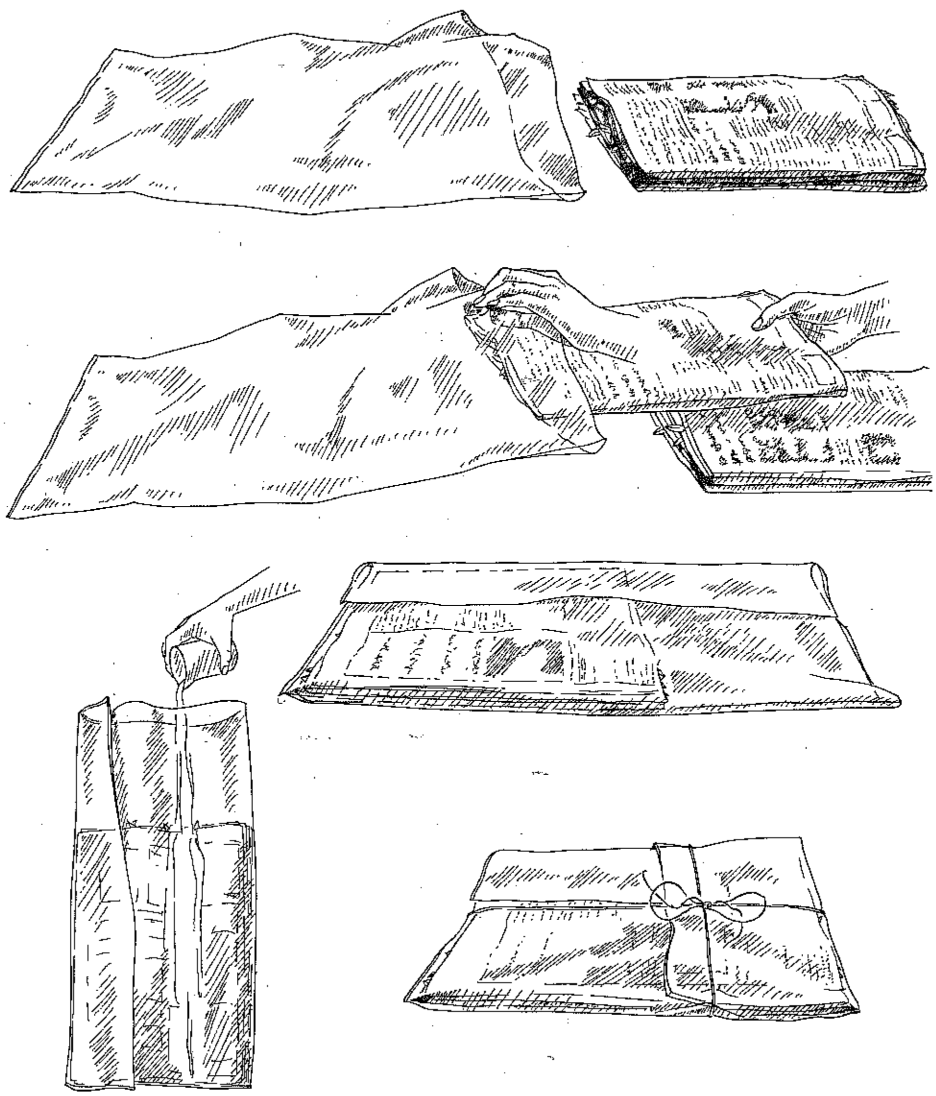

Figure 11.6. Partially pressed specimens can be preserved for later drying by sealing specimens and drying papers in a plastic bag after saturating the papers with methylated spirit or ethyl alcohol. These sealed bags of specimens can usually be kept for two or three months without deterioration. However, the specimens should be sent to a herbarium as soon as possible so that the drying process can be completed.

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11.6 WHAT YOU NEED FOR PLANT COLLECTING: PRE-FIELDWORK PLANNING

Botanical collecting in foreign countries, especially in remote areas, requires considerable pre-fieldwork planning to ensure that all the necessary collecting permits and other legal documents have been obtained, appropriate equipment is available, all the personnel have been fully briefed on the social and civil status of the area being visited, and the physical and health risks have been thoroughly assessed. Although some aspects of this planning may not be as necessary when undertaking field studies within the collector's own country, the following points should be considered carefully prior to undertaking any field studies. Cochrane et al. (2009) provide a 'collection checklist' that summarizes important issues to be considered when undertaking botanical collecting.

11.6.1 Plant collecting permit

Most countries are signatories to the International Convention on Biological Diversity (CBD 1993–). Therefore, it is advisable to be fully aware of the laws applicable to the area from which you wish to collect and to obtain the necessary approval and permits. You can usually obtain collecting permits from government departments that are responsible for environment management within the area to be visited. Contact the nearest major herbarium or museum (see Thiers 1997– for contact information) and seek their advice prior to making the collection. Remember, in many countries, separate permits are required for different States or Provinces as well as separate permits for different types of management areas (e.g. conservation parks, national parks, and nature reserves). Finally, remember to obtain permission from local landowners or custodians so that you can undertake field studies on their land.

11.6.1.1 Special permits

Phytosanitary permits will probably be needed when transporting plants across borders of different countries. These permits must be obtained from the country of origin.

The Convention on International Trade in Endangered Species (CITES) legislation regulates and controls the international trade in material obtained from plants considered to be endangered. Remember: scientific material is not exempt from CITES regulations. Therefore, CITES-listed plants require a *CITES export permit* from the country of origin as well as a *CITES import permit* from the authority (herbarium or museum) receiving the material. Since not all botanical authorities are registered as an agency approved to receive CITES material, it is important to verify that your collections are being sent to a herbarium or museum that is legally allowed to receive these specimens.

11.6.2 Pre-planning meeting: field hazard assessment

Possibly the most important aspect of field studies is the recognition, by all members of the field team, of the possible hazards that they are likely to encounter in the field. Careful planning and preparation can avoid many of the potential difficulties of working in remote areas. It is recommended that a 'Field Hazard Assessment' document be completed prior to any fieldwork. A copy of the completed document must be held by the principal organization involved with the work. This document should form the basis of a post-fieldwork evaluation of all aspects of the field study.

