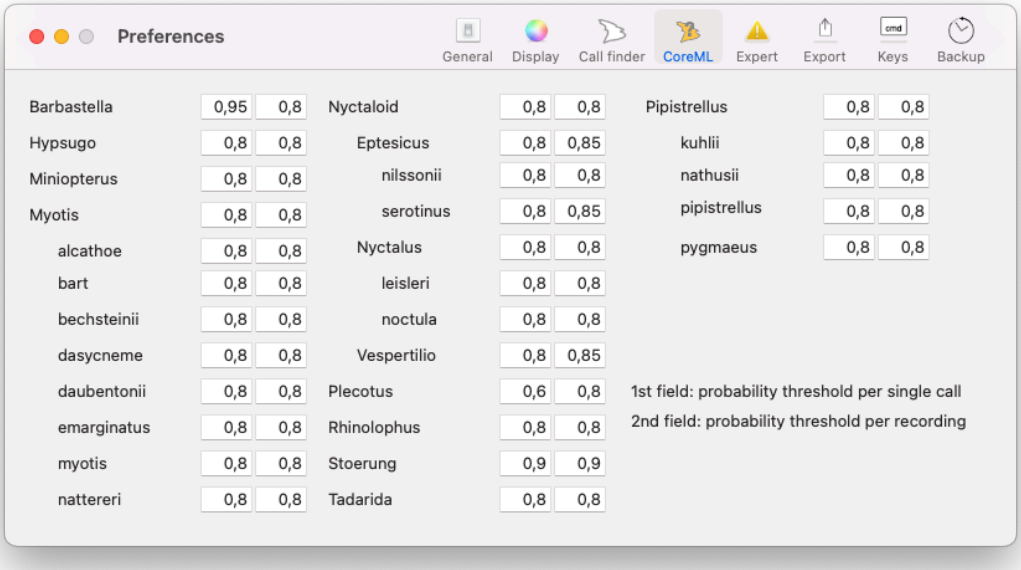
Furthermore this dialog lets you choose to use the CoreML classifier instead of batIdent. We do recommend to use the new CoreML-based species identification. If you are using it,

you can still opt-in to create the csv files that were used by batIdent. These nevertheless are not necessary anymore



