



Natural sound archives: past, present and future

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Manuscript received on January 15, 2004; accepted for publication on February 5, 2004.

ABSTRACT

Recordings of wild animals were first made in the Palearctic in 1900, in the Nearctic in 1929, in Antarctica in 1934, in Asia in 1937, and in the Neotropics in the 1940s. However, systematic collecting did not begin until the 1950s. Collections of animal sound recordings serve many uses in education, entertainment, science and nature conservation. In recent years, technological developments have transformed the ways in which sounds can be sampled, stored and accessed. Now the largest collections between them hold altogether around 0.5 million recordings with their associated data. The functioning of a major archive will be described with reference to the British Library Sound Archive. Preserving large collections for the long term is a primary concern in the digital age. While digitization and digital preservation has many advantages over analogue methods, the rate of technology change and lack of standardization are a serious problem for the world's major audio archives. Another challenge is to make collections more easily and widely accessible via electronic networks. On-line catalogues and access to the actual sounds via the internet are already available for some collections. Case studies describing the establishment and functioning of sound libraries in Mexico, Colombia and Brazil are given in individually authored sections in an Appendix.

Key words: sound archives, bioacoustic libraries, audio recording, digitization.

HISTORY AND PRINCIPLES

The recording of animal sounds stretches back over 115 years, beginning in 1889 with the recording on an Edison wax cylinder by Ludwig Koch in Germany of a captive Indian Shama *Copsychus malabaricus*. The first recordings of wild birds anywhere were probably those captured by Cherry Kearton in England around 1900: the Song Thrush *Turdus philomelos* and the Common Nightingale *Luscinia megarhynchos* (Ranft 2001). In the Nearctic region, Garner in the United States made the first bioacoustic recordings in 1892 of captive primates (Garner 1892). He was able to study their structure and function by playing the recordings back

at reduced speed. In 1898, participants at the 16th Congress of the American Ornithologists' Union were played the song of a Brown Thrasher *Toxostoma rufum*. The first recordings of wild birds in the Americas were those made on optical movie soundtrack in 1929 by Peter Kellogg and Arthur Allen. In the Australasian region, the first recordings of wild birds were those of a Superb Lyrebird *Menura novaehollandiae* recorded and published on a 78 rpm disc in 1931. In the Antarctic, recordings date from 1934 with the braying of an Emperor Penguin *Aptenodytes forsteri*. In the Oriental region, the Carpenter expedition of 1937 made recordings of Hornbills (Bucerotidae); while in the Neotropics, recordings made on Barro Colorado Island in Panama date from the 1940s (Boswall and Couzens 1982).

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The systematic recording of animal sounds can be said to date from the 1950s, following the early efforts made by Kellogg and Allen in the USA, whose recordings eventually formed the basis of what is now the Macaulay Library of Natural Sounds at Cornell University. For any institutionalized natural sound archive, there are a number of principles that distinguish it from other collections, many of them very extensive and with high scientific significance, which are held in private hands. These principles can be summarized as the following requirements for the satisfactory foundation of a sound collection:

- 1) long-term vision and planning;
- 2) the support of a major institution to ensure that the facilities for the acquisition, organization, storage of and access to a collection are available over a long timescale; this in turn requires a farsighted aspiration on behalf of the institution and the regular commitment to financial resources;
- 3) the technical expertise, equipment and storage facilities to support the process of acquiring, storing and making accessible the audio collection;
- 4) a robust collection preservation policy including a program for disaster recovery;
- 5) the preservation of the integrity of the audio data in the long-term; this means, for example, that data reduction, or down-sampling of recordings, must be avoided;
- 6) a commitment to standardize the documentation of recordings, in order to facilitate data exchange between users of the collection and between the different sound archives;
- 7) the protection of the intellectual property rights and copyrights of the recordings entrusted to them by donor recordists;
- 8) the provision of access to the collection; in many of the larger archives, there are facilities to provide access both to the general public and to specialists users;
- 9) the fostering of cooperation between sound archives;
- 10) the provision of professional advice and assistance to sound recordists, particularly in the form of training in techniques and hardware operations required to obtain high-quality recordings.

