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Collection and Preparation Techniques of Bryophyte Specimens in Biodiversity Inventories

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Biodiversity inventory is a critical step in determining the distribution, abundance, rarity, and conservation priorities of species and their essential habitats. Techniques on inventory sampling and procedures for obtaining and processing high-quality bryophyte museum specimens were implemented during the 2011 Philippines biodiversity expedition. Bryophytes in the Philippines comprise an extremely species-rich group of land plants and are a key component of ecosystem function in both tropical lowland and montane forest systems. Inventory and specimen acquisition of bryophytes are urgently needed in addition to training of field-oriented biologists in this taxonomic group.

KEYWORDS: biodiversity inventory, bryophytes, herbarium specimen acquisition, record-keeping, sampling techniques

With the current focus on molecular systematics, one would assume that basic natural history inventories have been completed, that all species have been discovered, named, and conservation actions are in place to conserve this biodiversity. Many countries, however, have only basic inventories of their biota (such as checklists or literature reviews), and where inventories do exist, they are considerably less refined below taxonomic groups containing 'fur, feathers, or flowers'. The ongoing interest from governments and conservation organizations continues to focus on biodiversity issues involving human interaction with the natural world and how climate change may impact a nation's biodiversity. For its size, the Philippine archipelago is among the most species-rich areas for bryophytes in Southeast Asia with over 1200 species reported (Tan and Engel 1986; Tan and Iwatsuki 1991; Tan et al. 2000). In this paper, we focus primarily on our experiences in collecting bryophytes (mosses, liverworts, and hornworts) as part of a renewed bio-inventory program in the Philippines. Although the examples used will be based on the effective practices and appropriate procedures needed for the collection of bryological specimens, most of the techniques and field procedures described herein can be easily adapted to other taxonomic groups.

WHAT IS A BRYOPHYTE?

Bryophytes are considered the first land plants and include three distinct lineages: mosses, liverworts, and hornworts. Collectively they are estimated at 20,000 species worldwide (Crandall-Stotler et al. 2009; Frey 2009; Goffinet et al. 2009). They differ from the flowering plants primarily by lacking roots, flowers, seeds, and a defined system of internal tissues known as the vascular system (xylem and phloem) for transporting fluids throughout the plant. In most bryophytes, the leaves are only one cell thick. Bryophytes reproduce not by seeds but by single-celled spores. Many bryophytes can also form new plants by vegetative means (tubers, gemmae, leaf fragments). Bryophytes have two adaptations that make them fairly unique: they are capable of dealing with

extended periods of desiccation by shutting down all cellular activity and the ability to rapidly come back to life when water again becomes available. Because bryophytes have no roots they are not confined to living on soil and therefore they can grow on rocks, tree trunks, rotten wood, and even colonize leaf surfaces. Bryophytes are frequently used as biological indicators of environmental health because pollutants in water are absorbed directly through the outer cell wall when hydrated (Govindapyari et al. 2010).

The role of voucher specimens in conservation biology

Museum specimens are a valuable source of information obtained from conducting inventory efforts and form the foundation for checklists, monographs, and floristic treatments (Bartram 1939; Del Rosario 1967; Linis 2010; Linis and Tan 2008, 2010; Tan 1992; Tan and Iwatsuki 1991). Specimens provide a historical framework and provide insights into species distribution and habitats. Voucher specimens are used to document the following: where species occur, where populations have expanded, or reduced, species now extirpated, and species inadvertently introduced due to habitats being altered or converted by human activities. Properly prepared and identified specimens are also essential for ongoing and future molecular studies so that researchers can examine source materials. In our view, all inventories and checklists should be based on an examination of existing specimens located in museums and herbaria and, where applicable, the acquisition of additional specimens that are properly labeled and curated so they are readily accessible to the scientific community. It is through the ongoing efforts of specimen acquisition that new range distributions are documented, species new to floristic regions are reported, and species new to science are discovered (Linis and Tan 2010; Tan et al. 2000). Herbaria also serve as biological libraries for ecological studies where accurate species identification is paramount (Bortolus 2008) and vouchers aid in determining conservation priorities. Unfortunately, many historic specimens in herbaria have either inadequate or poor label data to answer many basic conservation questions and even contemporary collections can suffer from poor label documentation. The need for detailed and accurate information gathered at the time of collection is therefore critical. Today, with access to high quality topographic maps and global positioning systems (GPS), the location information for a specimen should be quite detailed.