The topics and issues that should be covered by this document should include the names of participants, including Team Leader; description of project and area to be visited; dates when field team expected to be at specified localities; and insurance arrangements, especially for non-staff.

11.6.3 Emergency aids and contact schedule

Mobile/cell telephone numbers of all team members must be listed and held by all members of the team. However, since the work is in remote areas, a review of any expected areas of non-coverage is essential. If satellite telephones are to be used (and this is strongly recommended for remote areas), all members of the team need to be trained in their use. Likewise, if a two-way radio is to be used, then all members must be familiar with its operation.

Each member of the team must carry matches (in a water-proof container) or a fire lighting flint, a watch (for estimating time) and/or compass for estimating direction, a small reliable light (head-lamps are usually more convenient), survival blanket (especially recommended in alpine zones or high latitudes), and a whistle (for attracting attention).

11.6.3.1 Personal Locating Beacons (PLB) and Emergency Position-Indicating Radio Beacons (EPIRBS)

Emergency or radio beacons are tracking transmitters which aid in the detection and location of boats, aircraft, and people in distress. The basic purpose of the distress emergency beacon is to get people rescued within the first twenty-four hours following a traumatic event, when the majority of survivors can still be saved. Every botanical collecting trip, especially to remote areas, should carry an emergency beacon.

11.6.3.2 Contact arrangements

It is essential that a regular and frequent contact schedule is developed so that emergency rescue authorities can be informed of potential problems if the team fails to make contact at a designated time. The most important safety action is to ensure that people know where you are planning to be and where you actually are so that they can monitor the progress of the fieldwork. Therefore, make sure that there is a reliable contact person that the field team can contact regularly. The primary organization requires agreed emergency procedures and protocols that will be activated when there has been no contact with the field team after a set amount of time.

11.6.3.3 Global positioning systems and maps

A Global Positioning System (GPS) is an instrument that provides spatial coordinates and should be used in conjunction with good maps. A GPS is an excellent way of obtaining accurate coordinates for a locality, but they should not be viewed as a replacement for detailed maps. Always select the best map, at the best scale, for the area that you are visiting. In the event of an emergency, an accurate geocode reference of the team's locality will help rescue agencies to provide rapid assistance.

11.6.3.4 Vehicles to be used, vehicle recovery, and safety equipment

For motor vehicles it is important to list personnel with recovery training or substantive experience; assess physical strain risks for potential recovery tasks; list recovery equipment items being taken, such as gloves, snatch strap, tree strap, chain, shackles, spare tyres.

Other considerations include:

- Boat: record boat registration and ownership; review boat operator licences, radio skills, radio schedules, motor service status, navigational skills and equipment, safety gear, general equipment status—including mandatory certifications.
- Dive equipment and skill (review Divemaster and SCUBA certifications, equipment status—including mandatory certifications, and dive schedules with regard to personnel experience and capabilities.
- On foot: although most of the fieldwork requires considerable amount of time and often involves a considerable distance to be walked, frequently whilst carrying heavy equipment and supplies, there is a tendency not to consider the

risks and hazards associated with this aspect of the work. Review on-track and off-track work expected, with regard to personnel experience, capabilities, and navigational skills/equipment, tree- and rock-fall hazards, and likelihood of danger from animals and poisonous plants).

When working in developing countries and remote communities, the available vehicles (including boats) may not be of a standard that will provide the maximum safety. However, it is still important to ensure that the vehicle, the driver, and the recovery equipment are as good as possible. It is also an excellent opportunity to increase the awareness of general safety issues for within-country agencies if that is required. Well-maintained vehicles are more reliable. It is important to minimize the chances of serious breakdowns, especially in remote areas, as these can seriously impact on the safety of all participants.

11.6.3.5 *First aid training and kits*

Since botanical specimens are often gathered from relatively remote areas, it is important that all members of the field team have training in basic first aid techniques, and that each member always carry a first aid kit that they are familiar with. Knowledge of cardiopulmonary resuscitation and other basic remote area first aid is important. Contact an organization that presents first aid courses in your area for training and more information.

Although you may visit a remote area alone, it is never safe to do so. The field team should consist of a minimum of three people. The skills and limitations of each person should be known to all members of the team to ensure that the fieldwork can be done efficiently and safely.

11.6.3.6 *Medical conditions and personal capabilities*

Within the limits of privacy and with due regard for confidentiality, the field leader must be aware of any medical conditions or physical limitation of all members of the team that may affect the safety of fieldwork. The leader is responsible for providing advice to personnel should a member require medication during fieldwork. All team members must ensure that they have all of their required personal medications.

It is the leader's responsibility to make adjustments to schedules and tasks to ensure minimal stress on all personnel. Furthermore, the leader should consider the interpersonal dynamics of the team under field conditions and monitor the level of activities and rest periods accordingly.

Medical advice should be sought prior to obtaining antiseptic solutions and medicines for pain management, antihistamines, anti-emetic medicine for nausea, antispasmodic medicine for diarrhoea, and treatment for other medical conditions.

11.6.3.7 *Climatic hazards*

An assessment of the climatic conditions of the area being visited is important. The precautions for dealing with excessive heat, humidity, aridity, cold, and/or wet weather should include having water, protective clothing, sunscreen, amongst other aids. Drinking-quality water should be available, together with water-purifying tablets when relying on local water supplies of unsatisfactory quality.

