Saving Waves: BioAcoustica Progress Report 1

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Abstract

This report details work on the BioAcoustica project up to the end of March 2016. Functionality and datasets currently available are described and ongoing work is listed. Usage statistics are provided and future plans are presented. Outputs of the project are listed in appendices including a list of peer-reviewed papers generated by the project and peer-reviewed papers that have deposited their bioacoustic data in BioAcoustica. In addition a list of species which are represented in the BioAcoustica database is provided.

Contents

1 History

The BioAcoustica project was initially developed by Ed Baker late in 2014. The first public announcement was made in November 2014 (as the Wildlife Sound Database), the BioAcoustica name (and bio.acousti.ca domain name) were first used in December 2014. A publication in the journal *Database* [**baker2015a**] was used to formally announce BioAcoustica to the academic community.

The BioAcoustica infrastructure is based on two European Union funded biodiversity infrastructure projects. The Scratchpads Virtual Research Environment from the EDIT and ViBRANT projects, and the BioVeL Portal. Scratchpads provides data storage and discovery for the BioAcoustica project, and analysis services based on a grid computing infrastructure is provided by the BioVeL Portal. Transfer of large sound files between these systems is facilitated by Scratchpads being connected to the high speed Janet network through the Natural History Museum.

The only funding for the project has come from a small award from the Natural History Museum's Life Sciences Departmental Investment Fund: Developing the NHM Wildlife Sound Archive.

2 Current Functionality

2.1 Annotation

An annotation feature has been developed that allows sub-recording metadata to be collected. This allows voice introductions to be removed from analyses; two species in the same recording to be separated; periods of extraneous noise to be easily identified; and the marking of individual syllables and echemes (Figure 1). This functionality was first announced in [**baker2015a**].

Annotation will be of great use to those using recordings from BioAcoustica for automated machine learning as it allows non-representative sections of audio to be automatically removed. The bioacousticaR library (below) is an example of a system that can be used to conduct analyses on annotated data.

Figure 1: Annotated waveform generated using the Regions plugin for wavesurfer.js. Annotated regions are colour coded by the type of annotation (blue for voice introductions, red for extraneous noise and green for calls). Annotated regions are translucent to show where regions overlap. From: http://bio.acousti.ca/node/11778.

2.2 Analysis

Analyses are automatically performed on sections of recordings that are annotated to indicate they contain useful information (Figure 2). Analyses are performed on the BioVeL grid computing infrastructure. This functionality was first announced in [**baker2015a**].

Analyses make use of custom R scripts encapsulated in a Taverna workflow that runs on the BioVeL Portal. In the future we plan to make more analysis functions available via the BioAcoustica web interface, in particular for the analysis of soundscapes.

Analyse by Default The use of an external grid computing infrastructure that deals automatically with resource allocation allows BioAcoustica to use an 'analyse by default' philosophy. By default all annotations that could feasibly be used for analysis are analysed.