Why voucher specimens?

Among plants, bryophytes offer several inventory challenges since many species are quite small in size and species recognition in the field can be difficult. Species are identified by morphological characters that may be hard to see with the naked eye and most often require greater magnification provided by a dissecting and/or compound microscope. With practice, many species can be identified in the field, but others cannot be named with a high degree of assurance so nothing will substitute for a properly prepared voucher specimen.

Today, the number of bryological specimens residing in Philippine herbaria is still relatively low. Historically much of the bryophyte collecting and inventory work was done by foreign scientists, often before the Philippines became an independent nation. These collections were brought to European or American museums and herbaria. Additionally this under-representation is the result of bryophytes receiving less collection attention among botanists as compared to vascular plants. The inordinate value placed on being vascular has had a detrimental impact on collecting bryophytes and associated inventory efforts to expand the bryological holdings within Philippine herbaria. In addition, a lack of easy access to a wide variety of the bryological literature has also compounded this situation. There is clearly a need to develop a cadre of resident professional

botanists and taxonomists to actively pursue the acquisition and identification of bryological specimens through intensive inventory and field work with the long-term goal of developing a bryoflora of the Philippines.

Techniques and procedures for making high quality museum specimens

Pre-field Preparation. Before departing on a collection trip or expedition, one should review as much information as possible including: the extent of previous collection for this taxonomic group, who conducted the previous survey, how long ago was the survey done, how intensive the survey was and whether the landscape has changed over the interval. One must also be aware if voucher specimens have been obtained in previous surveys and in which herbaria they reside. Topographic maps are also very useful in planning a collecting inventory event. Maps provide an indication of the complexity and difficulty of the terrain to be surveyed, identify access to the area by roads and trails, and generally indicate physiographic features such as springs, streams, waterfalls and rock outcrops that are likely to provide a suite of microhabitats suitable for the taxonomic group to be surveyed. In addition, taking a simulated over-flight of an area with Google Earth on a computer is a useful adjunct to studying maps. Satellite imagery may reveal interesting geographic features not reflected on maps. One should also have a good overview of the vegetation since this will indicate the bryophyte species likely to be encountered. Collecting routes can be prioritized to maximize sampling on as many different microhabitats as possible. These pre-field assessments will make the time spent in the field considerably more productive. Climatic conditions may also influence when a survey is conducted depending on the project objectives.

Conducting biodiversity inventory work can be an expensive and time intensive enterprise. There are the costs of personnel, the time required to obtain the necessary permits, the associated travel expenses and the actual collection of specimens, the time required to identify specimens, the time required to develop high quality herbarium labels, and the time to properly prepare the collections for permanent museum storage. It is, therefore, essential that the time invested while in the field is spent efficiently and effectively. Pre-field preparation is a key step toward maximizing the time spent collecting specimens and documenting their habitats.

Importance of Collection Numbers. Specimens should always be assigned a collection number at the time of collection. Although many numbering schemes for specimens collected have been utilized by various collectors, the two most frequently used are a chronological numbering sequence (1, 2, 3, etc.) or a combination of the year followed by sequential numbering identifying a collection event. Regardless of the numbering system used, an efficient method of record keeping is essential. As specimens are collected each is assigned the next available number and recorded in a field notebook. This procedure ensures that each specimen is numbered as it is collected and no number can be used more than once.