11.6.4 Working with local communities

The above points have been provided to assist researchers to work in a safe environment, according to the various regulations. However, it is equally important to ensure a respectful, equitable, and mutually beneficial relationship with local community where the field studies are being undertaken. The following suggestions are offered:

1. Plan on a medium- to long-term relationship—although one-off visits are often all that is possible, longer-term collaborations are usually more beneficial to both the researcher and the community.
2. Learn the language—being fluent in a language that allows for communication between yourself and the community is extremely beneficial to essential. Plan ahead—start learning the language at least six months in advance.
3. Obtain at least one extra bilingual dictionary to share with your field research associates if the local language is not fluently spoken by team members.
4. Introduce yourself and your team—it is important to take the time to introduce yourself and your associate researchers to the community so that everyone has some understanding of who is involved with the research program. A introductory photographic album that includes topics of interest, such as photographs of your family, friends, home, garden, and workplace, can be useful.
5. Have copies of your research proposal in the local language—as well as organizing meetings with the local people to explain what you are intending to do while in their area, written proposals allow for people to consider your proposal further after the meeting.
6. Develop a bilingual cooperative agreement/Memorandum of Understanding between yourself and your national counterparts. As part of this process, explain the project at a meeting with local community members. Ensure that women are also informed, either at these meeting or at separate ones, if that is culturally preferable.
7. Purchase additional sets of national and/or local maps to share with the community.
8. Donations and gifts—discuss with the community their needs to ascertain whether or not you can assist. It may be possible to assist a community obtain

funding for a community-based activity. Present any donations in an informal ceremony to institutional representatives, along with an inventoried list of the donations which is signed by the recipients. Do not present donations to individuals. In developing communities, donations of medical supplies for local health clinics or educational supplies for local schools may be welcomed. However, be cautious about providing medical supplies that require greater skills to use than is available within the community.

9. Recruit local community members as field assistants—without discrimination on basis of gender, age, marital status, religion, profession, level of formal education, political affiliation, or sexual orientation.
10. Take photos of community members and distribute them as soon as possible.
11. Translate research results into the local language—make photocopies and distribute widely within the community, inviting comment, and deposit a set of the data with the community.
12. Joint publication with local field assistants: the individuals who provide field assistance and knowledge are rarely included as co-authors of scientific publications. It is always important to consider the significance of their contribution, and to determine if they should be joint authors—or at least fully acknowledged within publications.

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CHAPTER 12

ETHNOBIOLOGY

BASIC METHODS FOR DOCUMENTING BIOLOGICAL KNOWLEDGE REPRESENTED IN LANGUAGES

WILL McCLATCHEY

12.1 INTRODUCTION[1]

Ethnobiology methods are undergoing a certain degree of standardization following Martin's (2004) very influential ethnobotany methods book outlining many of the basic field techniques. Translation into Chinese, Spanish, Bahasa Malaysia, and French is evidence of acceptance of this book and its role as a basic tool for learning fundamental techniques. Among its many useful chapters is one on linguistic methods. The descriptions provided in this chapter are intended to build on Martin's procedures, but add recent trends that reflect recent important changes in ethnobiological research. I begin with a discussion of some of the sorts of research ethnobiologists are doing around the globe (which

1 Thanks to Bruce Hoffman for help with literature sourcing and Kim Bridges, Piet Lincoln, David Reedy, Nat Bletter, Al Chock, and Valerie McClatchey for reading drafts. Thank you to three anonymous reviewers for providing many detailed and helpful comments.

takes place everywhere from modern cities to remote rural forests). This is followed by discussion of some key aspects of the discipline, in order to set the stage for the presentation of five basic field methods that may be applied to collect integrated ethnobiological and linguistic data. The primary purposes of this chapter are to provide encouragement to field linguists considering working with biological materials, and to promote collaboration among scholars, particularly linguists and ethnobiologists.

Ethnobiology is the scientific study of dynamic relationships among peoples, biota, and environments (Salick et al. 2003). This discipline has departed from being descriptive and now attempts to use the full spectrum of scientific methodologies and tools to understand and explain cultural differences and similarities in the knowledge and use of biota and environments (Balée 1994). This methodological shift has taken the discipline well beyond its original inventorying activities (Fox 1953; Diamond 1966; Conklin 1967; Bulmer and Tyler 1968) into an era of the analysis of processes. For example, recent studies have focused on:

- acquisition, distribution, and control of biological knowledge (Berkes and Folke 2001; Zent 2001; 2005; Torre-cuadros and Ross 2003; Zent and López-Zent 2004);
- ongoing management of wild and domesticated natural resources (Posey and Balée 1989; Berkes 1999; Cunningham 2001; Anderson 2005; Ticktin et al. 2006);
- management and conservation of landscapes and biocultural diversity (Sillitoe 1998; Saemane 1999; Maffi 2005; Stepp et al. 2004; Shepard et al. 2004; Lampman 2007; Hoffman 2009); and
- indigenous responses to global climate change (Bridges and McClatchey 2009; Salick et al. 2007; Turner 2009).

In addition, much attention has been paid to intellectual property rights of traditional knowledge holders, and researcher ethics and responsibilities (see Laird 2002). Ethnobiologists are examining topics that cut across the biological and social science disciplines. These have been summarized as: 'knowledge systems [including cognitive research]; medicine, health, and nutrition; ecology, evolution, and systematics; landscapes and global trends; and biocomplexity' (Salick et al. 2003: [3]). Linguistics can benefit not only from recent developments in ethnobiological techniques, but also from the advances in scientific theory being generated in the above research. Obviously this has reciprocal importance: good linguistics research not only aids an ethnobiologist or local people, it may often be a critical contribution in developing scientific and cross-cultural understanding.

An area of past and future research cooperation between linguists and ethnobiologists is a focus on cognitive research. The next section outlines a general understanding of this area by ethnobiologists, and is presented here as a starting point for further discussion and research. This is followed by a section that focuses on basic methodological aspects of ethnobiological research, particularly as they relate to (and may be used by) linguistic researchers. Another view of this research area is seen in the analysis of thirty-four recently conducted ethnobiological studies by Reyes-García et al. (2007). They concluded that there is a 'lack of conceptual consistency and comparable data [that] limit the inferences that can be drawn from empirical analyses of ethnobotanical knowledge' (p. 182). They recommend: 'Future research should 1) validate the consistency of measures of individual ethnobotanical knowledge; 2) analyse the reliability of data generated by the different methods developed so far; and 3) address the relationship between the various dimensions of ethnobotanical knowledge' (p. 182) Their recommendations clearly point to our need to be better aware of methods used by other researchers, and to adopt these when possible in order to generate comparable data sets.