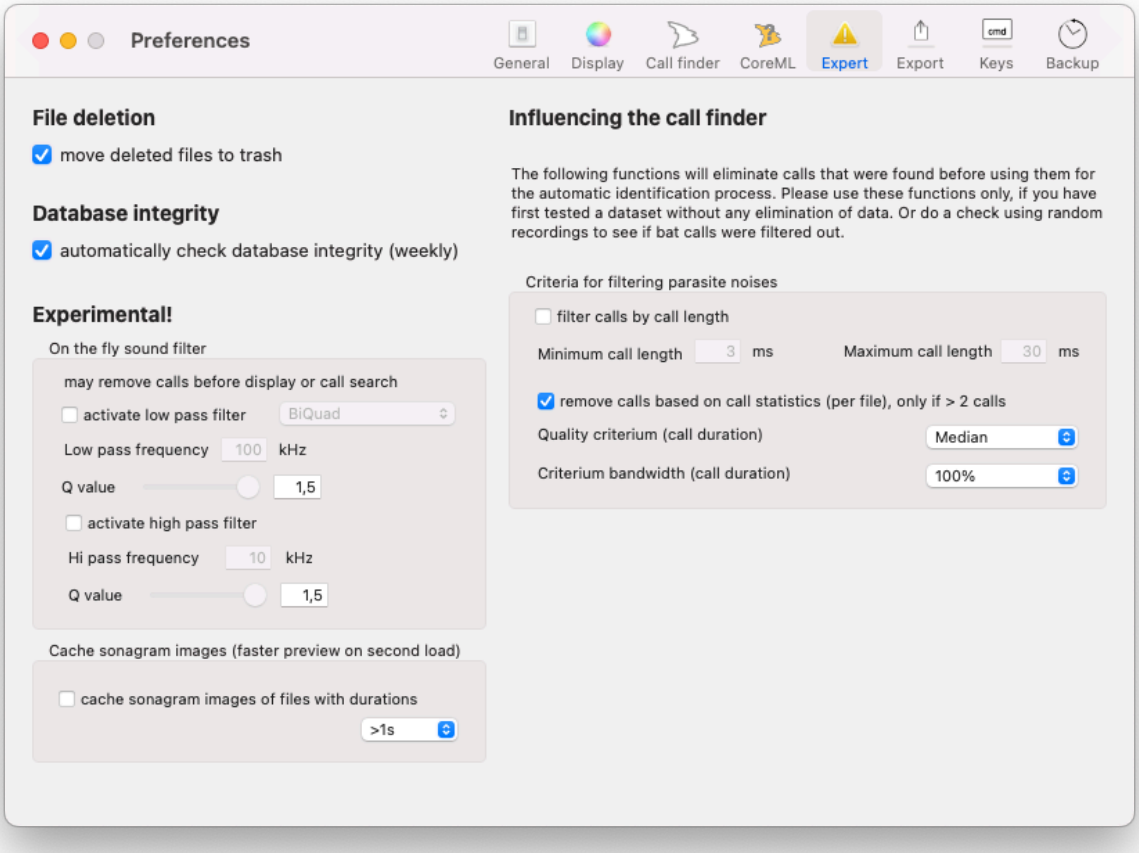
11.4. CoreML

In this dialog you can choose specific thresholds for accepting a call (left column) as well as the final result as correct. That means if you choose a threshold of 0.9 (=90%) a call needs to be at least with a probability of 90% assigned to that species. And if you choose 0.9 (=90%) for the final result in the second column, all calls together need to achieve at least this overall probability.



11.5. Expert

Here you have the possibility to adjust settings that may highly influence the call finder process, these should be only set by expert users.