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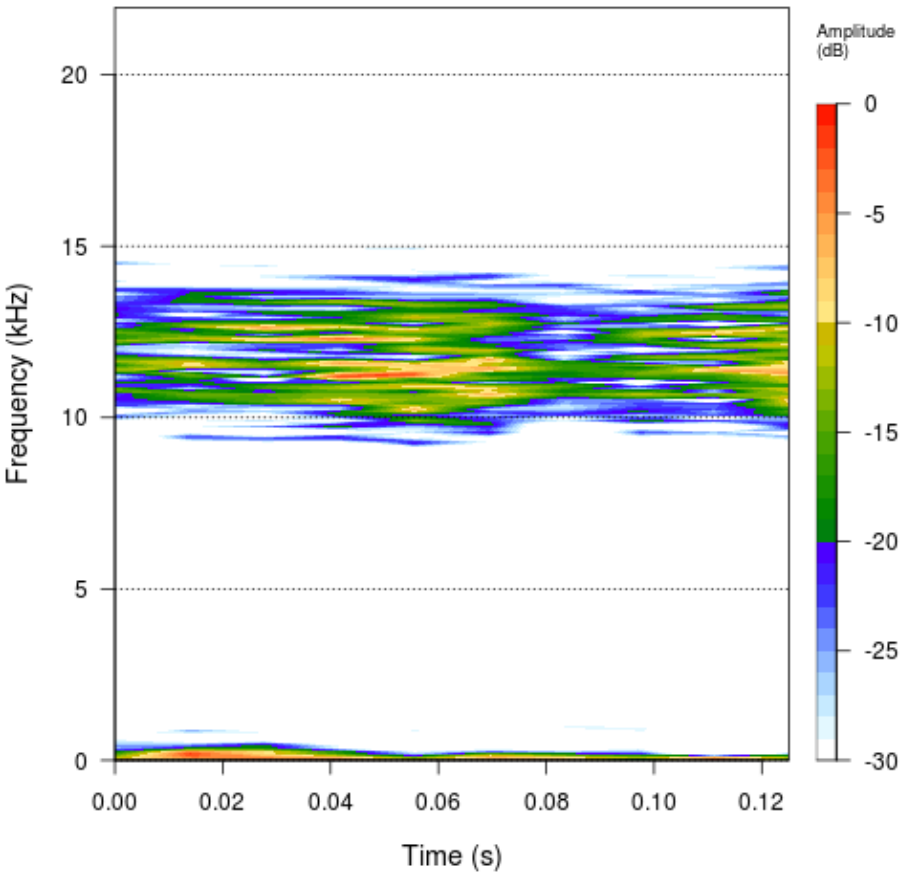

Figure 2: Spectrogram from the short section of the call of *Platypleura haglundi* from 1.

2.3 bioacousticaR

Integration with the R environment for statistical computing is provided via the bioacousticaR package. This allows BioAcoustica to be queried from within the R environment. At present bioacousticaR can query against taxa, recordings and annotations. This functionality was first announced in [**baker2015a**].

2.4 Collections

The collections functionality allows individual BioAcoustica users to create a collection of recordings. This collection can then be presented on a single page, along with an automatically generated citation that credits all of the projects that contributed recordings to that collection, and BioAcoustica itself. This

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functionality will be announced in a future publication.

2.5 Data Sharing

2.5.1 Global Biodiversity Informatics Facility (GBIF)

Specimen and observation data from BioAcoustica is harvested by GBIF using the process described in [**baker2015b**]. The BioAcoustica dataset can be viewed at http://www.gbif.org/dataset/30f55c63-a829-4cb2-9676-3b1b6f981567. At present the data is updated by [SIMON].

2.5.2 Encyclopedia of Life (EoL)

Recordings with appropriate licences are harvested regularly by EoL.

3 Current Datasets

3.1 Global Cicada Sound Collection

The first three components of the Global Cicada Sound Collection are now available online via BioAcoustica (GCSC1, GCSC2, GCSC4). The Natural History Museum's collection of cicada sounds (GCSC3) is currently in the process of being digitised.

3.1.1 GCSC1: South Africa and Malawi

This collection consists of 219 recordings of 133 voucher specimens of 42 taxa from South Africa and Malawi. This collection has been published as a data paper in the *Biodiversity Data Journal* [**baker2015b**]. All specimens are georeferenced.

3.1.2 GCSC2: Thailand

This collection has previously been published in the Cicadas of Thailand: Volume II [**boulard2013**], and is made available on BioAcoustica with the permission of the publisher (Siri Scientific Press). No specimen data is available to BioAcoustica.

3.1.3 GCSC4: Marshall et al, 2016; Lee et al, 2016

A collection of 106 cicada recordings (all representing different acoustic-species) complimenting Marshall et al (2016) [**marshall2016**]. All have been linked to voucher specimens in the University of Connecticut or have 'Living Specimen' observation records when not collected. Many taxa are of novel, as yet undescribed species. A significant number of voucher specimens have been linked to GenBank sequences.

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A further four songs from Lee et al (2016) [**lee2016**] have been made available, and the identity of one of the unidentified songs from Marshall et al, 2016 is confirmed as a new species.

3.1.4 User Contributions

The project has received a number of individual contributions from registered users, include a holotype cicada recording.

3.2 Soundscapes

A special section of the site has been created for the storage and analysis of soundscapes (longer recordings of an environment rather than individual species). Soundscapes can be analysed using a variety of methods to identify, for example, regions of anthropogenic noise and seasonal variations in the Acoustic Complexity Index.