12.1.1 Cognitive research

One of the core areas of research within ethnobiology is the study of human cognition (alternative areas of emphasis include economic, social, legal, and nutritional aspects). While there are many interesting areas within this core, the study of folk or ethnobiological classifications is most germane to this chapter. Berlin (1992) has outlined the essential characteristics of ethnobiological classification systems that most ethnobiological researchers agree are universals. The heart of Berlin's classification consists of nine major 'principles' (Berlin, Breedlove, and Raven 1973) that are cross-cultural and for the most-part comparable (see Dwyer 2005 for an alternative perspective). These are:

1. Nomenclature: In all languages it is possible to isolate linguistically recognized groupings of organisms (taxa) of varying degrees of inclusiveness that have names.
   - Examples at different taxonomic levels are: *animal, bird, raptor, owl, barn owl.*
2. Taxa are further grouped into a small number of classes referred to as taxonomic ethnobiological categories similar in many respects to the taxonomic ranks of globalized science.
   - These categories number no more than six: *unique beginner, life form, intermediate, generic, specific,* and *varietal.*
3. The six ethnobiological categories are arranged hierarchically (as ranks) and taxa assigned to each rank are mutually exclusive.
   - Consider what example we might choose as the archetype for 'plants' or 'animals'? Although we can all identify these, there is not a 'unique' type that is *the* plant or *the* animal that is the 'unique beginner'.
4. Taxa of the same ethnobiological rank usually are at the same taxonomic level in any particular cultural (linguistic) taxonomy.
5. In any system of ethnobotanical or ethnozoological classification, the taxon that occurs as a member of the rank 'unique beginner' (*plant* or *animal*) is not (normally) named with a single, habitual label. This means that people speaking

a particular language often recognize inclusive ranks such as *animals* and can sort a group of things into the that rank, but won't necessarily have a name for the grouping that they have made.

6. There are usually but a handful of taxa that occur as members of the category 'life form', ranging from five to ten, and they include the majority of all named taxa of lesser rank.
   - These life-form taxa are named by linguistic expressions that are lexically analysed as primary lexemes, e.g. *bush, liana, palm, reptile, fern,* and *bird.*
7. The number of generic taxa ranges around 500 in typical folk taxonomies, and most are usually included in one of the life-form taxa.
   - A number of generic taxa may be aberrant, however, and are conceptually seen as unaffiliated (i.e. are not included in any of the life forms). Aberrance may be due to morphological uniqueness and/or economic importance. Examples vary widely between cultures: baobab trees and camels are morphologically unique for many cultures in tropical Africa, while grasses/grain and cattle raised for food are economically important in many Eurasian cultures. Each of these may be generic taxa that are unaffiliated with other generic taxa because of their outstanding or unusual roles in society.
   - Generic taxa are the basic building blocks of any folk taxonomy, are the most salient psychologically, and are likely to be among the first taxa learned by the child, e.g. *dog, taro, oak, banana, ant, clay.*
8. Specific and varietal taxa are less numerous than generic taxa, and occur in small contrast sets typically of two to three members. Varietal taxa are rare in most folk biological taxonomies.
   - Both specific and varietal forms are distinguished from one another in terms of a few, often verbalized characters.
   - Taxa of the specific and varietal rank are commonly labelled by secondary (vs. primary) lexemes, e.g. *three-needle pine, Mexican evening primrose, blue heron.*
9. Intermediate taxa occur as implied members of the category 'intermediate' and usually include taxa of generic rank that have residual characteristics. Residual characteristics are unusual features that distinguish either a monotypic taxon (a weird/unusual sort of thing) or a group that is placed together because of a single (unusual) characteristic. These are not often named but are implied in cultural conversations. However, some can be mentioned.
   - Examples that are named: *spiders, root crops,* and *pigeons.*

The nine principles above are slightly enhanced from the Berlin et al. (1973) outline. For more clarity, see the longer explanation in Martin (2004).

Ralph Bulmer (1974) independently verified and proposed very similar concepts, although Berlin's (1992) theoretical structure is cited by most ethnobiologists. Holman (2005) has verified the generalized, cross-cultural ethnobiological

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hierarchical folk classification systems for plants and animals showing evidence that they are different from other domains. Holman (2005: 71) states that 'cross-cultural regularities suggest that taxonomic judgements are not entirely determined by culture'.

There is a key assumption implicit in the above that we will accept for the purposes of the balance of this chapter: that cultures are similar enough to be comparable, and that naming and classification systems have not primarily emerged as individual or culture-specific practices but are rather part of generalized human traits. Furthermore, from a biological perspective, we will accept the assumption that taxonomic diversity in the world is discontinuous in its spectrum of characteristic distributions, and that humans are able to recognize discontinuities (see also Turk et al., Chapter 16 below). The result is that humans group like things together in categories as described above using the discontinuities as indicators of domain circumscription. If these assumptions are correct (and some argue that they are not: see Ellen 1996; 2003a; 2003b; 2006; 2007), then comparisons may be made by information learned between individuals and/or groups of people at differing scales (e.g. families, communities, 'cultures', 'languages'). Further, the results then inform us about variations in the human condition and human responses to differing cultural, psychological, physical, and biological environments.

Note that this type of research emphasizes comparisons. Although it is possible to use a non-comparativist approach to research, even non-comparativists must be aware that the results of their work, once published, will be used by comparativists. The danger is that if the research is not framed within a standardized structure, the research will be forced into one, and likely misrepresented. With that in mind, it is probably best to conduct research assuming that the data will be used for comparisons even if that is not the immediate intention.

Modern research in the sister biological discipline of systematics (the study of diversification and relationships of life on earth) provides a clear lesson that relates to the long-term value of these sorts of studies. Systematists are returning to stored biological specimens in herbaria and museums to verify species identities with genetic, anatomical, chemical, and other physical analyses. Studies which generate lists of names/terms must be supported by the deposition of appropriate physical evidence in a secure storage facility. This physical evidence is now a requirement of publication within ethnobiological journals (e.g. Verpoorte 2009). Therefore, modern ethnobiological research increasingly relies upon an evidence-based system that blends quantitative and qualitative data collection (Cook and Prendergast 1995; Alexiades 1996) and analysis in the testing of one or more hypotheses about dynamic relationships between peoples, biota, and environments.