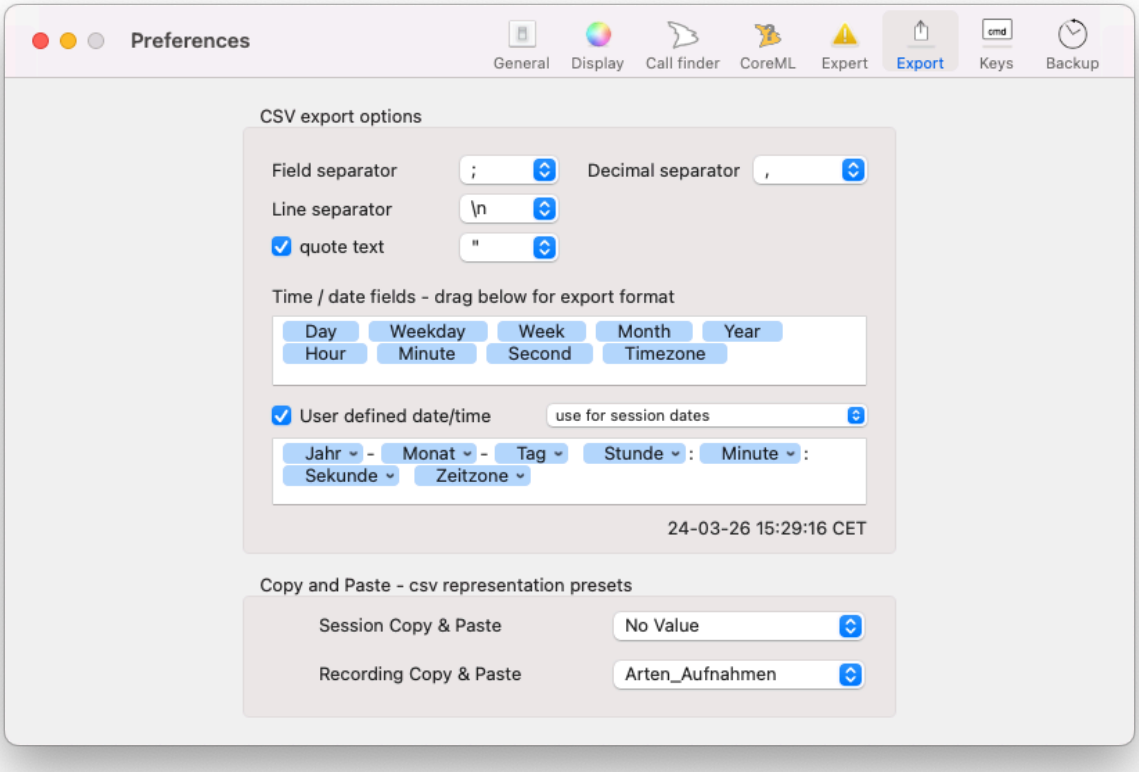


The experimental features allow filtering of sound data before display or analysis. Choose hi and or lowpass filtering to eliminate unwanted noise before analysis and display. This takes some calculation time but is still quite fast. You can also choose to cache sonagram images which is useful when accessing files over a network connections. These tend to have rather a lot of latency.

A new feature is influence of the call finder. The feature to eliminate calls based on a statistical evaluation of call calls of a file shows very promising to get rid of noise like echoes. This will highly improve the CoreML species identification without sacrificing valuable data.

11.6. Export

Parameters for export are used application wide and can be set here. That primarily influences the creation of CSV files, thus you can set column and decimal separators and such. If you want activity and species reports not to be transformed when exported to CSV, you can choose this here as well. Also, if presets for CSV export are stored, you can choose one here which will be used for copy and paste to other applications.



11.7. Key bindings

The file browser as well as the recording table allow the quick adding of species to the selected recording. They key bindings for this feature can be set here application wide. This allows you to set the species entry of a recording to the one you bound to the according key. If you use this feature, but want to add a species, just press the **alt** key when using the quick key.

11.8. Templates

Choose the default labels for the various flags. These are used then when a new document is created. If you created your own colour sets for species you may want to automatically use it for newly created documents. To do this, just choose a PLIUST file created with the Taxon-Editor.