3.3 BioAcoustica Talks

An additional section of the site holds recordings of talks related to natural history. The need for this sction arose while digitising the NHM Sound Collection.

3.3.1 BioAcoustica Talks Podcast

The talks hosted by BioAcoustica are available via the BioAcoustica Talks Podcast. The feed is available via iTunes.

3.4 3D Scans

The NHM Orthoptera collection has a small collection of burrow casts of mole crickets (Orthoptera: Gryllotalpidae). Burrow casts of *Gryllotalpa gryllotalpa* and *Gryllotalpa vineae* have been scanned and published [**baker2015c**].

4 Usage

BioAcoustica uses Google Analytics to capture information about visitors to the site. In the year up to and including 30/03/2016 1,938 unique visitors from 106 countries (Figure 3) used BioAcoustica, spending on average 3 minutes and 42 seconds on the site and visiting 3.85 pages. 22.9% of users visited the site more than once.

4.1 Wikipedia

At present 43 Wikipedia pages have links to pages on the bio.acousti.ca domain - these are mainly pages for individual taxa present on BioAcoustica.

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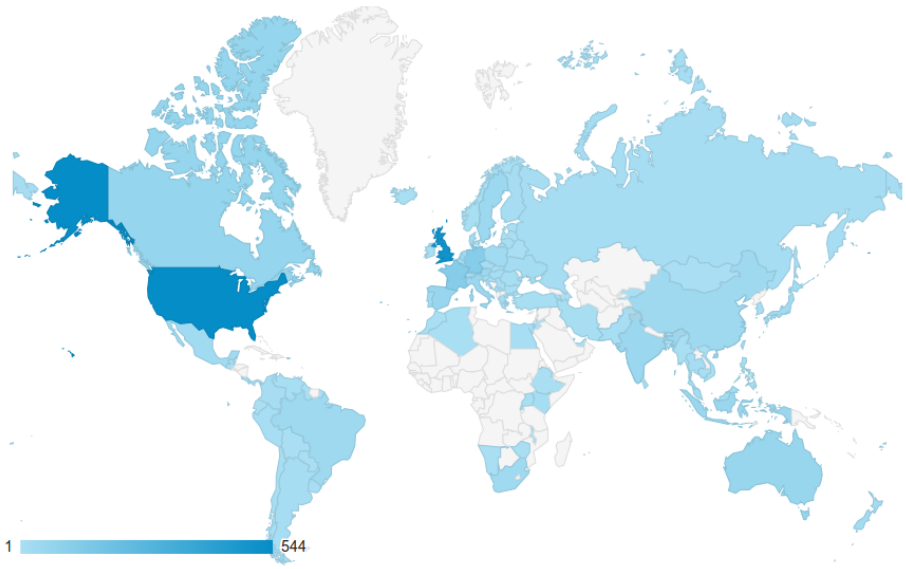

Figure 3: BioAcoustica visitor map 30/01/2015-30/01/2016.

5 Ongoing Collections Work

5.1 NHM Sound Collection

The first section of the NHM Sound collection (Orthoptera: Gryllotalpidae) has already been published [**baker2015c**]. The following additional publications are in preparation or being planned.

5.1.1 Orthoptera: Grylloidea

The metadata entry for this collection is nearly complete. Specimens still need to be given unique identifiers and matched to recordings.

5.1.2 Orthoptera: Tettigoniidea

The metadata entry for this collection is underway. Specimens still need to be given unique identifiers and matched to recordings.

5.1.3 Orthoptera:Acridoidea

Metadata collection will begin in Summer 2016 as the first stage in this group.

5.1.4 Mulu Frogs and Soundscapes

A collection of recordings by Julian Dring on the RGS Mulu Expedition of frogs has been uploaded. Only a few specimens remain to be matched to recordings.

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An additional set of soundscape recordings from the same area by Jon Martin will be presented in the same data publication.

5.1.5 GCSC3

The NHM's collection of cicada recordings is currently being digitised to form the third contribution to the Global Cicada Sound Collection.

5.2 Spanish Translation

The site interface, structure and content are being translated into Spanish by Carlos Grau (NHM) on a voluntary basis. An announcement of this work, plus an overview of BioAcoustica in general will be submitted to a Spanish language biology journal.