Recording Field Data. When arriving at a site to begin inventory sampling, one should first enter into the field notebook the country, county (or other land administrative unit), date, specific location, GPS coordinates, overview of the general habitat (vegetation cover, i.e. mixed subtropical hardwood forest), rock type, elevation, date, and of course the name(s) of the collector(s). With these data obtained and written into the field notebook you are now ready to begin the inventory process. Each specimen collected receives the next available number in the field notebook and a quick note about its specific micro-habitat (i.e., aspect, exposure, slope, canopy cover, moisture, etc.) and substrate (i.e., on bark, rotten wood, litter, boulder, etc.) is added next to the collection number (Fig. 1). All of these data will be essential in the creation of detailed and informative herbarium labels for each specimen collected. Record keeping is perhaps the most critical compo-

nent of conducting any field work. These data need to be gathered in a consistent manner at the time of specimen acquisition. Since collecting events can be impaired by weather such as rain, the person doing inventory voucher sampling needs to have a reliable procedure that can be achieved even when field conditions are less than ideal. In the case of the Philippines, where rain is abundant, a pocket-sized notebook made of paper that does not easily disintegrate when wet is highly recommended.

How to collect bryophytes

Bryophyte collecting is generally quite simple. The ideal collection method for bryophytes is to place a sample directly into a small folded paper packet (Fig. 2). Except for liverworts fused to the surface of leaves, bryophytes should not be placed in a plant press. The reason is many species have diagnostic features seen when the plants are dry and these characteristics could be lost when pressed flat. In addition, there is no need to treat bryophytes with alcohol because the leaves will remain intact and mildew is unlikely to form if specimens are dried soon after collection. Bryophyte specimens should not be placed in plastic bags. If bryophytes are collected in plastic bags they will need to be transferred into some type of paper container as soon as possible so the plants can air dry. This transfer is time-consuming and therefore this technique of bryophyte collecting should be avoided. There is a long history of bryologists collecting specimens in small brown paper bags, however, we have concluded that the ideal collection method for bryophytes is to place the sample directly into a small folded paper packet. The problem with collecting in bags, whether it is plastic or paper, is that specimens have to be separated later and transferred into a packet. All of this requires more time and cost and increases the potential for creating errors of data transfer from the