COLLECTING POLICIES AND USES

The primary acquisition policies of the large bioacoustic archives are (Kettle 1983, Alström and Ranft 2003): (a) to collate recordings from many individuals such that their individual contributions are pooled to form a useful resource that would be impossible for a single individual to collect; (b) to collect samples representing the regional, individual and seasonal variations in the vocalizations of animals.

The primary uses of sound archive collections are for science, nature conservation, education and entertainment (Alström and Ranft 2003). The scientific uses are: the description, comparison, and analysis of sounds; the identification of species, populations and individuals; taxonomy and systematics; playback, luring and trapping, and pest deterrence. Uses in education and entertainment include the playing of audio samples in museums and zoos, in teaching institutions, on websites, television and radio programs, and in audio publications.

Between them, the largest natural sound archives hold over 0.5 million audio samples (Table I). Most of these recordings have been collected over the past fifty years. Although the growth of these collections has been rapid, they remain small compared with collections of animal specimens that have been collected over the last 200 years. These traditional zoological specimen collections between them contain many millions of samples. For example, the Natural History Museum in Britain alone contains over one million eggs and over one million avian skin specimens, representing 95% of all known species.

Because of their loud, often musical vocaliza-

TABLE I

Major natural sound archives (adapted from Alström and Ranft 2003)

Sound library	year established	number of recordings
Macaulay Library of Natural Sounds, Ithaca, USA	1956	150,000
The British Library Sound Archive, London, UK	1969	140,000
Tierstimmenarchiv, Berlin, Germany	1952	100,000
Fitzpatrick Bird Communication Library, Pretoria, South Africa	1979	30,000
Australian National Wildlife Collection, Lyneham, Australia	1961	25,000
Arquivo Sonoro Neotropical, São Paulo, Brazil	1978	25,000
Borror Laboratory of Bioacoustics, Ohio, USA	1945	24,000
Florida Museum of Natural History, Florida, USA	1973	15,000

tions and their dependency on the acoustic mode of communication, birds as a group have been the most well studied acoustically and intensively sound recorded. Despite the relatively recent history of animal sounds collecting, it was estimated that by 1965, 25% of the world's 10,000 bird species had been tape-recorded. By 1982, the proportion had risen to 50% (Boswall and Couzens 1982). By 2003, I estimate that more than 90% of all bird species have been sound recorded; that is, represented in the major sound archives by at least one example.

However, coverage for many species is poor, especially for the species-rich tropical regions. The lack of audio specimens is a hindrance for the proper study of bioacoustics. For example, Garrido et al. (2002) compared specimens of the Grey-headed Quail Dove *Geotrygon caniceps* from populations in Cuba and Hispaniola. While the data from physical specimens supported the suggestion that the two forms should be regarded as separate species, there were no recordings of the song of the Hispaniola population to support their conclusions. The only known recordings attributed to the Hispaniolan race are on a set of commercially-issued LP discs. Unfortunately, these were discovered to be the same tracks from a later publication of bird recordings from Cuba! This particular case highlights the unreliability of some commercially-available record-

ings compared with the original archival recordings. Finally, while there is clearly a need for a considerable increase in avian acoustic specimens, other taxonomic groups (mammals, amphibians, reptiles and invertebrates) are even more poorly represented in the world's sound archives.

THE BRITISH LIBRARY SOUND ARCHIVE: CURATORIAL PRINCIPLES

Formerly known as BLOWS (British Library of Wildlife Sounds), the bioacoustic collection in the British Library Sound Archive had its origins in 1969. It is part of one of the world's major sound archives, containing over 5 million recordings of all kinds: music, speech and bioacoustical sounds. It currently has around 140,000 bioacoustic recordings, each with their detailed documentation (Ranft 1997). Over the past 35 years, some 600 recordists worldwide have cooperated by donating their recordings to this collection. Geographical coverage is worldwide and recordings date from 1889 to the present-day. With representative examples of 8,300 species of birds and 2,100 species of mammals, amphibians, reptiles and invertebrates, and their habitats, it is the most diverse collection of its kind.

