

THE USE OF SOUND RECORDINGS AS VOUCHER SPECIMENS AND STIMULUS MATERIALS IN ETHNOZOOLOGICAL RESEARCH

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ABSTRACT.—The importance of collecting voucher specimens in ethnobotanical research is well recognized. However, collecting zoological vouchers—especially of large vertebrates—may prove beyond the capacity of many field projects. I describe the potential of field tape recordings of animal vocalizations as both vouchers and as stimulus materials for eliciting native terms and associated cultural data. Sound recordings can be at least as reliable for species documentation as photographs, study skins, or skeletal specimens, and such recordings are easily copied and edited for use in naming tasks with consultants at a later time. Basic equipment and procedures involved in making and using such recordings are also described.

RESUMEN.—La importancia de coleccionar especímenes comprobantes (voucher specimens) en la investigación etnobotánica ha sido ampliamente reconocida. Sin embargo, la colecta de especímenes zoológicos—especialmente de vertebrados de gran tamaño—puede estar más allá de la capacidad de muchos proyectos de campo. Describo el potencial de las grabaciones de campo de vocalizaciones animales, tanto como especímenes comprobantes como materiales de estímulo para elicitación de términos indígenas y los datos culturales asociados. Las grabaciones de sonido pueden ser por lo menos tan confiables para documentar la identidad de especies como las fotografías, pieles, o esqueletos, y tales grabaciones pueden ser fácilmente copiadas y editadas para uso en pruebas de identificación con consultores tiempo después. Se describen también el equipo básico y los procedimientos necesarios para hacer y usar tales grabaciones.

RÉSUMÉ.—L'importance de la collecte des échantillons de référence en ethnobotanique est reconnue depuis longtemps. Néanmoins, la collecte des échantillons de référence en ethnozoologie, surtout pour les grands vertébrés, est souvent trop difficile pour la plupart des projets de recherche sur le terrain. J'expose ici l'utilité potentielle des enregistrements de vocalisations d'animaux faits dans la nature, aussi bien en tant qu'échantillons de référence que méthode servant à stimuler des informateurs indigènes dans l'exposé de leurs savoirs biologiques populaires et des noms concernant les animaux en question. Les enregistrements peuvent être aussi utiles pour la documentation et l'étude des animaux comme le sont les photographies, les squelettes, ou les dépouilles préservées. Et les enregistrements sont facilement copiés et remaniés pour les études ultérieures de lexicographie à l'aide d'informateurs. Le matériel et la méthode employés pour faire ce genre d'enregistrements sont présentés.

The critical importance of voucher specimens in ethnobiological research has been repeatedly emphasized (Norton and Gill 1981; Bye 1986). As Bye notes (1986:2), the voucher specimen is the link between two bodies of information, that of Western biological science and that of the ethnosciences of the native culture the ethnobiologist seeks to document. For example, Sahaptin-speaking Indians of the Columbia Plateau employ a plant they call *chalu'ksh* for a variety of purposes, nutritional, medicinal, and as a fish poison (Meilleur et al. 1990). This fact remains an ethnographic particularity, however, until it can be established that *chalu'ksh* means *Lomatium dissectum* (Apiaceae). On the basis of this equation it is possible to compare a segment of Sahaptin ethnoscientific knowledge with a corresponding segment of Western botanical systematics, phenology, ecology, and pharmacology. This equation also makes possible comparisons with the ethnoscientific traditions of other cultures within the range of this species. The resulting synthesis is of greater value than the sum of its parts, the disconnected bits of ethnographic detail we would otherwise have to deal with. The link to Western biosystematics that the voucher establishes allows us to address fundamental questions, such as the nature of human knowledge itself in the context of human adaptation.

WHAT IS A VOUCHER?

Bye (1986:1), following Lee et al. (1982), defines a voucher specimen as "an organism or sample thereof 'which physically and permanently documents data in an archival report by: (1) verifying the identity of the organism(s) used in the study, and (2) by doing so, ensure[ing] that a study which otherwise could not be replicated can be accurately reviewed or reassessed' [Lee et al. 1982:5]." To accomplish this purpose voucher specimens should meet several criteria, namely: (1) have recognized diagnostic characters; (2) be preserved and maintained in good condition, (3) be thoroughly documented, and (4) be readily accessible in a suitable repository institution (paraphrasing Bye 1986:1).

In the instance of vascular plant vouchers, standard operating procedures are well known. Basic collecting equipment such as plant presses, newsprint, hedge clips, pocket knives, and field dryers (or formaldehyde in the humid tropics) are relatively simple to obtain and use and easily transportable to the field. With minimal practice acceptable specimens can be produced by nonspecialists at an efficient rate. The accurate scientific identification of vouchers and their permanent curation, of course, require close collaboration between the field ethnobotanist and specialists based in established herbaria.