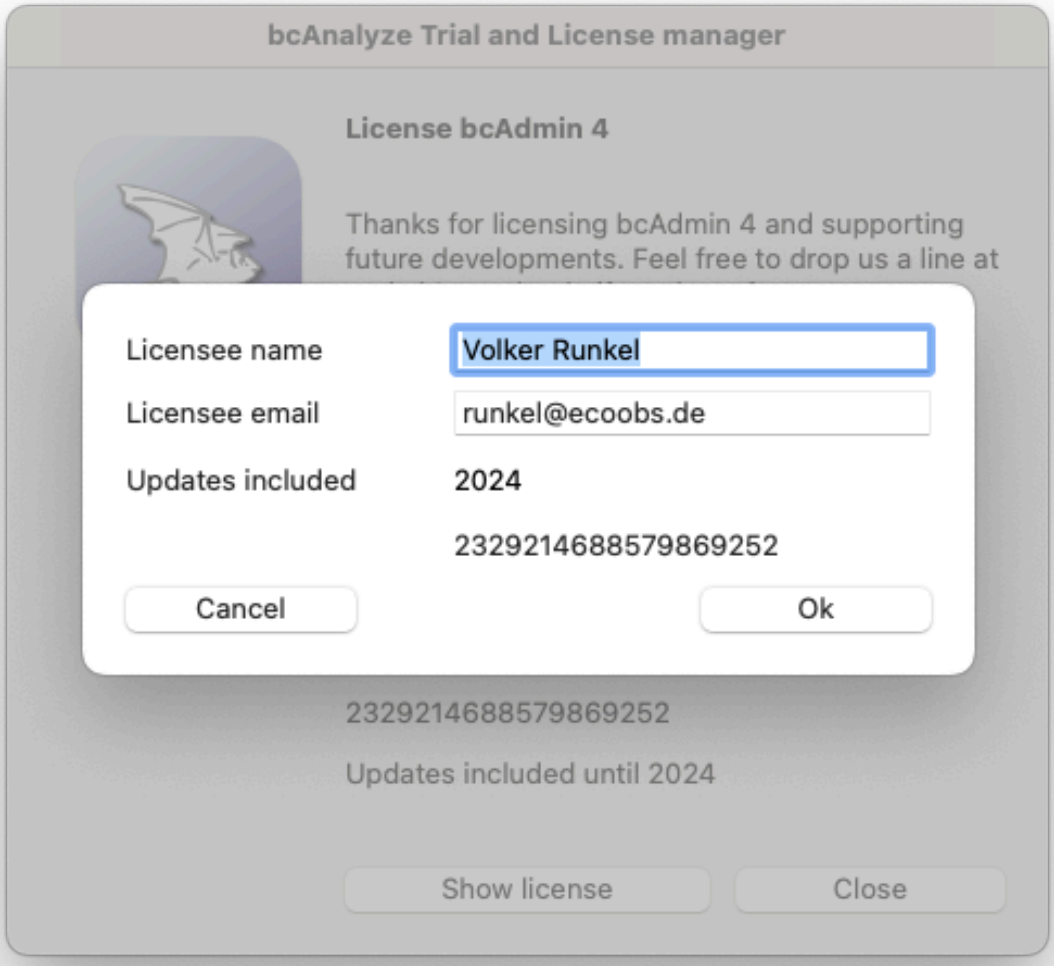
12. Miscellaneous

12.1. Licensing

The application runs for ca. 30 days without the need of a license key. If you want to use it after that period you will need to buy a license. The license will be registered for your name and email address. Both will be regularly checked by bcAdmin via connecting to our license server. Thus you need to connect your Mac to the internet at least once a week (a mechanism exists to prolong this period if you are doing field work for example).

Multiple licenses or multiple computers

We added due to many requests a new feature in bcAdmin 3.0: you now can deactivate the license for one computer and activate on another, thus you can switch between multiple Macs. Running bcAdmin is possible only on one simultaneously. If you need to run it on multiple Macs add your wish, you can also buy additional licenses. The new license server can be set to allow multiple connections.



12.2. Updates

There will be free updates to bcAdmin on a irregular basis. Note that you need a license including the updates for the current year.

13. Tips & Tricks

13.1. TimeMachine Backups

Mac OS X comes with a powerful backup tool, directly implemented in the core OS: Time Machine. It backups you hard disc hourly and allows to travel to various points back in time if you need to restore a certain version of a document. All you need is an external disk and allow Mac OS to use it as TimeMachine volume.

13.2. Folder structure for recordings

We can recommend the following structure of folders for recordings to simplify backup and for moving old projects to archive disks without much hassle for bcAdmin.

Recordings

ProjectA

SESSIONA

ProjectB

SESSIONX

100505

100515

ProjectC

SESSIONA

100601

1007005

SESSIONB

100520

100521

SESSIONC

If you use the SDHC-import feature of bcAdmin, the folders for each night (for example 100505 = May 5th 2010) are created automatically.

This folder structure allows copying of whole projects to an external disk and allow a simple filelocation change for all sessions belonging to this project.

13.3. Working with large numbers of recordings

Since the introduction of the batcorder-system its usage has changed. While in the beginning single nights were recorded, today the log-term monitoring extensions are used heavily. Thus, large numbers of recordings collected over a long time period have to be handled. This has implications on the way species identification can be audited. It is hardly possible to look through each recording and another scheme for auditing has to be used. The following process can be seen as a prototype for auditing these quantities of data and can be adapted to your needs. Always keep in mind, that if you work with larger numbers to not look at absolute sequence counts of species. If you record 10000 N. leisleri and batIdent has an error rate of 10% for misclassification of N. leisleri to V. murinus, you will end with around 1000 recordings classified as V. murinus. If you recorded 10, it will be 1. Thus, keep the percentages in your mind!

First rough auditing

In a first step, directly after importing batident results we recommend to filter Pipistrelloid social calls and look at these. Bad quality N. noctula calls tend to get classified as Pipistrelloid social calls and this can be quickly evaluated and changed via the batch replace species command for example. Next look at the species tree and get an overview of identified species. Then automatically replace species not occurring in your area.

Analyse species groups

After the first cleanse of identification errors certain species groups, relevant for your project should be investigated. We recommend to browse through single nights using the file brwoser and activate the temporal context colourisation in the recording table. That way you‘ll be bale to quickly fix results for groups of recordings belonging to the same bat. Make heavy use of the quick keys for setting correct species results. Don‘t look at every single recording than but rely on the fact that a single bat will produce a couple of recordings if it is hunting in the vicinity. After some training you should be able to do that task fairly quickly without many errors. Always allow some checking by randomly selecting. Even after this second step some misinterpreted results will be left. They may be ignored.