The bioacoustic recordings in the British Library Sound Archive are acquired from several

sources. Recordings made by Sound Archive staff and on commercial publications form a small proportion of the collection. The majority of recordings are donations of unpublished field recordings from individual scientists and sound recordists. Recordings are received on many different formats, including wax cylinders, analogue tapes and discs, wire recordings, open-spool tape, and various digital formats: compact disc, MiniDisc, recordable compact disc, computer files and Digital Audio Tape (DAT). Each format has its advantages and limitations. For example, MiniDiscs risk losing data because of the data reduction used in this format, while recording speed errors are common on some portable analogue tape recorders especially compact cassette.

The original recordings are stored unedited off-site on their original carriers along with edited copies on archival-quality carriers. Playback copies of each track are made for daily use and stored on-site. Until 1995, these were copied to quarter-inch tape at 19 cm/s. Since 1995, the copies have been made onto audio CD at the international 'Red Book' standard at 44.1 kHz, 16-bit word length via SADiE digital editors. The CD format was chosen because of the very wide user base worldwide of this format – with over 500 million CD players in use, it is expected that the format will be playable for many years to come (Copeland 1998). Two identical copies of each CD are prepared at the digitization stage on different brands of CD. The manufacturer's brand name and batch number are part of the documentation in the Sound Archive database. The purpose of this is to ensure that, should one particular CD deteriorate in the future, the whole batch can be retrieved for examination and if necessary any remedial action taken. If necessary, digital clones may be restored from the unaffected second copy. A CD testing program is currently under way using a Clover Systems CD tester to analyze representative CD batches for block error rate, jitter and pitch geometry.

The list of data items accompanying each recording follows the scheme published in Kettle and Vielliard (1991) (Table II). Recordings at the

British Library Sound Archive are documented on a single fast-access database with links between individual recordings and the original collection from which the playback copies have been compiled. The database so far covers 50% of the collection (76,000 recordings). It is fully searchable, its search engine supporting full Boolean searching on any string and combination of characters including wildcards. Rights of access and care of each donated collection are governed by a donor's copyright form, which specifies the responsibility of the sound archive and details the level of access permitted.

Whatever the recording, the usefulness of recordings depends on the original audio quality and the data quality including the accuracy of identification in the field.

STORAGE, PRESERVATION AND ACCESS

Audio carriers commonly used for archival audio preservation are analogue quarter-inch tape and digital optical disc. The carrier and format selected should be a standardized format, with a wide user base and relatively low cost. Recordings should be stored in a secure, stable environment with low humidity (< 40%) and a uniform temperature of around 18°C. A duplicate backup collection should be stored off site as added security. Both the access and the backup collection should be monitored at regular intervals to ensure the preservation of the whole collection.

There are advantages to the storage in the digital domain: accurate and fast data transfer, reliable transfer over networks and low-cost. However, one of the main problems includes the lack of digital standards, hence the old adage, "The great thing about standards is that there are so many to choose from"! The rapid changes in digital technology are problematic: new products are brought out into the market with ever-shortening commercial lifespans, to the extent that we have now reached a point where technology obsolescence precedes media decay. Precautions must be taken to avoid as far as possible proprietary software, and to ensure the

TABLE II

Essential data items (after Kettle and Viellard 1991)

* Recordist
* Field recorder, microphone, parabola, recording format and technical settings
* Date and time
* Location (including altitude)
* Habitat
* Weather conditions
* Species name
* Number, age and sex
* Visual identification?
* Type of sound (song, call, stridulation, echolocation, etc.)
* Behavioral observations, including whether playback used
* Temperature (if relevant, e.g. for invertebrates, amphibians)
* Distance from subject

continuity of both the carrier and the devices needed to play them.

There are a number of ways to provide access to an audio collection: (a) on-site listening; (b) supplying copies of audio and their documentation; (c) sales of audio publications; (d) broadcasting on web sites, television and radio broadcasts; (e) networking over the internet. On-line catalogues are already available for the Borror (<http://blb.biosci.ohio-state.edu/BLBCatalog.htm>) and the British Library Sound Archive (<http://cadensa.bl.uk/>) collections. Networking of the actual sound recordings is under active development by several archives.