The procedures for collecting and preserving ethnozoological vouchers are not so straightforward (see Bulmer 1969 for a discussion of ethnozoological field methods). The preservation of adequate vouchers of birds in the traditional form of the museum study skin is a difficult and demanding skill that few ethnobiologists will command. Furthermore, birds are highly diverse in most of the world's regions, so that the ethnobiological researcher must deal with dozens, even hundreds of species, a number that typically exceeds by a substantial margin the number of all other terrestrial vertebrates combined. Birds are also elusive,

though they may be quite conspicuous. They must first be trapped, netted, or shot before the onerous task of preparing their skins can begin. Furthermore, most are also protected from casual hunting by national regulations and by international treaties barring their transport across national boundaries. Collecting permits are not easily obtained. Thus, unless one is collaborating with a professional museum ornithologist in the field, ornithological vouchers seem beyond reach. Yet birds are easily misidentified and vernacular bird names are notoriously idiosyncratic.

Producing a voucher specimen for a large mammal such as a jaguar, grizzly bear, or caribou, not too mention a whale, is clearly a major technical undertaking that could occupy the fieldworker for many days. Similar difficulties may be encountered by ethnobotanists, of course, as anyone who has tried to collect vouchers of columnar cacti or a coyol palm could attest (see Anderson 1971:227-231 for some creative suggestions for dealing with such problems). We normally make exceptions to the general rule that voucher specimens are required when we are dealing with large, universally recognized organisms. A photograph or reference drawing in our notes or reference to published illustrations may suffice. However, in my opinion, this is not an adequate solution in the case of birds.

Yucatec Mayan ethnoornithological vocabularies have been published on the basis of the researcher sitting down with one or two Yucatec speakers and a copy of Peterson and Chalif's *A Field Guide to Mexican Birds* (1973). Hartig's *Las Aves de Yucatan* (1979)—which lists Yucatec and/or Spanish loan "names" for 279 species and subspecies of birds—was compiled in this way. The results are less than satisfactory. An analysis of the Yucatec-Latin correspondences cited in Hartig demonstrates the need for fieldwork-based "ground truthing" to avoid incorrect and/or misleading attributions. Hartig began with a list of 491 bird taxa (species and subspecies) attributed to the Yucatan Peninsula avifauna.¹ However, she did not distinguish common species from rare, casual, and locally distributed species. This led to many overgeneralizations of native terms to species unlikely to have been familiar to her native consultants, such as the aplomado falcon (*Falco femoralis*), sandhill crane (*Grus canadensis*), white-rumped sandpiper (*Calidris fuscicollis*), and gray-cheeked thrush (*Catharus minimus*), which are rare at best on the Peninsula.

Hartig (1979) reported one to three native names for each of these 279 bird taxa (56.8% of the total listed for the Yucatan Peninsula). However, only 74 distinct folk generic names (see Berlin 1992 for definitions of terms) are included in this nomenclatural inventory. The majority of the species "named" are labeled by broadly inclusive descriptive terms which do not function as true names. For example, *ch'ich'il ha'* (water bird), used alone or with various ad hoc modifiers, is reported as the "name" of 17 different bird species representing five taxonomic orders (i.e., Pelecaniformes, Ciconiiformes, Anseriformes, Gruiformes, and Charadriiformes). An additional 21 species, equally eclectic, are lumped as *bech' ha'* (water quail), again variously and seemingly idiosyncratically modified. Given the fact that aquatic birds such as these are rarely and irregularly encountered on the Yucatan Peninsula except at favored coastal localities, it is unlikely that Hartig's main consultant—a man from a village near Valladolid—had more than

a casual acquaintance with most of these birds. In addition to overgeneralization of descriptive terms and the widespread use of nonce forms, there are numerous misidentifications. At least 50 nomenclatural assignments are clearly in error. These misidentifications appear to be due to two main factors, the consultants' difficulty distinguishing field guide illustrations drawn at different scales and their difficulty distinguishing obscurely or cryptically plumaged birds when little or no information on their vocalizations, behavior, or habitat was available. Scale is most likely the reason several bright yellow wood warblers (Parulinae, Emberizidae) were misidentified as one or another type of oriole (*Icterus*, Icterinae, Emberizidae), though the orioles are twice the linear dimensions of the wood warblers. The same difficulty may account for the equation of the Caspian tern (*Sterna caspia*) with the brown pelican (*Pelecanus occidentalis*), and the confusion of the diminutive blue-black grassquit (*Volatinia jacarina*) with the bronzed cowbird (*Molothrus aeneus*). The inadequacy of pictorial representations to distinguish obscurely plumaged birds most likely accounts for the near random assortment by her consultants of diurnal raptors (Accipitridae, Falconidae), owls (Strigiformes), nightjars (Caprimulgidae), and tyrant flycatchers (Tyrannidae) among the various named Yucatec categories appropriate to species within those larger groupings. Without some indication of the size, behavior, vocalizations, and habitat of these species the illustrations are simply inadequate as stimuli for accurate terminological responses by native consultants.