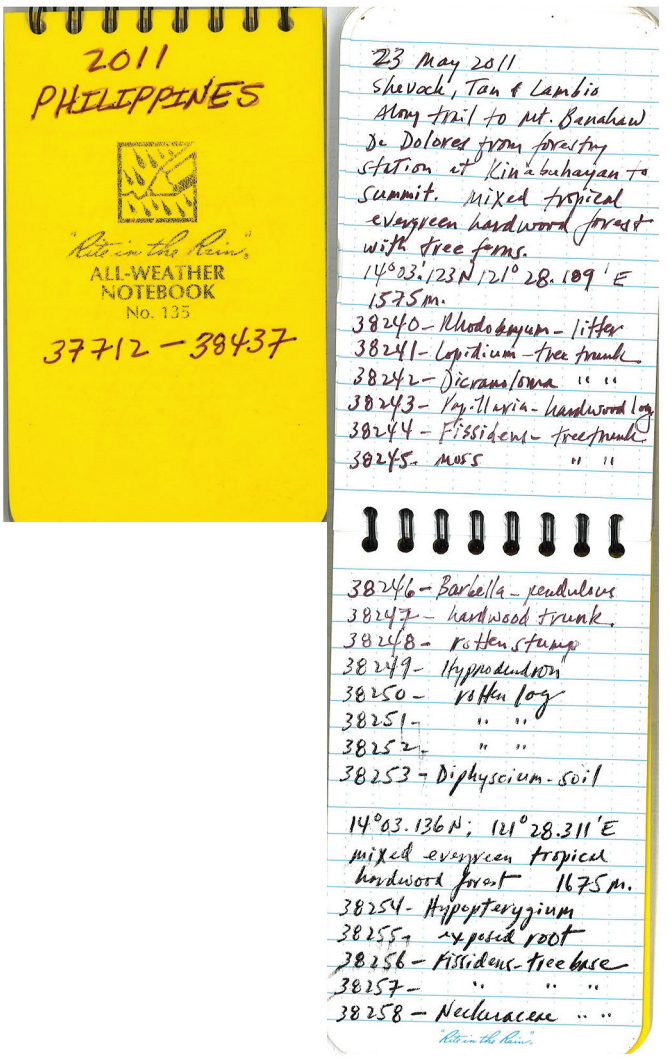

Figure 1. The field notebook is a critical piece of equipment. It contains all of the locality data for each collection site recorded at the time of collection and lists the corresponding collection numbers obtained from that location.

bags to packets. Therefore, it is best to just start off by developing good collecting habits and techniques and use paper packets for specimen acquisition. A packet can be folded from a sheet of photocopy paper (although a heavier stock weight is required) to provide wet specimens greater support until dried. Standard photocopy paper easily falls apart or tears when wet so it should not be used. In extremely wet climates, we find 'water-repellent' paper to be ideal although a bit more time will usually be required for the specimens to dry and the unit cost per packet is greater. Other types of paper available in different countries may also be superior to photocopy paper. As long as the paper selected does not readily tear when wet and dries quickly then it can be used for collecting specimens. A folded packet from a sheet of paper is generally around 9.5 x 14 cm.

In order to consistently obtain the same types of data about each specimen collected, a template form with various ecological attributes is printed on sheets of paper and when folded into a packet becomes the front flap of the collecting packet (Fig. 3). This template is an easy way to document various attributes and ecological features regarding a collected specimen. All one has to do is circle all of the appropriate habitat conditions (i.e. available light, moisture, substrate etc.) for that specific collection and place the specimen in the packet. The use of the template form on the front flap of the col-

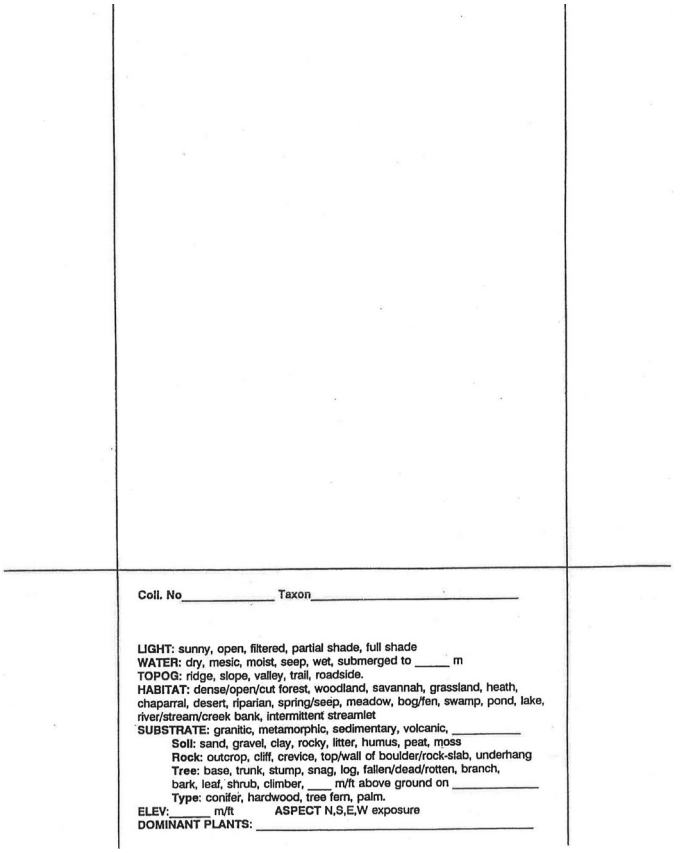

FIGURE 2. Collecting packets are photocopied from 8.5 x 11 (short bond paper of heavier weight) that can withstand tearing when wet. Fold along the printed lines to create a uniform sized packet approximately 9.5 x 14 cm.