What is the near future likely to hold for the processes of acquiring, storing and networking sound library collections? As more recordings are being created digitally, and networks increase their bandwidth, electronic acquisition by e-mail or FTP will become an alternative to the traditional methods that sound archives receive new recordings. Completely automated electronic archiving is unlikely, however, because of the need for quality assurance by curators or technicians. Electronic storage and networking of collections is widespread within broadcasting, film and audio organizations, but among the larger

sound archives we are still determining the adoption of a widely used format for the interchange of data between users and archives. The broadcast wave format (.bwf), developed by the European Broadcasting Union, already widely used in the radio and film industry, is a likely contender for archival file storage. It is being adopted by some of the major audio archives as it incorporates the use of a widely available file format, the Windows wav format, with additional metadata stored in the file header. Electronic storage permits efficient access potentially at both high and low-resolution versions. Increasingly, mobile devices are being used to access information worldwide. A recent example has been the provision of wildlife sound recordings to the European mobile phone networks. The latest models of mobile phones support the ability to replay low-quality audio files. But it will not be long before CD-quality audio can be accessed and reproduced over mobile devices almost anywhere in the world. This opens up the prospects for sound archives to make their collections available instantly worldwide. This would have a huge benefit to field researchers who may need access from remote locations to large data banks of audio files.

RESUMO

As primeiras gravações de animais silvestres foram feitas em 1900 no Paleártico, em 1929 no Neártico, 1934 na Antártica, 1937 na Ásia e nos anos 40 na região neotropical. Todavia, o registro sistemático começou somente nos anos 50. As coleções de gravações de sons animais têm muitos usos: educação, entretenimento, ciência e conservação da natureza. Recentemente, os avanços tecnológicos transformaram as maneiras como os sons podem ser registrados, armazenados e acessados. Hoje os principais arquivos detêm, juntos, em torno de meio milhão de gravações com seus dados. O funcionamento de um grande arquivo é descrito baseando-se no British Library Sound Archive. Preservar grandes acervos é uma preocupação básica nesta era digital. Enquanto digitalização e preservação digital apresentam muitas vantagens sobre os métodos analógicos, a velocidade das mudanças tecnológicas e a falta de normas criam um problema sério para os grandes arquivos do mundo. Outro desafio é tornar os acervos mais fácil e amplamente acessíveis via redes eletrônicas. Catálogos on-line e acesso a arquivos sonoros via internet são disponíveis em algumas coleções. Estudos de caso descrevendo a criação e o funcionamento de arquivos sonoros no México, Colômbia e Brasil são fornecidos por seus respectivos autores e agrupados em um Apêndice.

Palavras-chave: arquivos sonoros, acervos bioacústicos, gravação áudio, digitalização.

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APPENDIX:
NEOTROPICAL SOUND ARCHIVES: CASE STUDIES

Recording and Archiving Animal Sounds in México

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Several institutions in Mexico hold sound recordings of Mexican species. The Instituto de Ecología A.C. (INECOL) is putting together a bird sound library (González-García 2004) and will be accepting any bioacoustic sounds that other researchers donate for inclusion in the library. The following is a brief summary of the status of bioacoustics recordings in Mexico.

Recordings from some of the 1,076 species of Mexican birds are held in many places throughout the world, and include mainly species inhabiting the states of Veracruz, Oaxaca and Chiapas. Some of the places that hold Mexican bird recordings are: (a) Instituto de Ecología A.C. (INECOL), Departamento de Ecología y Comportamiento Animal, Veracruz, Mexico; (b) Macaulay Library of Natural Sounds, Cornell University Laboratory of Ornithology, New York, USA; (c) Sam Houston State University, USA; (d) Florida Museum of Natural History, USA (e) British Library Sound Archive, London, UK.