A SOLUTION TO THE DILEMMA

A simple alternative to sole reliance on pictorial stimuli presents itself: the use of sound recordings. Such recordings may be obtained from prerecorded collections when available or recorded locally in the course of the research. The latter is preferred as it more closely links the stimulus to the specific environmental experience of one's consultants. Field guides are strictly visual, while birds, especially forest birds, are far more often heard than seen. The birds themselves recognize one another on the basis of a variety of characteristic vocalizations—songs and calls—rather than by sight. These characteristic vocalizations can be used by knowledgeable observers to identify many birds quickly and reliably at the level of species, and in some cases may reveal sex, age, and subspecific identity as well (Johnson 1982). As vocalizations are important in species recognition as well for frogs and toads, many insects, and certain mammals, the techniques described below are not relevant solely to ethnoornithological investigations.

I have recently experimented with the use of field sound recordings to elicit ethnozoological data on birds. Serendipitously I realized that these recordings made excellent voucher specimens. By depositing copies of my field recordings in a suitable archive I met two of the four criteria Bye (1986:1) cites as necessary for an adequate voucher specimen, i.e., that they "be preserved and maintained in good condition" and that they "be readily accessible in a suitable repository institution." Though at present relatively few institutional repositories exist, interest in establishing such repositories is growing, with Cornell University's

Library of Natural Sounds the leading exemplar to date² (see Boswall and Couzens 1982 for a list of extant collections). As of 1992, the Cornell collection includes nearly 85,000 recordings of 4,965 animal species (Gulledge 1979).

But what of Bye's two remaining criteria? Can they be met by sound recordings? The third criterion is a matter of basic research methodology: that vouchers "be thoroughly documented" means that each vocalization must be identified as to the person making the recording, the date and location of the recording, associated behavioral data, habitat associations, and technical data on the recording equipment used. The Library of Natural Sound provides donors with standard documentation forms on request, as illustrated in Fig. 1.

LIBRARY OF NATURAL SOUNDS
CORNELL UNIVERSITY
150 SARGENT WOODS RD
ITHACA, NEW YORK 14850

TAPE CODE #12-
RECORDIST'S
REFERENCE
NUMBER (RNN) #69-

*** IDENTIFICATION AND DATE (COMPLETE THIS SECTION FOR EACH DATA BOND) ***

SPECIES, SOUND, OR SUBJECT: _____

SAME SOUND SOURCE AS RNN: _____ CROSS REFERENCE TO CATALOG NO #06-
RECORDIST(S) #42- _____

TIME (24HR) #13- _____ DAY #14- _____ MONTH #15- _____ YEAR #16- _____

RELATIVE TIME #17- DAWN (+)(-), NOON (+)(-), SUNSET (+)(-) HR
MOONLIGHT #18- NONE, SOME, BRIGHT, SPECIMEN COLLECTED #19- YES, NO
HOW IDENTIFIED #20- SIGHT, SOUND, CONFIDENCE IN IDENTIFICATION #21- _____
DISTANCE TO SOUND SOURCE #31- _____ M. RECORDIST(S): TAPE # _____, CUT # _____
BACKGROUND SOUNDS #22- _____

*** GEOGRAPHIC (EXCEPT AS NOTED, SAME AS RNN) ***

COUNTRY OR ARCHIPELAGO #07- _____
STATE, DEPT, PROV, OR ISLAND #08- _____
LOCALITY #09- NW N S E W of _____
LATITUDE #10- _____ LONGITUDE #11- _____ ALTITUDE #12- _____ M

REFERENCE FOR ANIMAL NAMES: _____

*** BEHAVIOR AND BIOLOGY (EXCEPT AS NOTED, SAME AS RNN) ***

NUMBER OF ANIMALS #23- PRENATAL; NESTLING(S); FLIDGLING(S); JUVENILE(S);
IMMATURE(S); ADULT(S); UNKNOWN AGE

SEX #24- MALE(S); FEMALE(S); UNKNOWN SEX

SPECIES SOUND OR SOCIAL CONTACT #25- ISOLATED; INFREQUENT; FREQUENT; CONSTANT;
FAMILY; MIXED SPECIES; COLONY; FLOCK; TROOP;
HERD; OTHER SOCIAL UNIT: _____