12.1.2 Evidence-based research

Ethnobiological studies, including research on languages, requires evidence. This evidence may be primary/physical, secondary/documentary, or tertiary/observational. While all three of these are important, the first is the most critical. Unfortunately, primary/physical evidence is most often neglected by non-biologists who are doing ethnobiologically-related, ethnographic research.

Primary or physical evidence of language is a sample of the things that people are talking about such as specific birds, plants, insects, rocks, soil, water, or diseases (when samples are collected). These samples are typically stored as catalogued, labelled vouchers in a museum, archive, or other repository designed to maintain them for long periods of time. These facilities also provide appropriate access to scholars and the public so that research results may be verified by others once work has been published.

It is completely understandable that many scholars feel overwhelmed when faced with the need to collect physical samples of evidence from a wide spectrum of things. However, without such evidence, the results of the research are merely hearsay (Bye 1986). Modern science requires verifiability, and this means that other researchers must have a way to check the results by examination of the samples returned from the field site (see Conn, Chapter 11 above, on the collection of samples). In addition, the Biodiversity Assessment of Tropical Island Ecosystems manual (Mueller-Dombois, Bridges, and Daehler 2008) is available in print or for free on-line and includes detailed instructions for non-biologists on how and why to collect a wide range of biological samples. An excellent resource for collection of plants is Womersley (1976), which was specifically prepared for anthropologists and geographers.

Secondary or documentary evidence of language includes photographs and video and audio recordings. These are critical tools for modern ethnobiological researchers, but in most cases they are insufficient for the positive scientific or cultural identification of the items that people are talking about. This is because they cannot record the genetic or other biochemical, morphological, anatomical, viscosity, or the many other physical characteristics that cultural and scientific experts need to assess in order to identify and distinguish samples. However, documentary evidence supplements primary evidence, as it often provides important information about a sample that is lost because of changes that occur due to sampling, decay, or removal from the natural environment.

Tertiary data or observations about a sample are important for establishing the context in which the sample normally resides. The best observations include a combination of etic[2] and emic perspectives and multiple scales from the most immediate/local to the landscape in which the sample resides. For example, a

[2] See the introduction to Dousset, Ch. 9 above, for a definition of 'etic' and 'emic'.

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collected lizard sample would include observations that note where the lizard was found, such as on a particular named sort of rock outcropping (also sampled), that the collector (scientist or local expert) has said that local experts report that this type of lizard is known to frequent particular forest patches (indicator species sampled), that this type of forest patch is found across a named vegetation zone (indicator species sampled), and that the name of the lizard carries a meaning associated with its use as a food to be consumed in a particular place and time (timing determined within local reckoning). Important types of observational data that have long been recorded by biologists and ethnobiologists that need the help of linguists are the vernacular names and their associations (including metaphorical allusions) and other cultural data recorded on specimen labels associated with primary evidence. Far too many scientists rely too much on the primary evidence to speak for itself, and miss the opportunity to provide critical observations, particularly from emic perspectives.

12.1.3 Comparative ethnobiology

While ethnobiologists consider it desirable to produce data sets that can eventually be comparable in multi-site analyses (Reyes-García et al. 2005), some researchers have conducted comparisons within their data collection and analysis efforts. For example, Nguyen (2006) studied food plant assemblages used by Vietnamese in Vietnam and Hawaii, analysing patterns of evolutionary change in plant constituents as people migrated to new environments. Furthermore, she discussed interconnected roles of botanical and linguistic evidence in understanding human interactions with complex environments (e.g. natural and artificial ecosystems, and other multi-species interactive systems).

12.1.4 Ethnobiology ethics and legal issues

The collection of ethnobiological data, whether it is primary, secondary, or tertiary, has increasingly become the focus of ethical and legal discussions (Laird 2002; see also Rice and Newman, Chapters 18 and 19 below). The most extreme concerns have been fear of bio-piracy, commercialization of traditional knowledge, or the misuse/mismanagement of information that is shared with researchers. Ethical and legal matters are tightly intertwined.

The International Society of Ethnobiology Code of Ethics (2006) is used as a minimal 'framework for decision-making and conduct of ethnobiological research and related activities. The goals are to facilitate ethical conduct and equitable relationships, and foster a commitment to meaningful collaboration and reciprocal responsibility by all parties.' Anyone planning to engage in ethnobiological research should first take the time to read and understand this document (it is published in a number of languages). Among the many concepts of the code of ethics is that of working with people in communities rather than treating them as the subjects of research. Therefore, ethnobiologists, like many linguists, often work and publish with community participants in collaborations, and do not think of or refer to anyone as informants.

12.2 Data collection

Ethnobiological research design (Alexiades 1996; Höft, Barik, and Lykke 1999; Martin 2004) typically follows a hypothesis-driven scientific method of evaluation. Five common methods (see below) used by ethnobiologists for the documentation of traditional biological knowledge are likely to be of use in basic linguistic field research settings. These are used to obtain information that is associated with physical evidence. A critical aspect of these methods is that none of them requires that the researcher have more than passing knowledge about the organisms being examined (i.e. they need not be a biologist, although there is a caveat in the final paragraph of this chapter). In each case the actual organisms are the focal point and also serve as the evidence at the conclusion of the study. Local participants and their specifically local perspectives and knowledge are critical to understanding these organisms. These methods are commonly conducted as ethnographic interview surveys either within the environment (*in situ*) using biological materials or using fresh, or preserved biological materials away from the environment (*ex situ*) (Thomas et al. 2007).