5.3 Burrow Casts

Additional work on new burrow casts is underway. This includes digitisation of the casts and a paper reviewing Gryllotalpid burrow morphology, and proposing standard measurements that can be used for identification.

6 Future Functionality

6.1 bioacousticaR-tools

The bioacousticaR-tools project (GitHub) aims to create an R package that bridges the gap between bringing data into the R environment (e.g. bioacousticaR) and direct sound analysis (e.g. seewave, soundecology). At present it provides windowing functions that allow sequential analysis of sections of audio (Figure 4). Two functions are provided, a standrad version for local processing, and a BioVeL compatible version that may allow for parallel processing on suitable servers.

6.2 Improved handling of large files

For reasons explained in the blog post 'Does MP3 work for wildlife sound?' BioAcoustica deals in wave format rather than mp3 wherever this is feasible (the sole exception is for the BioAcoustica Talks where mp3 compression is ideal). Downloading large wave files means that the wave visualisation is delayed while the file downloads. The visualisation library used (wavesurfer.js) allows for pre-rendered waveforms to be sent to the browser to allow rendering and playing of the waveform while the file is downloaded. Development of this has been delayed until after the Scratchpads project has full developer support.

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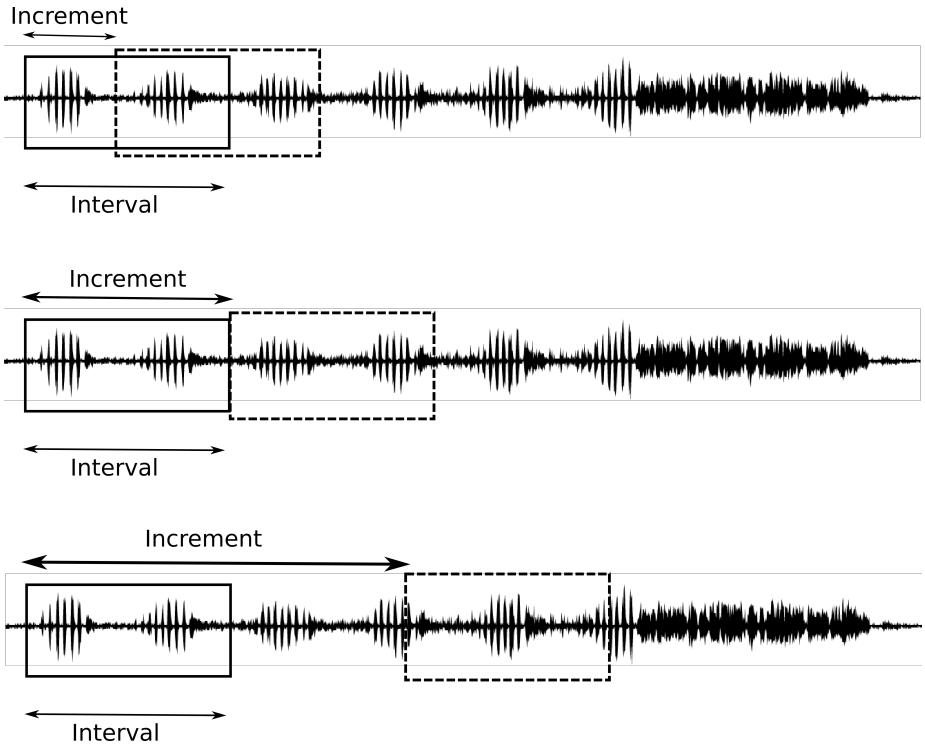

Figure 4: bioacousticaR-tools windowing function showing overlapping, sequential and sub-sampling functions.

6.3 Using BioVeL for file processing

In order to remove extraneous, generally anthropogenic, noise it is common to filter recordings to remove frequencies below and/or above the desired range. The BioVeL Portal could provide the capacity to allow this to be done on a batch basis, with processed files being returned to BioAcoustica for storage.

Similarly BioVeL could be used to transcode files into different formats (e.g. FLAC, zero-crossing) when this is required by the end user. The use of MP3, while not ideal for wildlife sound recordings, could significantly increase the utility of BioAcoustica for users with limited internet bandwidth, particularly if transcoding could be done 'on the fly'.