RANGE STATUS #26- NORMAL; RANGE EXTENSION; MIGRATION; ACCIDENTAL;
INTRODUCED; CAPTIVITY

BREEDING STATUS #27- NOT TERRITORIAL; TERRITORIAL; TERRITORIAL SOLITARY;
TERRITORIAL PAIRED; BREEDING; NOT BREEDING

SOUND CATEGORY #28- SONG; CALL; MECHANICAL; DEVELOPMENTAL SUBSONG;
OTHER SUBSONG; OTHER

SPECIAL SONG TYPE #29- Duet; Counter Singing; Flight; Whisper;
Dawn; Mimicry; Other: _____

STIMULUS FOR SOUND #30- NATURAL (ON PLAYBACK); SQUEAL-SPISH; HUMAN IMITATION;
PLAYBACK OWN SONG; PLAYBACK SAME SPECIES;
PLAYBACK ARTIFICIAL SOUND; OTHER: _____

RESPONSE TO PLAYBACK #31- NONE; ORIENTATION; APPROACH; NORMAL SONG(SOUND);
DIFFERENT SONG(SOUND); ATTACK

BEHAVIORAL CONTEXT #32- OF SOUND: EXPERIMENT; ADVERTISING; COURTSHIP; COUPULATION;
MOVING; INVITATION; LEC; MATE CONTACT;
NEST INVITATION; INCUBATION; NEST RELIEF;
CARE OF YOUNG; PARENT-YOUNG CONTACT; BEGGING;
ANNOUNCE; ALARM; THREAT; SCOLDING;
DISTRESS; AGGRESSION; MOODING; FIGHTING;
FLYING; FORAGING; FLOCK CONTACT; BOOSTING;
CONTENTMENT; ARRIVAL; DEPARTURE; FLUSHED;
OTHER: _____

SOUND DELIVERY RATE #33- SPORADIC; LOW; NORMAL; HIGH; AGITATED

SOUND SOURCE #34- STRIKE; LARKIN; AIR SAC; BILL; BILL DRUMMING;
WINGS; TAIL; FEET; HORN; OTHER: _____

VISUAL DISPLAY WITH SOUND #35- NO; YES (DESCRIBE IN NOTES #67) OR VERBALLY ON TAPE

*** HABITAT AND ENVIRONMENT (EXCEPT AS NOTED, SAME AS RNN) ***

GENERAL CLIMATE #36- WET; HUMID; ARID; CYCLIC WET-DRY

ENVIRONMENTAL ZONE #37- TROPICAL; SUBTROPICAL; TEMPERATE; BOREAL;
ARCTIC; MONTANE; ALPINE; OTHER: _____

SEASON #38- SPRING; SUMMER; FALL; WINTER; WET; DRY

GENERAL HABITAT #39- WOODS; FOREST; BAINFOREST; CLOUDFOREST;
BUSH; CHAPARRAL; GRASSLAND; SAVANNAH;
STEPPE; SWAMP; MARSH; TUNDRA; MIRE;
TAIGA; DESERT; DUNES; BEACH; SHORE;
MARINE; OPEN WATER; BURL; URBAN; SUBURBAN;
ISLAND; OTHER: _____

HABITAT TYPES #39- CONIFEROUS; DECIDUOUS; EVERGREEN; SECOND GROWTH;
UNDERGROWTH; SCRUB; THICKET; GROVE; SANDY;
ROCKY; CANYON-RAVINE; CLIFF; BAY; CAVE;
BURROW; SALT; FRESH; BRACKISH; BOG;
MUDFLAT; SANDSPIT; PASTURE; MEADOW; ORCHARD;
HEDGEROW; EDGE; TUSSOCK; YARD; PARK-CAMPUS;
CULTIVATED; FALLOW; BARN; FIELD; ROADSIDE;
BURN; CLEARING; EXOTIC; OTHER: _____

DOMINANT PLANT(S) #40- _____

COVER DENSITY #41- NONE; OPEN; SPARSE; MEDIUM; THICK

STRATA IN HABITAT #42- SURFACE; LOW; MEDIUM; HIGH; CANOPY;
TRUNKS-LIMBS; LOW FLIGHT; HIGH FLIGHT; SONG PERCH

WATER ASSOCIATION #43- NONE; MOUNTAIN STREAM; CREEK; RIVER; POND;
LAKE; LAGOON; ESTUARY; SEA-OCEAN; BAY

WEATHER #44- CLEAR; CLOUDS; OVERCAST; FOG; RAIN; SNOW;
WIND; OTHER: _____

TEMPERATURE (AIR) #45- DEGREES (C)(F) WATER #46- DEGREES (C)(F)