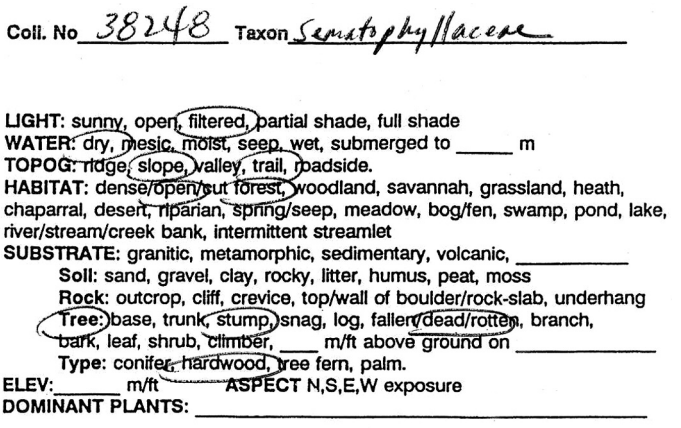

FIGURE 3. The front flap of a bryophyte collecting packet lists a suite of ecological and habitat-specific categories. The collector simply circles all of the appropriate site specific attributes for that collection and then places the sample into the packet. The template provides a simple, easy, and consistent way to record data in the field.

lecting packet ensures that each collection receives the same level of ecological data obtained directly at the time of collection. It is difficult to consistently write on every brown paper or plastic bag all of these important ecological attributes about a collection, especially if weather conditions in the field are not ideal. Circling the attributes for a collection on the template form takes only a few seconds. Also, once the specimen is dried, identified, and ready for processing into the herbarium, the front flap of the field collecting packet with the circled ecological data becomes part of the specimen record. If there is only a single collection for a particular number, the template with the circled ecological attributes can be cut from the field packet and placed inside the labeled archival quality herbarium packet thereby adding further to the scientific value of the collected specimen. If there are additional duplicates of a particular collection number the ecological data form is simply replicated and a copy of the original data is placed within each duplicate specimen packet of that collection number. Specimens collected and dried directly in packets have the following advantages:

1) Specimens are much better looking since they dry relatively flat
2) Specimens are handled less frequently before being dried thereby saving valuable time
3) Data is recorded directly on the field collecting packet at the time of collection and remains with the specimen
4) Data recorded for each specimen at a collecting site is more consistently obtained
5) Specimens dried in packets will later fit perfectly into the archival herbarium packets
6) Packets dry faster since there is more exposed surface area available for drying than in bags
7) Draft labels can be stapled directly onto the front flap of the packets once specimens are dry
8) Specimens are easier to store and sort into taxonomic groups until identified.

A small plastic shoe-box sized container is ideal for transporting specimens while in the field. The specimens fit nicely in these inexpensive plastic boxes and they are placed in the box like a row of filing cards. These plastic containers easily fit in a daypack or backpack. This is also especially useful while collecting in wet weather since the samples are protected from the elements plus the packets are less likely to be damaged during transport. A rubber band can be used to keep bulky specimens from moving about. For bryophytes collected from wet habitats (like streams, lakes, rivers, springs), gently place the specimen between your hands and squeeze out any excess water. If a water source is nearby bryophytes collected on muddy soil can be rinsed off, squeezed to remove excess water (do not wring) and then placed into the collecting packet. Keeping the collections in numerical order ensures that each collection has been properly numbered as it is collected and is linked back to the field notebook.

In addition to the collecting packets and a container to transport them from the field, we have found that a field vest is an essential piece of equipment while conducting surveys. The field vest provides a convenient place to store essential items to conduct a survey including collecting packets, a field notebook, pens, GPS, and a knife or other tool for removing bryophytes from the substrate all neatly fastened to the vest to avoid losing them in the field while collecting.