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7 Future Opportunities

7.1 Grants

BioAcoustica is mentioned as a source of recordings and repository for future recordings in a Leverhulme grant application by a team from the University of York (David Chesmore, Peter Mayhew, Jon Hill, Katie Davis, Ed Baker). This project plan makes extensive use of the machine readable (bioacousticaR) interface to the dataset to train automated taxon identification systems.

8 Acknowledgements

Yoke-shum Broom (NHM Volunteer) has digitised a vast amount of the supporting metadata for the NHM Sound Collection. Nomenclatural names of Orthoptera were checked by Leroy Smith. Simon Rycroft (ex-NHM Scratchpads Developer) provided a great deal of support in developing the core BioAcoustica infrastructure, especially the links with GBIF and the BioVeL Portal. Ben Price (NHM) has guided the development of BioAcoustica, helped secure the NHM DIF funding, and led the development of the Global Cicada Sound Collection. Carlos Grau (NHM Learning)has translated the bulk of the BioAcoustica website into Spanish. David Gower and Jeff Streicher (both NHM) located and made available the frog recordings of Julian Dring. George Beccaloni allowed access to the NHM Orthoptera collection to give specimens unique identifiers. Theresa Howard, Judith Marshall and Sue Ryder (all NHM) helped locate the original magnetic tapes, CDs and paper metadata files. David Marshall (University of Connecticut) has contributed many cicada recordings from published works to the project.David Penny (Siri Scientific Press) kindly granted permission to use recordings from the Cicadas of Thailand. Heather Bonney (NHM) kindly allowed access to, and assistance with a 3D laser scanner.

Appendices

A BioAcoustica Publications

- Baker E, Price BW, Rycroft SD, Hill J, Smith VS (2015) BioAcoustica: A free and open repository and analysis platform for bioacoustics. *Database* bav054.
- Baker E, Price BW, Rycroft SD, Villet MH (2015) Global Cicada Sound Collection I: Recordings from South Africa and Malawi by B. W. Price & M. H. Villet and harvesting of BioAcoustica data by GBIF. *Biodiversity Data Journal* 3:e5792.
- Baker E, Broom Y-s (2015) Natural History Museum Sound Archive I: Orthoptera: Gryllotalpidae Leach, 1815, including 3D scans of burrow

casts of Gryllotalpa gryllotalpa Linnaeus, 1758 and Gryllotalpa vineae Bennet-Clark, 1970. *Biodiversity Data Journal* 3:e7442.

B Papers with BioAcoustica as designated repository for sound recordings

- Marshall DC, Hill KBR, Moulds M, Vanderpool D, Cooley JR, Mohagan AB & Simon C (2016) Inflation of Molecular Clock Rates and Dates: Molecular Phylogenetics, Biogeography, and Diversification of a Global Cicada Radiation from Australasia (Hemiptera: Cicadidae: Cicadettini). *Systematic Biology* 65:16-34.
- Lee YJ, Marshall DC, Mohagan A, Hill KBR (2016) Cicadas (Hemiptera: Cicadidae) from Camiguin of Mindanao Province and Dinagat Island in the Philippines, with a new genus and three new species. *Zootaxa* 4097.

C BioAcoustica blog posts

- 2014/11/16: Wildlife Sound Database
  http://pblog.ebaker.me.uk/2014/11/wildlife-sound-database.html
- 2014/12/02: Getting the seewave R package installed on Mac OS X Yosemite
  http://pblog.ebaker.me.uk/2014/12/getting-seewave-r-package-installed-on.html
- 2014/12/20: Introducing BioAcoustica
  http://pblog.ebaker.me.uk/2014/12/introducing-bioacoustica.html
- 2015/04/13: BioAcoustica: Does MP3 work for wildlife sound?
  http://pblog.ebaker.me.uk/2015/04/bioacoustica-does-mp3-work-for-wildife.html
- 2015/04/14: BioAcoustica: Tape speed conversion table
  http://pblog.ebaker.me.uk/2015/04/bioacoustica-tape-speed-conversion-table.html
- 2015/09/06: BioAcoustica papers
  http://pblog.ebaker.me.uk/2015/09/bioacoustica-papers.html
- 2015/10/13: Install R devtools on Ubuntu
  http://pblog.ebaker.me.uk/2015/10/install-r-devtools-on-ubuntu.html
- 2015/10/13: Installing BioAcousticaR R package
  http://pblog.ebaker.me.uk/2015/10/installing-bioacousticar-r-package.html
- 2015/12/21: NHM Sound Archive (Part 1): Mole Crickets
  http://pblog.ebaker.me.uk/2015/12/nhm-sound-archive-part-1-mole-crickets.html