12.2.1 Free-listing

A common initial approach when working with a participant is to inquire about a category of information (e.g. animals: Nolan et al. 2006; desert plants: Khasbagan and Soyolt 2008; edible mushrooms: Garibay-Orijel et al. 2007; one tree genus: McClatchey et al. 2006; wild foods: Ali-Shtayeh et al. 2008). The result is a list of details, usually names and descriptions. Free-listing may be embedded within a survey that is highly structured (Brosi et al. 2007). Although this may appear to be simple, there are many possible errors to be made in asking poorly considered questions (see Alexiades 1996; McClatchey et al. 2008) that can easily produce useless or misleading results. While it may be desirable when building a dictionary, vocabulary list, etc. to learn 'everything', people seem to sort information into

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a. Decide upon a set of initial categorical 'free-list' questions, keeping them as simple as possible. These should be broad and simple but not leading questions. (Leading questions provide information that might be desired in possible answers.) The questions should be specific for the desired information and not waste the participant's time with other issues. Appropriate examples are: 'Please list the names of any fish that you catch in lakes but not in streams.' 'Please name as many kinds of fruit (you eat/people eat/animals eat) as you can think of.' 'When you were a child and went to the zoo, what sorts of animals did you see there?' 'What kinds of ingredients does your family use in treatments for coughs and colds?'
b. Each participant (or group of participants) is asked to list his or her answers to one question and their responses are recorded. For some kinds of research the order of the responses is important since what is recalled earlier may be of more importance than what is remembered later. If multiple questions are being asked, it is important that each participant or group be asked the same questions in the same order without other information being provided that would make comparison between participants difficult (in contrast to a free-flow text method, where participants can lead the discussion).
c. After a participant (or group) has finished with the questions, the researcher needs to ask the participant to help to locate and collect evidential examples of each of the responses that were provided. (Note that there is a natural tendency to skip this step if terms have already been identified in the past and recorded in a word list or dictionary. However, it is exceedingly rare that these are supported by physical evidence, it is not unusual for these to be scientifically incorrect, and it is fairly common for names of organisms to refer to more than one scientific taxon and the researcher needs to know which one this participant is talking about. Therefore, collection of physical samples is required to overcome assumptions.)

Since this process is time-consuming, it may require one or more additional interview sessions and take much longer than the free-listing exercise itself. An alternative approach is to complete a set of free-listing exercises with different individuals or groups, compile the composite results, and then, working with a few of the participants, collect the evidence samples. Although this would seem to be more time-efficient, it will still be necessary to take these samples to each of the participants for them to verify their answers; and since some time will have passed, and they were not involved in the collection of the samples, they may not be able to confirm or deny if the samples are representatives of their responses. This presumes that there is little synonymy or taxonomic overlap between individuals/groups, which is the most conservative option. It provides independent confirmation of terms when they are the same across the responses of the sample group, as well as evidence of differences when there is a spectrum of differences within a community of knowledge holders. The choice of using either individual or composite collections largely depends on the ease with which participants are likely to be able to identify the samples that are collected.

12.2.2 Inventory interview

A physical collection of one or more categories of organisms/environmental samples—for instance bees (Mendes dos Santos and Antonini 2008), birds (Boster 1987), crustaceans (Ferreira et al. 2009), fish (Johannes 1981), fungi (Lampman 2007), algae (Ostraff 2006), trees (Jernigan (2006)—is first compiled from a location where the researcher is working. This is then numbered and used as a standardized set of visual (and sometimes olfactory etc.) stimuli for eliciting responses from multiple individuals or groups of participants. Photographs are sometimes used (see Diamond 1991; Nguyen 2003), but there are so many drawbacks that their use is strongly discouraged, particularly because voucher specimens of actual materials will need to be collected as evidence eventually. Cases where photos are actually justified are when organisms are rare, endangered, extinct, or locally unavailable. Photos should not be used as a means to avoid work.

a. A participant (or group of participants) is shown specimens in a specific sequence and asked a set of questions about each one. The questions could be similar to those used in a free list but are often more specific to the details of the specimen being shown. For example, while being shown a specific soil sample (#1) a participant could be asked, 'Does this look familiar? If so, does it have a name? If so, where is this particular substance usually seen? Is it considered useful? If so, what would those uses happen to be?' After recording the responses to the questions, the participant would be shown the next sample (#2) and asked the same questions. Phillips and Gentry (1993a; 1993b) recommend that the minimum data required for inventory interviews are: 'Do you know this . . . ?', 'Do you know a name for this . . . (and if so, what is it?)', and 'Do you use this . . . (and if so, how do you use it)?'
b. The process is repeated with multiple participants (or groups) to produce comparable data sets.
c. With each repetition, additional activities may be conducted using the specimens. For example, specimens may be used in pile sorting exercises to identify Berlin's (1992) hierarchical classifications (Lampman 2007; Mekbib 2007) and, in group or individual follow-up discussions, to determine cryptic classifications (Souza and Begossi 2007). Sorting systems often represent ways in which information is perceived about the world. One way to see more clearly how this

information is perceived is to go beyond the classification by mapping indigenous world views (Davidson-Hunt et al. 2005).

12.2.3 Environmental transect

This has sometimes been called a 'walk in the woods' (Phillips and Gentry 1993a). It can be a formal survey of a specific area involving repeated examination of a specific set of organisms in their natural habitat by a group of participants in order to learn their responses to specific questions (e.g. What are these things called?, Do they have uses, and if so, what?, Are there things that are usually seen here that are not here now?, What is this environment called?) There are two variations on this—formal and informal; often these variations are combined. A formal transect is a specific pathway that is set out (see below) along which repeated participants may be taken to collect different perspectives on the same set of environmental stimuli. Informally, a participant may, for example, lead a researcher on a hike through the forest, a walk through their garden, market, or grocery store, or snorkeling through a reef pointing out specific biological resources and their names and uses. For informal transects to be systematically useful and reproducible they may need to be circumscribed as area inventories (see §12.4 below).

a. Working with one or more community participants, select a location that meets the needs of the project. A suitable site should have the ecological or taxonomic diversity that is needed to ask the questions that are planned, or it could be a trail/path through a location that needs to be better understood. For example, in order to learn about mangrove swamp organisms a boardwalk built for tourists might be selected because it allows easy, regular access for elderly participants to be able to follow along the same path and see the same locations along the way. As another example, a nylon rope could be tied between two poles fixed at points in a reef and the reef along the rope used as the transect that is to be followed and discussed.
b. Questions are formulated about organisms, ecosystems, contexts, and other features that are encountered along the transect. Questions are associated with specific points along the transect, although sometimes general questions about frequently encountered taxa may be asked at any point along the path.
c. Individual (or groups of) participants are led from a starting point on the transect to the finish point and asked questions at a set of points along the way. This process is repeated with each participant, recording his or her responses.
d. Samples of the taxa being discussed need to be collected, usually after the last interview, since the objective is to collect the sample of the same individual that was being observed throughout the process. However, for taxa that are large, such as trees, or numerous, such as some insects, it is possible to collect samples in advance.