*** TECHNICAL (EXCEPT AS NOTED, SAME AS RNN) ***

TAPE SPEED #47- CMS; FORMAT #48- TRK MONO; TRK STEREO; CASSETTE

FIELD RECORDER #49- MICROPHONE #51- TAPE;
NOISE REDUCTION SYSTEM: _____; EQUALIZATION;
COPY RECORDER: _____; FILTERING: NO; YES (DESCRIBE IN NOTES)

PARADOLA (D/F/L) #50- ON

*** EDITING AND CATALOGING (FOR USE BY LIBRARY OF NATURAL SOUNDS ONLY) ***

TAPE CATEGORY #52- FIELD; RESEARCH; BAPTIST; SOUND EFFECT;
INTERVIEW; PROGRAM; CYNTHIA; FROM RDS

CUT LENGTH #53- _____ QUALITY #54- SAFETY ARCHIVE COPY NO #55- _____

STETHOGRAPH FILED #56- YES; NO; NOTES ON TAPE #57- YES; NO

EDITED: _____ CATALOGED: _____, MICROFILMED: _____

*** NOTES ***

#67- _____

FIG. 1.—Example of Data Form for recordings deposited at the Cornell University Library of Natural Sounds.

Ethnographic information elicited from native consultants during review of tapes or subsequently elicited by reference to the native names recorded in response to the recorded vocalizations may be summarized in notes submitted to the institutional repository where the voucher copies are to be housed. This summary may include in addition to local names information on uses and other

aspects of local knowledge and belief about that particular organism. Published analyses of these data are then substantiated by references to the repository catalog numbers of each voucher vocalization.

I begin each taping session by recording in my own voice the date and time, location, and habitat. If consultants or colleagues are with me, that is also noted. I record on the same tape tentative identifications of the sounds or comments on the appearance or behavior of the organisms whose vocalizations I am recording as they occur. This information may be essential to verify identifications after the fact. I wait until the particular trip is concluded to prepare a master tape log. (Master tapes are my original, real time recordings; from these I may subsequently compose tapes arranged in systematic order, or otherwise arranged for specific purposes.)

The master tape log is simply a written listing of each identifiable vocalization on the master tape in the sequence in which it has been recorded, keyed to the tape counter—an arbitrary and variable index of elapsed time. I record in this log whenever possible the presumed identity of the calling or singing bird (or frog, cicada, or cricket, etc.) that is most prominent during that tape segment. I also note bird vocalizations or other noises in the background, as this may provide clues to habitat associations and my affect consultants' interpretations. If the bird was seen at the time it was recorded and its identity confirmed by visual cues, this should be noted. (Vocalizations of uncertain identity should be confirmed visually whenever possible.)

When a tape is subsequently reviewed by a native consultant, that consultant's identifications and comments may be keyed to the specific stimulus vocalization by reference to the master tape number and position on that tape—by side and elapsed time as indicated by the tape counter. Table 1 illustrates this procedure. Ethnographic notes in this instance have been limited to native names.

TABLE 1.—Yucatan bird tape with elicited Yucatan names.¹

Location	f/b	English name	Yucatec ID
2a:012-053	fore	"hammer" cricket	<i>martiyo maas</i>
2a:063	back	cricket sp. #2	—
2a:068	back	mottled owl	—
2a:111-131	fore	plain chachalaca	<i>baach [bach]</i>
2a:135-165	fore	mottled owl	<i>kul-te'</i>
2a:187-215	fore	mottled owl	<i>kul-te'</i>
2a:210	back	cicada sp. #1	—
2a:218+	back	brown jay	<i>pa'ap</i>
2a:222+	back	cicada sp. #1	<i>ch'och' lin [chooch lin]</i>
2a:226-233	back	blue-crowned motmot	—
2a:236+	back	cicada sp.	—
2a:240-244	back	mottled owl	—