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D List of valid species with recordings

Acantheremus colwelli Naskrecki, 1997 [1]
Acanthoplus discoidalis (Walker, 1869) [1]
Accipiter nisus (Linnaeus, 1758) [1]
Acherontia atropos (Linnaeus, 1758) [1]
Acherontia styx Westwood, 1847 [1]
Acheta domesticus (Linnaeus, 1758) [14]
Acrometopa macropoda (Burmeister, 1838) [4]
Adelia borealis (G. & F., 1904) [1]
Alauda arvensis Linnaeus, 1758 [1]
Allonemobius allardi (Alexander & Thomas, 1959) [4]
Alouatta pigra Lawrence, 1933 [2]
Amphipsalta strepitans (Kirkaldy, 1891) [1]
Amphipsalta zelandica (Boisduval, 1835) [2]
Ancistrura nigrovittata (Brunner von Wattenwyl, 1878) [2]
Andreiniimon nuptialis (Karny, 1918) [1]
Anoedopoda erosa Karsch, 1891 [1]
Anoedopoda lamellata (Linnaeus, 1758) [1]
Anonconotus alpinus (Yersin, 1858) [12]
Ansonia torrentis Dring, 1984 [2]
Antaxius hispanicus Bolvar, 1884 [14]
Antaxius pedestris (Fabricius, 1787) [14]
Antaxius spinibrachius (Marquet, 1877) [8]
Apis mellifera Linnaeus, 1758 [2]
Apus apus (Linnaeus, 1758) [1]
Arantia brevipes Chopard, 1954 [1]
Arcyptera (Arcyptera) fusca Arcyptera fusca (Pallas, 1773) [4]
Arcyptera Arcyptera tornosi Bolvar, 1884 [3]
Arcyptera Pararcyptera labiata (Brull, 1832) [2]
Arcyptera Pararcyptera microptera microptera [2]
Auscala spinosa (G. & F., 1904) [1]
Baetica ustulata (Rambur, 1838) [3]
Barbitistes fischeri (Yersin, 1854) [3]
Barbitistes obtusus Targioni-Tozzetti, 1881 [3]
Barbitistes serricauda (Fabricius, 1794) [2]
Barbitistes yersini Brunner von Wattenwyl, 1878 [1]
Baryprostha foliacea Ingrisch, 1990 [2]
Birrima castanea (G. & F., 1904) [1]
Birrima varians (Germar, 1834) [1]
Brachycrotaphus tryxalicarus (Fischer, 1853) [5]
Brachystola magna (Girard, 1854) [2]
Brachytrupes membranaceus (Drury, 1770) [1]
Bradyporus Bradyporus desypus (Illiger, 1800) [1]
Bradyporus Callimenus oniscus (Burmeister, 1838) [2]
Buteo buteo (Linnaeus, 1758) [1]