How much plant material should be collected?

An ample bryophyte collection is the amount of plant material that fits in the palm of your hand. However, some species occupy much smaller-sized colonies. While collection is an essential activity for developing biodiversity inventories, one must also consider the impact of collecting. A good rule to apply in the field is not to remove more than 10 percent of a population from the substrate. Some voucher specimens may be relatively small (a tuft only 25 mm in diameter) but many species occur in much larger colonies. Under most conditions, a single collecting packet can accommodate 2–3 duplicates depending on the size and amount of the bryophyte collected. To pro-

vide for additional duplicates (and if doing so would not adversely affect that population) then a more robust packet or additional packets of that collection number can be made. All duplicate packets of the same sample receive the same collection number. Obtaining enough plant material for a duplicate can be of great value. A duplicate specimen can be provided to another specialist to assist in the identification process. This practice is known as a 'gift for determination' and it is a very efficient way to have specimens examined and named by experts within certain taxonomic groups and adds to the value of the collected specimens once placed into an herbarium. Collecting specimens with enough material to provide for a duplicate is desirable for the following reasons:

1) Many agencies, as a requirement of granting a research or specimen collecting permit, will request either a duplicate sample for their herbarium or a synoptic set (one good labeled specimen to represent each species documented)
2) Duplicates placed in a major scientific institution are available to a wider research community
3) A duplicate specimen can be used as a 'gift for determination' and sent to a specialist
4) Extra duplicates can be used for herbarium specimen exchange purposes to increase the reference collection
5) Duplicates become more important when species are documented as new for a particular geographic area (like a country) or when the discovery is a species new to science (isotypes)

How are bryophytes dried?

Bryophytes are simply air dried much like one would do for a vascular plant collection except that bryophytes should never be placed in a plant press (except bryophytes fused to the surface of vascular plant leaves) and heat sources should generally be avoided. Once home from the field or at the end of each field day, remove the collections from the plastic shoe box sized containers. The packets are likely to be very wet. The key to drying bryophytes is to have air flow across and between the packets. A small fan works well to provide air circulation and expedite drying. In humid climates, an air conditioned room will greatly aid in specimen drying. Just about any method used for drying vascular plants will work for drying bryophytes as long as the specimens can air dry in a few days. If the packets remain wet for longer periods, they will probably begin to mildew or discolor. Wet packets should be separated and laid out to aid in drying. The paper packets absorb moisture from the bryophyte so placing the packet with the ecological data flap face down will expose the wettest part of the packet first (the portion that was adjacent to the substrate). As the paper dries, flip over the packet and repeat this procedure. Another drying technique is to have each specimen stand up forming a triangle or tent (Fig. 4). Air will flow between the specimens further aiding in the drying process. Hanging packets from a cord secured with clothes pins or binder clips is another technique when floor space for drying specimens is limited. Once dried, bryophytes are nearly indestructible.

Figure 4. Drying bryophyte collecting packets can be enhanced by standing them up like a row of tents. This procedure increases air flow between specimens which expedites drying.

Are sporophytes required?

While reproductive structures are generally essential for the identification of flowering plant specimens, sporophytes (the reproductive structure of a bryophyte) are rarely critical for species identification. However, when sporophytes are present they should be collected as part of the sample. Not all sporophytes are erect on a stalk (called a seta). For some bryophytes, the sporophytes can be hidden among the leaves but these structures can be easily seen with a hand-lens or dissecting microscope. A few bryophyte species have never been documented with sporophytes, so do not limit your inventory sampling based on the lack of reproductive structures. There will be cases where a specimen cannot be named with a high level of certainty to the species level without sporophytes, but at least you will have documented that a particular genus is present at a specific locality.