Location	f/b	English name	Yucatec ID
2a:249	back	blue-crowned motmot	<i>toh</i>
2a:255-260	fore	collared forest-falcon	<i>koos</i>
2a:260+	?	[cicada sp. #2 ?]	<i>chipitin</i>
2a:264+	back	barred forest-falcon	<i>x-k'ipch'o'</i> (in error)
2a:273	back	cicada sp. #2	<i>chipitin</i>
2a:282+	fore	red-throated anttanager	<i>sohlin</i>
2a:285-296	fore	black-faced antthrush	<i>beeche' lu'um / tsimin uk'aax</i> [syn]
2a:301	fore	red-throated anttanager	<i>sohlin</i>
2a:305	back	thicket tinamou	<i>nom</i>
2a:313+	back	black-headed trogon	<i>mut [mut']</i>
2a:320	back	spot-breasted wren	—
2a:326	fore	violaceous trogon ?	—
2a:328	back	white-fronted parrot	—
2a:332	fore	tropical gnatcatcher or vireo sp. ?	<i>ts'it-kalan-ts'e'</i> or <i>x-tatak'-che' [tatak-che']</i> [in error]
2a:345	back	barred antshrike	—
2a:352+	fore	euphonia sp. or masked tityra ?	<i>chinchinbakal</i>
2a:357	fore	red-eyed vireo ?	—
2a:368	fore	trill ?	—
2a:369	fore	red-eyed vireo	—
2a:371	fore	white-bellied wren	<i>x-yankotil</i>
2a:375	back	smoky-brown woodpecker ?	<i>takay</i> [in error ?]
2a:376-386	fore	black-cowied oriole	<i>yuya</i>
2a:386+	back	violaceous trogon	<i>mut [mut']</i>
2a:392+	fore	green-backed sparrow	<i>chak tsitsi [chak ts'its'i]</i> [in error]
2b:029+	fore	long-billed gnatwren	—
2b:032	?	[black-faced antthrush ?]	<i>beeche' lu'um [beche' lu'um]</i>
2b:035	back	white-bellied wren	<i>x-yankotil</i>
2b:046+	back	black-faced antthrush	see 2b:032
2b:050	fore	pheasant cuckoo	<i>x-baken-chulu</i>
2b:062	?	[stimulus uncertain]	<i>x-takay</i> [large fly-catcher sp.]
2b:068	back	melodious blackbird	<i>ts'iw</i> , corrected to <i>pich'</i>

Location	f/b	English name	Yucatec ID
2b:071	back	[stimulus uncertain]	<i>hwiido [huiro]</i> [rose-throated becard ?]
2b:073	fore	black-headed trogon	<i>mut [mut']</i> or <i>uulun k'aax</i> [both correct]
2b:080-086	back	large dove or pigeon sp. ?	<i>tsutsuy [Leptotila dove]</i> or <i>x-chuki [chuukib]</i> [scaled pigeon]
2b:087	back	violaceous trogon ?	—
2b:087	back	domestic dog	<i>pek'</i>
2b:094-102	fore	Yucatan flycatcher	<i>x-takay</i> , not <i>x-k'ok'</i> [<i>x-kok</i>] [clay-colored robin]
2b:120	fore	spot-breasted wren	<i>x-yankotil</i>
2b:123	back	brown jay	<i>pa'ap</i>
2b:128	back	[stimulus uncertain]	like <i>beech' lu'um [bech' lu'um]</i> [black-faced ant-thrush]
2b:130	fore	keel-billed toucan	<i>panch'el</i>
2b:123-135	back	[stimulus uncertain]	<i>yuya</i> [oriole spp.]
2b:132	back	lineated woodpecker drumming	<i>kolon-te'</i>
2b:137	fore	long-billed gnatwren	—
2b:140+	fore	barred forest-falcon	NR
2b:152	fore	white-fronted parrot	<i>x-t'ut' [x-t'uut']</i>
2b:153	back	black-headed trogon	<i>uulum k'aax = mut [mut']</i>
2b:172	back	flycatcher sp. ?	<i>x-takay</i>
2b:182	fore	green-backed sparrow	<i>chak ts'its'i</i>

¹Recorded by Eugene Hunn in the *ejido* of Chunhuhub, Quintana Roo, Mexico, 17 April 1991, in high forest (*selva mediana subperrenifolia*). Yucatec Maya identifications by Sr. Felix Medina Tzuc of Chunhuhub. Hunn's initial Yucatec transcriptions are compared with canonical forms (based on Anderson 1991) following in brackets. "Location" cites master tape number and side and tape counter position. "Fore" and "back" (f/b) refer to sounds in the foreground or background of the tape. "NR" indicates explicit non-recognition. "—" indicates no explicit comment or recognition of that vocalization. See endnote 3 for scientific names.

AN EXAMPLE

In April 1991 I joined my colleagues Gene and Myra Anderson in Chunhuhub, a Yucatec Mayan community in Quintana Roo, Mexico, for a week of field work.