12.2.4 Area inventory

One or more discrete areas—home gardens (Vogl-Lukasser and Vogl 2004), or markets (Nguyen, Wieting, and Doherty 2008), political regions (Pardo-de-Santayana et al. 2007)—or samples of an area—forests (Castaneda and Stepp 2007), or mangrove swamps (Steele 2006)—are inventoried for either a specific category (insects, plants, soil types, ecosystems) or for all categories of knowledge possessed by the participant community managing or interacting with the area. Area inventories are done as rapid assessments (Gavin and Anderson 2005) or as more thorough longer-term analyses (Etkin 1993; Reyes-García et al. 2005).

a. A location is selected, either randomly from within an area type or one that is typical of a particular area type. This is done with someone from the participant community who knows the area categories well. For example, if the objective is to conduct inventories of Puerto Rican markets in New York City, then a Puerto Rican community resident expert in New York City would help to identify a selection of markets that are frequented by members of the Puerto Rican community. A sample of these markets could then be selected at random.
b. The locations are then scouted out and the area boundaries demarcated if they are not already naturally or artificially discrete. Questions are formulated for the area much as they are for an environmental transect, except that the questions may not always be asked in the same order nor at the same location.
c. Participants (individually or in groups) are taken through the area and asked specific questions about the resources within it. It is not unusual for only a small number of participants to be exposed to a single location or (for example) for the location to be explained only by the location owner or manager.
d. Specimens are collected based upon the results of the questions asked. Usually this is done at the time of the interview with the participant directing the process so that the correct samples are collected.
e. At the conclusion the participants are shown the specimens and asked to verify the information associated with them.

12.2.5 Artefact interview

One or more cultural artefacts (e.g. tools, art, clothing, houses) are used as the focus of questions posed to participants usually to learn about such things as the components, history, uses, meanings (Banack 1991; and Lemonnier, Chapter 13 below). Since it is easy for participants to focus on the details of a specific artefact and fail to discuss the general category of the artefact, it is a good idea to have a spectrum of different examples of the same sort of thing present. If a disease complex can be considered as a cultural artefact (albeit an interpreted mental construct rather than a physical articulation), then artefact interviews would also

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include some kinds of disease-culture-centred research (of disease and its interpretations) that leads to the material basis of remedies (e.g. Balick et al. 2000).

a. For the purposes of an ethnobiological study, questions developed for an interview usually include focus on the material basis of the artefact. The questions should not lead but should rather be simple, such as 'What are the parts of this made from?' Many artefacts are composed of more than one part that is functional in and of itself. As such, these sub-artefacts should be recognized as separate components with their own questions. Some researchers may wish to ask about materials that are used in the production of an artefact but are not physically present in the final product. For example, a tool handle may be sanded with shark-skin during its production but the skin is not present in the final product. An appropriate question could be formulated to elicit this sort of information if desired.
b. At the time of the interview, the participant (or participants) are presented with the artefact(s) and asked the questions in a particular order. The responses are recorded.
c. Following the questions, any materials identified by the participants need to be located and specimens prepared of them. If this process is done with the same participants, they will have identified the materials; if not, the participants need to be shown the specimens in order to verify that what has been collected is the same as they had mentioned in the interview.
d. A special form of artefact interview is a production or reproduction interview wherein a participant or group of participants produces an artefact with the researcher either assisting as a participant in the process or as an observer (see e.g. Cox 1982; Nickum 2008; Rickard and Cox 1984).

12.2.6 Biological evidence

Naturalistic scientists (Atran 1990; 1998) collect almost any sort of evidence. Although it is best to plan for a project by practising how to collect and preserve plants, insects, mushrooms, fish, birds, and soil samples, it is also important to be creative and collect samples when they are realistically available and not be overly concerned about having a perfect sample. At the end of the day, an imperfect sample is better than no sample at all. Common sense should be a good judge about how to collect many samples and what should be collected. For example, preservation in alcohol or drying is often better than storage in water or at environmental temperature because most organisms will decay in the natural environment if left alone. Therefore, by creating an unnatural environment they may be preserved in some fashion. It is not unusual for people within a community to have methods for preserving materials, such as taxidermy, and these should be used when available.

When collecting samples, it is very valuable to collect them in at least triplicate if at all possible; one set for local national deposit, one set for distribution to different international experts for identification, and one set for deposit in another location, either at a different national location or internationally. Sample sets need to all be cross-numbered and labelled the same, so that data determined in one can be shared with the others. The primary set that is deposited locally is evidence that may be accessed by local collaborators and will eventually be the most useful and likely most accessed, so this should be the best set. The set that is distributed to experts will be broken up into separate units with specific items sent to specific experts who are identified as having particular expertise and being likely to identify a particular sample. For example, a beetle expert might be sent all of the beetles, while a humming bird expert might be sent the humming birds for identification. The experts will not send the samples back but will send back identifications and will incorporate the samples into larger international collections. The third collection is basically an insurance policy. Fires, wars, and other things can happen that can result in the loss of, or damage to, a repository. By being placed in a completely different location, the third collection represents a different set that can be used to replace the first if it should become lost or damaged in future.