Special things to do with liverwort collections

Liverworts have many important diagnostic features that are either lost in the drying process or are harder to recognize once the specimens are dry. Thallose liverworts and hornworts should always be examined when collected in a fresh condition because once dried they can look considerably different than when observed in the field. Liverwort packets can be placed within a plastic bag to keep them moist then placed into the plastic boxes for transport. Once home from the field, liverworts can be kept in their packets for a few days in the refrigerator to keep the material hydrated. Each liverwort collection should be examined under the compound microscope to record key diagnostic features that will then be used later during the identification process. Taking the time to gather these data while the specimen is fresh will expedite the eventual identification of the specimen later. Oil bodies and/or ocelli in many liverwort genera are critical to successful identification; however, these features can disappear either during the drying process or be altered substantially. For liverwort collections, examine cells across the leaf and record presence or absence of oil bodies and/or ocelli, their form, number, color, and their distribution in the cell. Under leaves (shape and size) are easier to examine on fresh material and these data should be added to the examination data set. Other diagnostic features observed on fresh specimens should be recorded to aid in identification of the specimen at a later date. Record the data on a sheet or card and place it within the packet so it is retained with the specimen. Once the data is recorded, dry the specimens as quickly as possible as described above.

How to process bryophyte specimens

As soon as possible after returning from a collecting event, a draft label for each collected specimen needs to be created. You should get into the habit of doing this at the end of each trip otherwise a backlog is created and the task may later become daunting. In addition to keeping up with your collecting activities, you are likely to have a clearer memory of the collecting sites in the event some particular item was overlooked during data collection. Among botanists the development of labels can be the greatest impediment toward processing collections. Many botanists enjoy the field work component or the identification process but do not follow through with timely label processing. There are several ways to develop a herbarium label but one should strive to have a computer database program so label information can be readily retrieved. First, develop then print a set of draft labels. When the specimens are dried, staple each numbered label to its corresponding numbered field collecting packet. Once the draft labels are attached to the specimen packets they no longer need to remain in numerical order, but rather, specimens can be organized by various taxonomic groupings to expedite the identification process. It is considerably easier to identify collec-

tions by grouping specimens by some taxonomic rank rather than attempting to name collections in the order they were collected. Many bryophytes as they are collected are "mixed" meaning that there is another species, sometimes only a few strands intertwined with the dominant taxon. Without the aid of a dissecting microscope some of these intertwined species that rarely grow as a larger colony can be easily overlooked. Yet it is these species occurring as a few strands that are most likely to be either under-collected or were not observed in the field while conducting the inventory. These taxa are also very important to add to the inventory process. Therefore, the collector should carefully examine the dried specimen packets and determine if any collection number has mixed samples that should be separated out and given their own unique identification number. This is achieved by removing the first intertwined item from the dominant numbered sample and giving this extracted specimen the same collection number followed by the letter 'A'. If more than one species is separated from the same collection, then the second species extracted from the packet is given the same collection number followed by the letter 'B' and so forth.

The key to processing specimens is to have a high quality draft label attached to each collection so you do not create a backlog of specimens without labels. It is very easy and quick to go from draft to final labels once specimens are named. For really puzzling collections it may be necessary or desirable to contact a bryological expert to examine one or more of your collections. If the specialist is willing then send a small sample of those collections *with draft labels* to be examined and named as a 'gift for determination'. Once a collection is named, a final label is produced (Fig. 5). The use of archival, acid-free paper is highly recommended. Print labels using a laser printer. Avoid ink jet printers because the ink can smear if moistened. The determination (who named the collection and the month/year) should be a data field on the final label. Additional labels can be printed to accommodate all of the duplicates of a particular collection number that exist. Single duplicates for other herbaria can be sent in the original field collecting packets. If one is splitting a field collection packet into multiple duplicates, additional packets can be folded from standard photocopy paper (even paper already copied can be recycled for this purpose). Place a final label inside the packet with the specimen. A copy of the ecological template data form (the front flap of the collecting packet) should also be enclosed with each duplicate specimen. There is no need to send duplicates to herbaria in archival quality paper since each herbarium has its own procedures and archival packets for adding specimens into its institutional collection.