Recordings of Mexican insects are held in the following places: (a) Instituto Tecnológico de Ciudad Victoria, Mexico (Dr. Ludivina Barrientos-Lozano); (b) Universidad Autónoma de Puebla, Mexico; (c) Universidad Nacional Autónoma de México, Centro de Ciencias Aplicadas y Desarrollo Tecnológico, Mexico (M. en C. Santiago Jesús Pérez-Ruiz).

Recordings of mammals include (a) Spider

Monkeys *Ateles geoffroyi* from the Yucatan Peninsula recorded by Pronatura (Wahlberg et al. 2002); (b) Humpback *Megaptera novaeangliae*, Fin *Balaenoptera physalus* and Gray *Eschrichtius robustus* Whales, by the Universidad Autónoma de Baja California Sur (UABCS), Departamento de Biología Marina, Mexico (Dr. Jorge Urbán-Ramírez); Instituto Politécnico Nacional, Centro Interdisciplinario de Ciencias Marinas (CICIMAR-IPN), Mexico (Dr. Diane Gendron); and Universidad Nacional Autónoma de México, Facultad de Ciencias, Mexico (Dr. Luis Medrano-González); (c) Vaquita *Phocoena sinus* by the Centro de Investigación Científica y de Educación Superior de Ensenada (CICESE) and Instituto Nacional de Ecología (INE: Dr. Lorenzo Rojas-Bracho), Mexico; (d) Bottlenose *Tursiops truncatus* and Spinner *Stenella longirostris* Dolphins by the Universidad Nacional Autónoma de México, Centro de Ciencias Aplicadas y Desarrollo Tecnológico, Mexico (Bazúa-Durán 2004).

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The Mexican Bird Sound Library

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The Mexican Bird Sound Library, which began in 1994, has among its goals the recording and documentation of the diversity of Mexican bird sounds for use in education, entertainment, science, management and conservation programs, and to produce national and regional media publications. At the moment, the collection has around 3,000 fully documented cuts of 300 bird species in analogue and digital formats.

In Mexico, the scope for bioacoustics research in birds is limitless. Given the extraordinary species diversity in our country, approximately 1,076 species in 471 genera (27% of the genera of the world) and a high number of endemics (approximately 107 species, 10%; Escalante-Pliego et al. 1993), the documentation and study of bird sounds have both potential and urgency.

The birds of the tropical zones are less well-known than temperate ones (Kroodsma et al. 1996a). New species are being described and many allopatric populations previously considered subspecies are elevated to species status. Because recordings of birds sounds can be obtained more easily than, for example, museum specimens or blood samples for DNA analysis, the study of vocalizations is a much quicker and more effective form of solving taxonomic problems at species level.

The antecedents of this type of activity in Mexico have been carried out mainly by foreigners and almost all the acoustic specimens are deposited in collections in the United States and Europe. It is important that our country has its own library of sounds. In 1994 the Departamento de Ecología y Comportamiento Animal of the Instituto de Ecología A.C. began the first bird sound library in Mexico. The dissemination of Mexican birds sounds has been mostly carried out through commercial cassettes, compact

disc and CD-ROM productions of foreign origin. Acoustics guides with sounds of Mexican birds are the following (after López-Lanús 2002): a) *Mexican Bird Songs* (Davis 1958); b) *Voices of Neotropical Birds* (Hardy 1983), ARA Records, Florida, USA; c) *Voices of Mexican Sparrows* (Hardy and Wolf 1993), ARA Records; d) *Songs of Mexican Birds* (Coffey and Coffey 1990), ARA Records; e) *Voices of New World Owls* (Hardy, Coffey and Reynard 1989), ARA Records; f) *Bird Songs of Belize, Guatemala and Mexico* (Delaney 1992), Cornell Laboratory of Ornithology; g) *Bird Songs of South-eastern Arizona Sound and Mexico* (Keller 2001), Cornell Laboratory of Ornithology.