Gene and I are both avid birders, so we took walks at dawn in the forests and fields within a short radius of the town. We took these opportunities—at a season and time of day when birds are conspicuously vocal—to record a sample of their songs and calls. Gene eventually recorded 183 bird species within the boundaries of the *ejido* of Chunhuhub (Anderson 1991). Some few we heard but never saw. Most were positively identified by sight at the time or were already well known to one or both of us. Of course, ethnobiological research progresses far more rapidly when the field worker knows the subject matter well. The fact that we were able to identify confidently the great majority of the bird sounds on our tapes facilitated our questioning of consultants. Nevertheless, it is possible to use this technique even in ignorance of the identity of the birds recorded, just as one can record valuable ethnographic information concerning plant specimens of unknown identity, so long as the vouchers are subsequently identified by experts.

After the morning chorus had waned, we returned to Chunhuhub and solicited local people willing to spend an hour or two reviewing the tapes with us. We had field guides available and used both aural and visual cues as stimuli. Our local "experts" included a thirteen-year-old boy, a middle-aged woman, and an elderly subsistence farmer and hunter known for his knowledge of the local natural environment. All readily recognized the majority of the taped vocalizations, while the farmer, Sr. Felix Medina Tsuc proved to be expert indeed. He confidently named 20 species of the 32 species of birds we had been able to identify on one tape. He classified these 20 species into 18 Yucatec folk generic categories. He offered three additional Yucatec names which could not be positively equated to Western scientific taxa. He misidentified just three species (and we were uncertain as to the identities of two of these vocalizations). He did not comment on six vocalizations and appeared not to have noticed them.³ Sr. Medina Tsuc identified a pheasant cuckoo (*Dromococcyx phasianellus*) that we were never able to see. On hearing the taped call, he accurately described the bird's appearance, behavior, and habitat preference, then pointed it out in the field guide. This consultant also distinguished nomenclaturally two types of cicadas we had inadvertently recorded in the background as well as a species of cricket—the so-called "hammer cricket" for its sharply metallic call—that I had suspected of being a frog.

Not only did he accurately identify the great majority of the taped calls, but as we reviewed the tape he took the opportunity to expound on related birds which we had not encountered, providing us a detailed comparative inventory of owls, nightjars, parrots, doves, toucans, "blackbirds," and orioles. In many cases he described the size, plumage, habitat, behavior, and cultural significance of species noted. In all he offered 55 folk generic animal names and four binomial folk specific names in response to some 45 minutes of tape.

CRITERION NUMBER 4: DIAGNOSTIC CHARACTERS

We now come to the last of Bye's (1986:1) criteria, which is perhaps the most problematical when dealing with recorded sounds: the voucher must "have recognized diagnostic characters." In other words, experts must be able to

identify the source of the sound unambiguously, preferably to species, on the basis of the recording. Though virtually all birds have species-specific vocalizations, there may be some difficulty in associating those vocalizations accurately with species normally identified on the basis of morphological characters visible to museum taxonomists. A recent celebrated case is that of two nocturnal birds common in the Yucatan Peninsula, the Yucatan poorwill (*Nyctiphrynus yucatanicus*) and the Yucatan (aka tawny-collared) nightjar (*Caprimulgus [salvini] badius*). Their distinctive calls had been confounded in the published literature—each attributed to the other—until the error was discovered by a group of birders employing just the sort of sound recording equipment I used in this study (Piereson 1986). They took advantage of a further useful feature of sound recordings to correct this long-standing error. They played back the bird's call immediately with the result that the calling bird came into view, seeking to drive off the unwelcome competitor—in this case, its own recorded call. Immediate playback is useful to confirm the identities of secretive forest, marsh, or nocturnal birds. In any case, properly curated vouchers are available for reevaluation in light of future advances in knowledge about birds and their vocalizations.

It is now possible to locate expert birders familiar with the avifaunas of virtually any region of the globe. These experts may not be academic scientists but rather may have gained their experience as a hobbyist or by working as professional tour guides on natural history excursions. Researchers should endeavor to contact such individuals prior to initiating their fieldwork for advice on song identifications in their target area and to contact local experts able to confirm the fieldworker's preliminary identifications. Likewise, the number and biogeographical coverage available on commercial recordings of bird songs is growing apace. Such pre-recorded collections may be used by fieldworkers to learn local bird songs and to help identify sounds they themselves record or to fill in gaps in their own field collections. (See Boswall and Couzens 1982 and Boswall 1985 for summaries of available recordings.)

