

Recording Frog Calls

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Frog calls are used in conjunction with several inventory techniques described in this book, for example, audio strip transects and acoustic monitoring at fixed sites. To utilize such techniques successfully, an investigator must have tape recordings of frog calls from which to learn the calls and verify species identifications. In addition, tape recordings of frog calls may be important for systematic and behavioral studies and as voucher material (see "Voucher Specimens" in Chapter 5).

Equipment

Analyses of vocalizations are based on tape-recorded calls. To obtain suitable quality recordings for signal analysis, recording machines must accurately capture the dominant frequencies of frog calls,

have good recording speed control, include an electronic record-level meter, and be portable and relatively easy to use. A variety of portable tape recorders meeting these requirements are available. Because frogs do not emit sounds of extremely high frequency, the recording equipment requirements for frogs are less demanding than those for bats, some birds, and many insects. Most species of frogs have dominant frequencies of about 4,000 Hz or less; only a few have calls with dominant frequencies in the 8,000–10,000 Hz range. Thus, a tape recorder with a flat frequency response from around 20 to 15,000 Hz is suitable.

Reliable recording speeds can be obtained with all but the least expensive recorders. However, speeds vary with all recorders when batteries begin to lose their charge. Some recorders have a safeguard against this problem and will not record when the battery charge is below a certain level; nevertheless,

recording speed (or battery level) needs to be checked frequently. A peak-level light indicator (or other electronic recording-level meter) is important to ensure that calls are recorded at optimal levels. If levels are too high (calls too loud), signals can be distorted. Regular view meters (also known as VU meters) cannot track click-like calls of some frogs, which often results in defective recordings (distorted signals with clipped waveforms when analyzed on an oscilloscope). Recorders with both a VU meter and a peak-level light indicator are recommended. Click-like calls also cannot be recorded properly with machines in which gain (intensity level of signal being recorded) is controlled automatically. Recorders that do not have the option of manually adjusted gain should be avoided.

The best recorders available for fieldwork at present are reel-to-reel Uher or Nagra recorders (Nagra recorders do not have peak lights). Both brands are expensive (U.S. \$2,000–\$6,000), and neither the machines nor their manufacturers' authorized repair services are readily available. Because the popular market for recording and playback equipment has shifted from reel-to-reel format to cassette tape format, at this time the most accessible and least expensive machines are cassette recorders. Many workers use Marantz and Sony equipment in the U.S. \$250–\$500 range with good results. Currently, most frog workers use analogue tape recorders. Digital (DAT) recorders probably will be preferred when they are more widely known and used. Currently, a portable SONY DAT recorder is about U.S. \$800 but does not work consistently under conditions of high humidity.

Microphone quality is as important as tape recorder quality. An acceptable microphone should have no noticeable distortion in the 20 to 10,000 Hz range (this information is documented in the specifications that come with microphones and recorders). If documentation accompanying a microphone does not include distortion information, the microphone is probably of low quality and should be avoided. Because most frogs are (or should be) recorded from short distances, either omnidirectional or directional microphones can be used. Some workers use "shot-gun" microphones, which are directionally intermediate. Generally, parabolic reflectors are cumbersome and not necessary for recording frog vocalizations.

None of the portable recording equipment currently available is built to withstand the kind of field use required for tape recording frog vocalizations.

Most recorders do not function well when exposed to high humidity for extended periods. Yet many species of frogs call only when it is raining or very humid. Even the best-maintained machines rarely last more than 10 years in tropical humid conditions. It is important to store recording equipment in plastic bags with drying agents in the field and in a dry place otherwise. When several individuals share equipment, availability of multiple recorders and microphones will ensure that at least one set is working properly at all times. This practice probably dictates the use of cassette rather than reel-to-reel equipment, considering unit costs.

Recordings made with the equipment recommended above will be suitable for all research applications. In the absence of good equipment, whatever is available should be used—any recording is better than none.

Making the recording

Investigators may record either frog choruses or calling individuals. Chorus recordings are not particularly useful for research and are little used. If chorus recordings are desired, one tapes the chorus from a distance at which no individual call is distinguishable to the human ear. Chorus recordings should be complemented by recordings of individuals at the site. Individual calling males are recorded at distances from 0.5 to 1.5 m. It is critical that the frog being recorded be observed calling. Using an appropriate gain level is important; this level can be determined by monitoring several calls before recording. One begins recording with the gain meter purposely high and then adjusts it to the point just below that at which the peak light comes on. Background noise from other calling males should be minimized to the degree possible.

Recordings should be made only on one side of a tape. This will minimize problems with tape "bleeding" (migration of the magnetic signal from one piece of tape to an adjacent section of the reel under certain long-term storage conditions) and also will accommodate some variation in head alignment when the tape is replayed. Thin tape should not be used. For reel-to-reel recording, 1.0-mil tape is acceptable; 1.5-mil tape is recommended. For cassette tapes, tape thickness rarely is stated, but usually it is inversely correlated with recording time. Sixty-minute tapes (30 minutes per side) are sufficiently thick to be used; 90-minute tapes are too thin.

The duration of a recording depends on various factors, including how often the frog calls and how much tape is available. Most species call regularly enough so that a minimum of 5 to 10 calls and often 40 or more can be recorded in a few minutes. Some species may have very long calls or low call rates. In such instances, care should be taken to record the entire call, as well as the complete interval between calls (within reason), to provide call rate information.

At the end of each recording segment (recording of chorus or of individual), the person making the recording should add a voice label giving, at a minimum, the place, time, species field identification, temporary voucher information, and temperature (see below). Voice labels aid immeasurably in later location of the recording on a tape. Stating "the end" on tape when each recording unit is finished is also useful.

Calling rate, pulse rate, call length, and sometimes broadcast frequencies vary greatly with ambient temperature (Duellman and Trueb 1986:104). Thus, temperature data are critical for comparing different recordings, audiospectrograms, and other call data. If a frog is calling in water, water temperature should be taken. If a frog is calling from land, air temperature should be taken at or near the site. For large frogs, cloacal or mouth temperatures should also be taken with a quick-reading thermometer.

Voucher specimens

It is essential to capture and identify frogs that are recorded. At least one voucher specimen per species

per calling site must be preserved (see Appendix 4), but we recommend that a voucher be made of each individual recorded. Call vouchers are important for species identification and for documenting the size of the individual recorded. Broadcast frequencies and other call variables vary with body size (Duellman and Trueb 1986:89).

Associated data

The following data in order of priority should be written in a field book (unless indicated otherwise) for each recording:

Mandatory. Tape identification—name of person making the recordings, field site, and tape number, to be written on the tape and the tape box (for example, "R. F. Inger, Borneo 1991, Tape 2"); field number of voucher specimen; specific locality at which recording was made; date of recording; temperature of air, water, and animal.

Strongly Recommended. Time of recording (24-hr clock); name of person recording the call if different from above (e.g., field assistant or student).

Highly Desirable. Weather conditions; calling site habitat; list of other species calling in background; tape recorder and microphone (equipment) used (microphone and tape recorder information can be noted on the tape box unless the equipment differs for different recordings on the same tape).

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