The first nationally-produced sound guides were: *Songs of Mexican Birds* (Ceballos and Wilson 1986: Pronatura) and *Songs and Calls of Birds. Area of Protection of Flora and Fauna Silvestre, Biological Corridor Chichinautzin* (Romo de Vivar and Urbina 2002: Conabio and Universidad Autónoma del Estado de Morelos). The last authors have produced another compact disc, yet to be reproduced commercially, the *Songs of Birds of San Blas, Nayarit*, with 46 species. It was produced by the Gobierno del Estado de Nayarit and the Universidad Autónoma del Estado de Morelos. As part of these activities, these Mexican colleagues have also begun a sound collection in the Centro de Investigaciones Biológicas of the Universidad Autónoma del Estado de Morelos. At the moment it has 44 cassettes with recordings from the states of Nayarit, Morelos and Michoacán. This collection is being digitized. Another small collection is in the Colegio de la Frontera Sur, in San Cristóbal de Las Casas, Chiapas, which only gathers sounds of the birds in the state of Chiapas. Access is possible through the following page: <http://www.ecosur.mx/pajaros/>

At the moment our collection has around 3,000 documented cuts of approximately 300 species, on 233 tapes and minidisks. The recordings come mainly from Veracruz, Oaxaca and Chiapas, and some from Michoacán, Morelos and Jalisco. Other recordings are from Guatemala, El Salvador, Nicaragua, Costa Rica and Panama.

All these recordings are recorded and documented with their basic, technical, geographical and bioacoustical data, according to Gullede (1976), Kettle and Vielliard (1991), Vielliard (1993) and Kroodsma et al. (1996b).

Each tape or optical disc is numbered and labeled consecutively and identified by the author's personal code (for example GOFG02-002 = González-García, Fernando, Year 2002, tape number 2). At the beginning of each tape, basic data are recorded: recording location, geographical coordinates, altitude, equipment used, tape number, recordist name and address, geographical location of the place. After each recording, the specific data are added according to the details in Kettle and Vielliard (1991).

The collection has its headquarters at the central office of the Instituto de Ecología, A.C. in Xalapa, Veracruz. The sounds are available to the scientific community, and for all public interested in the research and education. The collection is promoted by means of the website: www.ecologia.edu.mx/sonidos. A starting project is the production of a CD of the bird sounds of Veracruz State, Mexico, and a short and long-term hope is that each state of the Mexican Republic possesses its own acoustics guide.

Another objective of our sound library is to offer training courses in the techniques of recording and their application in bioacoustical analysis. The first course was held in El Salvador in 2001. Since then I have offered courses in Costa Rica, Nicaragua and Mexico between 2001 and 2003. The participants have come from Mexico, Guatemala, El Salvador, Honduras, Nicaragua, Costa Rica, Panama, Colombia, Spain and United States of America. As a result of these training courses, Mexico, Costa Rica and Nicaragua have begun their own collection of

sounds. Most of the participants have been students and biology professionals, and nature reserve wardens.

Without a doubt a fundamental aspect in the recent study and conservation of biodiversity has been the sound specimens in bioacoustic collections. As these sounds are filed and made easily available, they can help a great variety of studies. Sound libraries offer opportunities for carrying out significant and novel contributions to the study of animal communication. The importance of the collections of sounds is easily comparable to the herbaria, seed banks and zoological museums, and their uses can be diverse (Kroodsma et al. 1996b).

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**A Natural Sound Archive for Colombia:
The *Banco de Sonidos Animales* (BSA)**

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A natural sound archive helps to evaluate and document the biological richness of an ecosystem. Colombia is one of the richest countries for biodiversity, harboring many species for which there is still lacking information. Trying to cope up with the national biodiversity inventory, recording techniques serve well for a variety of organisms. The Instituto Alexander von Humboldt is in charge of building up biodiversity inventories for the country, and help to promote and generate research that will help conserve and ensure the sustainable use of its resources.

The “Banco de Sonidos Animales” (BSA) of the Instituto Alexander von Humboldt in Colombia was created in 1998 as a long-term strategy to preserve natural recordings, with advice from the Macaulay Library of Natural Sounds at Cornell University. The main objective of the BSA is to archive and document vocalizations of animals and environments. It harbors approximately 12,500 recordings at the present time, mainly of Colombian birds. Most of them result from field research undertaken by a rapid biological assessment team, as well as other research projects. Also several ornithologist as well as amateur ornithologists have deposited their recordings. The staff is composed of two biologists and a sound engineer.