An additional advantage of audiotape recordings over traditional voucher specimens is the ease with which they may be copied and edited. This facilitates professional consultations, when such are required to establish voucher identifications positively. By contrast, ethnobotanists must collect multiple—and non-identical—copies of their plant vouchers in order to have copies for circulation to taxonomic specialists. Sound recordings may be replayed any number of times with different consultants under controlled conditions to assess intra-cultural variation in ethnobiological knowledge. Tapes may be edited for presentation in random or nonrandom orders. Such editing requires nothing more elaborate than a "boom box" with two heads, one for playback and one for recording, though it is helpful if one's equipment allows collating commentary between edited segments.

In sum, sound recordings, if properly documented, meet all the essential requirements of voucher specimens, are relatively simple and inexpensive to collect and curate, and provide as well a flexible research instrument for systematically eliciting cultural data from a representative sample of local consultants.

A TECHNICAL NOTE ON EQUIPMENT

For the recordings described in this paper I used a high quality portable cassette tape recorder (a Marantz PMD-221) and a Sennheiser ME-20 omnidirectional microphone head attached to a Sennheiser K3U power module. The microphone was mounted on a Sony PBR-330 13" parabola. (For discussions of technological options see Davis 1981 and Wickstrom 1988.)

NOTES

¹Barbara M. de Montes (1985) has critically reviewed this list, noting a few species that should not have been listed and 37 additional species that should have been included.

²Ornithology Laboratory, 159 Sapsucker Woods Road, Ithaca, New York 14850, (607) 254-2473.

³The species he identified are: thick-knee (*Crypturellus cinnamomeus*), collared forest-falcon (*Micrastur semitorquatus*), plain chachalaca (*Ortalis vetula*), large dove or pigeon sp. (*Columba speciosa* or *Leptotila* sp.), white-fronted parrot (*Amazona albifrons*), pheasant cuckoo (*Dromococcyx phasianellus*), mottled owl (*Ciccaba virgata*), black-headed trogon/violaceous trogon (*Trogon melanocephalus*/T. *violaceus*), blue-crowned motmot (*Momotus momota*), keel-billed toucan (*Ramphastos sulphuratus*), lineated woodpecker (*Dryocopus lineatus*), black-faced ant-thrush (*Formicarius analis*), Yucatan flycatcher (*Myiarchus yucatanensis*), brown jay (*Cyanocorax morio*), spot-breasted wren/white-bellied wren (*Thryothorus maculipictus*/Uropsila *leucogastra*), red-throated ant-tanager (*Habia fuscicauda*), Euphonia sp., melodious blackbird (*Dives dives*), black-cowled oriole (*Icterus dominicensis*). Species apparently misidentified include smoky-brown woodpecker (*Veniliornis fumigatus*) [I am uncertain if the sound he was responding to was produced by this species or some other in the background of the tape], tropical gnat-catcher (*Poliophtila plumbea*) or Vireo sp. [I am uncertain of the identity of the sounds to which he was responding], and green-backed sparrow (*Arremonops chloronotus*) [which he twice called by the term presumed to name the northern cardinal (*Cardinalis cardinalis*)]. He initially misidentified the calls of the barred forest-falcon (*Micrastur ruficollis*) as the squirrel cuckoo (*Piaya cayana*), but later changed his mind to declare the sound unfamiliar. In fact, it is possible that the barred forest-falcon is extremely rare in this part of the Yucatan Peninsula. Species for which no names were offered include a backgrounded barred antshrike (*Thamnophilus doliatus*), long-billed gnatwren (*Ramphocaenus melanurus*), and red-eyed vireo (*Vireo violaceus*). Vocalizations named in Yucatec but not identified scientifically include "like beech' lu'um" "like the black-faced antthrust"; *hwido* for what may have been calls of a rose-throated becard (*Pachyrhamphus aglaiae*), and *yuya* for what may have been a second species of oriole (*Icterus* sp.).

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BOOK REVIEW

The Origins of Agriculture and Settled Life. Richard S. MacNeish. Norman: University of Oklahoma Press, 1992. Pp. xix, 433. \$75.00. ISBN 0-8061-2364-8.

No one has dug more assiduously in more agricultural homelands than Richard MacNeish. Given MacNeish's experience, and his creative and original mind, it is not surprising that he has produced a benchmark work on agricultural origins.

This book is not a full review of the "origins of agriculture" literature, though MacNeish does provide a 38-page bibliography. Rather, the book represents the model of agricultural development that MacNeish has been developing while excavating early agricultural sequences in Peru, Mexico, and the American Southwest.

MacNeish is too experienced to rely on one or two factors. He stands at the opposite end of the spectrum from the simplistic "population pressure" model of Cohen (1977) or Rindos's reduction of domestication to a virtually accidental biological side-effect of plant exploitation (Rindos 1984). MacNeish integrates these ideas with many others.