12.3 Data analysis

Each of the methods described is incomplete without leading to an analytical method. The hypothesis, data collection method, and data analysis method all combine to make a complete chain of logic. Results may often be analysed for frequency of mentioned items (Bernard 2002), list length (Brewer 1995), or salience (Smith 1993). Hoffman and Gallaher (2007) have reviewed a range of methods developed for analysing the importance placed on uses of plants and vegetation by people who use them. The same methods should apply to almost any things studied that people interact with from the environment.

12.3.1 Biodiversity

Collection of biodiversity information using participants from local communities and relying on their local expertise rather than on one's external university training is sometimes called 'parataxonomy'. Parataxonomy is being used increasingly to survey areas and to learn about the ethno-species or morpho-species diversity recognized within an area (Pfeiffer and Uril 2003; Janzen 2004; Sillitoe 2007) and to estimate local biological species richness (Oliver and Beattie 1993; Basset et al. 2000; Basset et al. 2004; Jinxiu et al. 2004).

For those who are not biologists, some important points need to be made about the relationships between common/vernacular names (in any language) and scientific names. Scientific names are not magical or more factually correct; they are often derived from common names at one point in the past and now serve as a unifying language around the world for comparative discussions in science. All of these names (scientific or common) circumscribe identifiable units or taxa that people can recognize. When comparing the taxa recognized by one group of people with those recognized by another group they may (a) have about the same circumscription (have the same constituents) or (b) include one considered to be grouping several taxa of the other into a single taxon (a 'lumper'), and thus the other is considered relatively to be dividing one taxon of the first into multiple taxa (a 'splitter'). These divisions are analytically relative to each other and are not based upon a standard other than one's point of reference. This is true not only of folk knowledge but also of scientific species concepts.

12.3.2 Gloss assumptions

Muller and Almedom (2008) have noted the dangers of gloss terms describing traditional foods, and how these may easily come to depict aspects of culture in unrealistic terms. They focused their analysis on the concept of 'famine foods', but a similar examination of almost any rapid interpretation applied by a researcher to describe a complex cultural phenomenon of human interaction with one or more biological organisms or environments will have similar pitfalls. There is not an easy recommendation for dealing with this problem other than to suggest that it is best to gather as much data as possible, with primary data being the best and to apply as much local expertise as possible within the interpretation of results to minimize misrepresentations.

Probably the best advice for those who are non-experts on a subject is to be as clearly descriptive as possible, including both etic and emic observations (see Diamond 1991) and minimal interpretations. For example, if a disease with a certain traditional name appears to be 'breast cancer' but the researcher documenting the term and gloss is not a physician seeing a patient and collecting a specimen to verify this, then it is best *not* to give this as the name, but merely to describe the traditional symptoms of the illness and say nothing about the assumption of breast cancer. The very important reason for not making the assumption is that placing information such as this within a dictionary could lead later to misdiagnoses based upon information that may or may not be true. The same is true for less critical cases, such as naming of birds, plants, soil types, and ecosystems.

A clear description, when joined with physical evidence, can be deciphered by a subsequent expert collaborating scholar, while a bad assumption may not be retracted.

12.4 Discussion

Each of the five methods for the collection of information described here may be used alone or in combination, and each has certain advantages and disadvantages. Free-listing is the most simple and common method, but it is problematic in that it is dependent upon human memories and subsequent ability to find samples of what was being discussed/remembered at an earlier time. However, free-listing can be the most creative because it is not constrained by the physical reality around people and therefore they are able to include examples of taxa that are now extinct, rare, out of season, or otherwise not present but still part of their cultural memory. It is not uncommon for free-listing exercises to result in some data points that lack supporting physical evidence; these problematic data must be either set aside as irreproducible or discussed as suspect. An artefact interview is merely a particular sort of free-listing exercise with a tangible object for the participants to focus their thoughts on. As such, it has similar strengths and weaknesses to be considered.

Inventory interviews, on the other hand, have a high level of reproducibility because the specimens are prepared a priori and therefore none are lacking at the completion of the data collection process. In addition, comparisons between interviews are unambiguous because there is little doubt that the participants were exposed to exactly the same physical stimuli to formulate their response. However, inventory interviews include displays of taxa outside their normal environments and often dried or preserved in ways that make them look less like they do in the natural environment. On the other hand, environmental transects allow for participants to observe taxa within their natural settings or within settings where they are normally encountered by people, and so they may be able to elicit a higher response level than results from an inventory interview. The problem with the environmental transect is that environments do change over time: some organisms move, die, or are damaged by weather. What is seen by one participant may not be the same as what is seen by subsequent participants over a series of days, weeks, or longer. Also, when specimens are collected at the end, they may not be present as they were at times during the interview period. An area interview is a much more formal and larger version of an environmental transect, and suffers from the same strengths and weaknesses, but magnified. However, since there are

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Ethnobiological research in many parts of the world has much to offer linguists in the identification of the vocabularies used by people to describe the world around them. Making these descriptions clear does not have to be difficult and, when done in collaboration with experts from other disciplines, should help linguists to feel more confident about the products of their work. As a concluding thought, consider a story (also mentioned by Evans, Chapter 8 above) told about an experience that Ralph Bulmer had with the Kalam in New Guinea (Diamond 1991: 85).

Bulmer, after years of working with the Kalam recording abundant information on plants and animals, recruited a geologist to come with him into the field. The Kalam opened up to the geologist and provided terminology and observations that Bulmer had expected but found difficult to elicit. When he expressed his disappointment that the Kalam had not had these conversations with him, they explained that when he asked about fauna and flora they realized he knew these topics well and was easy to educate. But they found his questions about rocks revealed that he had so little background knowledge that they foresaw a long and difficult process, which they pragmatically sidestepped by denying their geological lore, revealing a minimum of geology words. Had Bulmer selected a different interview technique, perhaps first making a collection of many different sorts of geological samples and then using an inventory interview, he might have had a different experience. But, in this example, the solution to Bulmer's research problem came about through a successful collaboration with an expert in another discipline. The ethnobiologists and other scientists are waiting for the linguists to call.