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Caliginopsalta percola Ewart, 2005 [1]
Capreolus capreolus (Linnaeus, 1758) [1]
Caprimulgus europaeus Linnaeus, 1758 [1]
Cervus nippon Temminck, 1838 [1]
Chelapsalta puer (Walker, 1850) [1]
Chorthippus Chorthippus albomarginatus (De Geer, 1773) [10]
Chorthippus Chorthippus dichrous (Eversmann, 1859) [4]
Chorthippus Chorthippus dorsatus (Zetterstedt, 1821) [15]
Chorthippus Chorthippus jucundus (Fischer, 1853) [2]
Chorthippus Chorthippus lacustris La Greca & Messina, 1975 [4]
Chorthippus Chorthippus loratus (Fischer von Waldheim, 1846) [5]
Chorthippus Chorthippus oschei Helversen, 1986 [14]
Chorthippus cialancensis Nadig, 1986 [1]
Chorthippus Glyptobothrus alticola Ramme, 1921 [2]
Chorthippus Glyptobothrus apicalis (Herrich-Schffer, 1840) [3]
Chorthippus Glyptobothrus apricarius (Linnaeus, 1758) [5]
Chorthippus Glyptobothrus biguttulus (Linnaeus, 1758) [50]
Chorthippus Glyptobothrus binotatus (Charpentier, 1825) [18]
Chorthippus Glyptobothrus biroi (Kuthy, 1907) [1]
Chorthippus Glyptobothrus bornhalmi Harz, 1971 [9]
Chorthippus Glyptobothrus brunneus (Thunberg, 1815) [49]
Chorthippus Glyptobothrus cazurroi (Bolvar, 1898) [6]
Chorthippus Glyptobothrus corsicus (Chopard, 1924) [17]
Chorthippus Glyptobothrus crassiceps Ramme, 1926 [34]
Chorthippus Glyptobothrus jacobsi Harz, 1975 [29]
Chorthippus Glyptobothrus marocanus Nadig, 1976 [7]
Chorthippus Glyptobothrus mollis (Charpentier, 1825) [21]
Chorthippus Glyptobothrus pulloides Ramme, 1926 [8]
Chorthippus Glyptobothrus pullus (Philippi, 1830) [7]
Chorthippus Glyptobothrus reissingeri Harz, 1972 [2]
Chorthippus Glyptobothrus rubratibialis Schmidt, 1978 [19]
Chorthippus Glyptobothrus sangiorgii (Finot, 1902) [1]
Chorthippus Glyptobothrus vagans (Eversmann, 1848) [36]
Chorthippus Glyptobothrus willemsei Harz, 1971 [10]
Chorthippus Glyptobothrus yersini Harz, 1975 [60]
Chorthippus nevadensis Pascual, 1976 [3]
Chorthippus sampeyrensis Nadig, 1986 [4]
Chrysocharon dispar (Germar, 1834) [2]
Cicadetta camerona (Davis, 1920) [1]
Cicadetta montana (Scopoli, 1772) [2]
Clidophleps distanti (Van Duzee, 1914) [2]
Clinata nodicosta (G. & F., 1904) [1]
Clinopsalta adelaida (Ashton, 1914) [1]
Clinopsalta tigris (Ashton, 1914) [1]
Columba palumbus Linnaeus, 1758 [1]
Conocephalus Anisoptera dorsalis (Latreille, 1804) [7]

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Conocephalus Anisoptera longipennis (Haan, 1842) [4]
Conocephalus Anisoptera maculatus (Le Guillou, 1841) [1]
Conocephalus Anisoptera melaenus (Haan, 1842) [2]
Conocephalus Chloroxiphidion laetus (Redtenbacher, 1891) [1]
Conocephalus Conocephalus carbonarius (Redtenbacher, 1891) [9]
Conocephalus Conocephalus conocephalus (Linnaeus, 1767) [25]
Conocephalus Conocephalus kisi Harz, 1967 [3]
Conocephalus Xiphidion angustifrons (Redtenbacher, 1891) [1]
Conocephalus Xiphidion cinereus Thunberg, 1815 [1]
Conocephalus Xiphidion ictus (Scudder, 1875) [1]
Conocephalus Xiphidion magdalenae Naskrecki, 2000 [1]
Conocephalus Xiphidion saltator Saussure, 1859 [1]
Copiphora brevicauda Karny, 1907 [1]
Copiphora cultricornis Pictet, 1888 [1]
Copiphora hastata Naskrecki, 2000 [1]
Copiphora rhinoceros Pictet, 1888 [1]
Corvus corone Linnaeus, 1758 [1]
Cotesia congregata (Say, 1836) [1]
Crotopsalta fronsecetes Ewart, 2005 [1]
Crotopsalta plexis Ewart, 2005 [1]
Ctenodecticus bolivari siculus Ramme, 1927 [1]
Cuculus canorus (Linnaeus, 1758) [1]
Cycloptiloides canariensis (Bolvar, 1914) [1]
Cyphoderris buckelli Hebard, 1934 [1]
Cyphoderris monstrosa Uhler, 1864 [1]
Cyphoderris strepitans Morris & Gwynne, 1978 [1]
Dama dama (Linnaeus, 1758) [1]
Decticoides brevipennis Ragge, 1977 [2]
Decticus albifrons (Fabricius, 1775) [7]
Decticus verrucivorus (Linnaeus, 1758) [12]
Dendrocopos major (Linnaeus, 1758) [1]
Diceroprocta vitripennis (Say, 1830) [1]
Dociostaurus Dociostaurus maroccanus (Thunberg, 1815) [1]
Drymadusa dorsalis (Brull, 1832) [1]
Ducetia japonica (Thunberg, 1815) [3]
Dundubia vaginata (Fabricius, 1787) [1]
Elimaea chloris (Haan, 1842) [1]
Ephippiger discoidalis Fieber, 1853 [7]
Ephippiger ephippiger (Fiebig, 1784) [24]
Ephippiger perforatus (Rossius, 1790) [2]
Ephippiger ruffoi Galvagni, 1955 [4]
Ephippiger terrestris bormansi Brunner von Wattenwyl, 1882 [3]
Ephippigerida areolaria (Bolvar, 1877) [4]
Eppia truncatipennis Stl, 1876 [1]
Erempsalta hermannsburgensis (Distant, 1907) [1]
Erinaceus europaeus Linnaeus, 1758 [1]