BRYOFLORA OF THE PHILIPPINES, LUZON, REGION IV-A
MT. BANAHAW PROTECTED LANDSCAPE AREA

Warburgiella philippinensis (Williams) Brotherus
det. by Ivy Lambio & Jim Shevock i.2013

QUEZON PROVINCE, PH
San Pablo Quad. Along trail to Mount Banahaw De Dolores from Forestry Station at Kinabuhayan. Slopes below the summit. WGS-84: Lat/Long: 14 degrees 03.123' N, 121 degrees 28.189' E. Elev: 1575 m. Mixed tropical evergreen hardwood forest with tree ferns. On rotten hardwood stump in filtered light.

James R. Shevock 38248 23 May 2011
with Benito C. Tan & Ivy Lambio

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FIGURE 5. The final herbarium label is the integration of the locality data for that collection number recorded in the field notebook and the ecological and site specific habitat data circled on the field collecting packet. Labels are glued or can be printed directly onto archival paper and folded into packets for placement in the herbarium. Many herbaria use archival packets that are the same size as the field collecting packet. Although labels can be of various dimensions, they should not exceed 9 cm tall and 13.5 cm wide so they will comfortably fit on the archival packet.

How should bryophyte specimens be sent to herbaria or to other bryologists as gift for determination?

Once specimens are completely dry, packets (with either a draft or final label) can be mailed at any time. A few dried specimen packets can be placed on a sheet of recycled photocopy paper and wrapped like a small package, using tape to secure the ends. These samples can then be placed in either a padded envelope or a cardboard box for shipment in the mail. If you seek a determination or confirmation of one or more of your bryophyte collections, contact the bryologist before sending any specimens to ensure that person is willing to take the time to examine them on your behalf. Clearly state if the specimens being sent are a 'gift for determination'. Many bryologists will not accept specimens for identification without a draft label attached with the specimen and most are going to want to keep the samples sent for their herbarium in exchange for providing this identification service. Be advised that several countries have special procedures and import forms in order to receive dried plant materials through the mail.

Developing a species list

All inventories should clearly state how the species lists were developed. Is the species list based on a literature review, based on existing herbarium specimens, or were additional collections also obtained by the project? These data provide a foundation to assess the quality and completeness of any inventory. All species should be referenced based on literature citation, specimen collection, or field observation. This is especially important in the computer age because once data (as a species checklist) are in electronic formats they can all appear as if of equal quality.

Professional responsibilities while conducting foreign expeditions

With the use of internet, it is much easier today to stay in professional contact with scientists around the world and develop new partnerships and collaborative ventures. Both the bryological literature and specimens in major herbaria are widely scattered around the globe. It is critical that collaboration occurs and efforts spent on various components of biodiversity can be integrated. Many countries, as a condition of granting collecting permits, require duplicate specimens to be deposited in a herbarium in the country of origin. Sometimes, this arrangement may be simplified by providing a synoptic set. Unfortunately for bryophytes, it is considerably more difficult to divide collections into duplicate sets without the aid of a dissecting microscope. This work usually needs to be done in the lab, versus in the field. If all of the specimens obtained by a foreign scientist are initially taken out of the country then that scientist has a professional responsibility to return as soon as possible a complete duplicate set of specimens (with at least draft labels for each collection) to the host country institution and then provide final labels as specimens are identified.

Collaboration can occur on several fronts from assisting with the actual field work to offering species identification and associated molecular services. Publications are also more likely today to have co-authors residing in different countries. These professional associations should be encouraged and strengthened through biodiversity inventory efforts. There are wonderful opportunities to continue bryophyte collecting throughout the Philippines with the goal of enhancing and expanding the species diversity within local herbaria. However, specimens need to be gathered and subsequently processed in such a way as the data and the actual voucher specimens are readily available to the scientific community.

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