A natural sound archive allows not only biological studies, but serves also as an aid in identification of specific taxa difficult to see but heard frequently, in estimating relative abundance of species, and evaluating taxonomy, but also in training and learning for educational and recreational use.

In the field the sounds are recorded using analogue cassette recorders and shotgun microphones

(mainly Sennheiser ME67). The cassette recordings are later digitized for computer editing through an audio interface at 44,100 Hz sampling rate and 16-bit resolution. The recordings are transferred for digital storage onto CDs using PCM encoding. Other audio file formats are not used because they can be difficult to listen to in a non-professional audio facility. The two ornithologists who record the sounds in the field also determine and help to classify the sounds to species level in almost all the cases. The digitization, cataloguing, editing and restoration of the recordings are carried out by the sound engineer. All recordings deposited at the BSA are exact digital copies of the original recordings.

To manage the archive, all the edited recordings are separated into cuts or tracks. Each track is assigned a unique identification serial number that is also recorded for the digital version and which is linked to the data base. Data information for each track (sound and serial number assigned) includes at least locality, date and recordist. The use of a database (FileMaker or Access, depending of the kind of computer system used) makes efficient searching of the sound material.

One of the principal goals of the BSA is to enlighten, and raise awareness amongst the Colombian community of the natural richness around us and to have recordings available for future generations. To do so, the production of bird sound guides on CD intends to make sound catalogues of the Colombian fauna available to the general public and the scientific community. This process of creation of the master CD is made using MATLAB software.

The BSA is processing several new collections incorporating almost 1,000 cuts yearly and will con-

tinue growing. More people are recording and some of them are depositing their recordings at the BSA. This promotes and helps preserve recordings and their use. So far, four published sound guides have been produced at the BSA. One includes bird species from the Eastern Cordillera of Colombia. The other three include the Central Cordillera, the northern

portion of the Andes near the Venezuelan border, and the eastern slopes of the Western Cordillera of Colombia.

Finally, any person interested in natural sounds (mainly from the Neotropics) may leave their recordings at the BSA and may ask for material for scientific, educational or personal use.

Establishing a Bioacoustic Collection in the Neotropics: Present and Future of the Arquivo Sonoro Neotropical

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The “Arquivo Sonoro Neotropical” (ASN) was created in 1978 as a result of the four expeditions I made in Brazil for the Academia Brasileira de Ciências from 1973 to study natural bird communities. Because of the necessity to know the voices of bird species for any ornithological field research and of the lack of sound references, except for the work of a few amateurs, I initiated the task to establish a national sound archive. This objective was achieved when UNICAMP (Universidade Estadual de Campinas) invited me to found a Laboratory of Bioacoustics. Since then, the archive has grown rapidly, thanks to the numerous field expeditions I made with the support of the federal research agency CNPq, and also through the contributions of students and collaborators. It became clear to me that an archive needs the collaboration of all interested people, and that this is facilitated if it is associated with a teaching and research institution. The Laboratory of Bioacoustics I am managing now offers technical assistance, graduate and post-graduate courses, media publications and every possible support to any query. This policy helps promote our

aims, mostly public and government awareness to nature preservation issues, and gather contributing recordists. In spite of cyclical financial restrictions, the Laboratory and Archive have remained active without interruption since its creation a quarter of century ago. I am also very proud of the strong collaboration received, which contributed to the scientific value of ASN and its continuing position among the major natural sound archives of the world. Today, I am glad to announce that its more than 25,000 fully-documented cuts will start to be transferred to a high-definition digital support (DVD) and possibly incorporated later into a large scientific data-base accessible on-line, that the São Paulo State research agency FAPESP is creating. Although it implies new investments, digital transfer is the solution for sound archives: cheaper equipment and media, easier conservation (especially in tropical climates), cheaper and easier copying. The future of wildlife sound archives is of new possibilities of expansion, but the fundamental rules for valuable scientific recordings remain the same: accurate technical standards and rigorously documented data.