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Erioloides brevipennis (Redtenbacher, 1891) [1]
Euchorthippus angustulus Ramme, 1931 [9]
Euchorthippus chopardi Descamps, 1968 [4]
Euchorthippus declivus (Brisout de Barneville, 1848) [12]
Euchorthippus pulvinatus (Fischer von Waldheim, 1846) [15]
Eugryllodes pipiens (Dufour, 1820) [17]
Eumodicogryllus bordigalensis (Latreille, 1804) [4]
Eupholidoptera chabrieri (Charpentier, 1825) [3]
Eupholidoptera epirotica (Ramme, 1927) [1]
Euthystira brachyptera (Ocskay, 1826) [4]
Ewartia brevis (Ashton, 1912) [1]
Ewartia cuensis (Distant, 1913) [1]
Falco tinnunculus Linnaeus, 1758 [1]
Galanga labeculata (Distant, 1892) [1]
Gampsocleis abbreviata Herman, 1874 [2]
Gampsocleis glabra (Herbst, 1786) [2]
Garrulus glandarius (Linnaeus, 1758) [1]
Gelidea torrida (Erichson, 1842) [1]
Gomphocerippus rufus (Linnaeus, 1758) [22]
Gomphocerus sibiricus (Linnaeus, 1767) [8]
Graminitigrina bolloni Ewart & Marq., 2008 [1]
Gryllodes sigillatus (Walker, 1869) [3]
Gryllotalpa gryllotalpa (Linnaeus, 1758) [20]
Gryllotalpa rufescens Chopard, 1948 [3]
Gryllotalpa vineae Bennet-Clark, 1970 [10]
Gryllus bimaculatus De Geer, 1773 [5]
Gryllus campestris Linnaeus, 1758 [23]
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Gudanga kalgoorliensis Moulds, 1996 [1]
Gymnogryllus brachyxiphus Chopard, 1931 [2]
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Larus argentatus Pontoppidan, 1763 [1]
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Leptobrachella baluensis Smith, 1931 [1]
Leptobrachella brevicrus Dring, 1984 [1]
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Leptophyes boscii Fieber, 1853 [5]

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Locustella naevia (Boddaert, 1783) [1]
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Neoconocephalus punctipes (Redtenbacher, 1908) [1]
Neoconocephalus spiza Walker & Greenfield, 1983 [2]
Neoconocephalus triops (Linnaeus, 1758) [1]
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Pipilopsalta ceuthoviridis Ewart, 2005 [1]
Pipistrellus pipistrellus (Schreber, 1774) [1]
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Poecilimon Poecilimon artedentatus Heller, 1984 [2]
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Poecilimon Poecilimon nobilis Brunner von Wattenwyl, 1878 [2]
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Poecilimon Poecilimon ornatus (Schmidt, 1850) [6]
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Poecilimon Poecilimon veluchianus Ramme, 1933 [2]
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Stenobothrus posthumus Ramme, 1931 [1]
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Yersinella beybienkoi La Greca, 1974 [2]
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