Community-Based Natural Resource Management in the Hukaung Valley Wildlife Sanctuary: Phase 2

Report of Research

Charles M. Peters, Ph.D.
The New York Botanical Garden

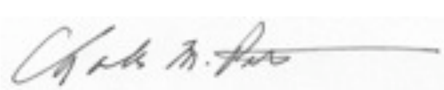
December 2009

ACKNOWLEDGMENTS

Thanks to everyone for another productive round of fieldwork in the Hukaung Valley Wildlife Sanctuary (HVWS). The more we learn about the plant resources and the communities of the Hukaung Valley, the closer we get to developing management systems for the use and conservation of local forests that are truly sustainable. The recent demarcation and inventory of a 100 hectare management area outside of the village of Shinlonga is a giant step in this direction.

Special thanks to the Ministry of Forestry and the Myanmar Forest Department for granting the necessary permissions to conduct the research. The Wildlife Conservation Society (WCS) has played a key role in promoting community forestry in the HVWS, and I gratefully acknowledge their continued support. In the WCS Yangon office, U Than Myint was extremely helpful in putting together the research proposal and organizing the logistics for the trip. Colin Poole from the WCS New York office provided invaluable advice about community-based resource management, offered useful suggestions about long-term strategies, and helped secure the funding for the research.

Finally, none of the fieldwork would have been possible without the hard work, enthusiasm, and good humor of the scientific team, the local program staff, the forest guards, and the residents of Shinlonga. In particular, I wish to acknowledge the diligence and dedication of Jonkhume and Kyaw Zay Ya for finishing the inventory work and compiling the plot data, Saw Htun for making sure that all of the logistics ran smoothly, and Rob Tizard for helping in the field, sharing his thoughts on community forestry, and knowing all the animals. Finally, I would like to thank the Blue Moon Fund for their financial support (and patience). Palms together in gratitude to all...



Charles M. Peters

Executive Summary

From November 27 to December 16, 2009, fieldwork was conducted in the forest outside of the village of Shinlonga within the Hukaung Valley Wildlife Sanctuary. The main objective of the work was to finalize a list of important plant resources for the village, document the nomenclature of these plants in both Myanmar and Kachin languages, layout a 100 hectare Village Management Area (VMA) for Shinlonga, and conduct a quantitative inventory of selected resources within the management area.

Building on the results from the household surveys and preliminary forest inventories conducted earlier in May (see *Report of Research*, June 2009), 27 plant resources were selected for inventory and management: 15 timber species, 4 bamboos, 1 rattan species, and 7 medicinal plants. Both Myanmar and Kachin names were recorded for each taxa.

The location of a 0.5 kilometer by 2 kilometer (100 hectares) VMA was agreed on by the community and the scientific staff, and the resultant area was demarcated and spatially referenced on the village land-use map. The western edge of the management area was then located in the field, the line carefully cleared, and transect stakes (n = 20) set every 100 meters to provide a systematic 10% sample. The resource inventories on transects 1 and 2 were completed after laying out the baseline; the remaining 18 transect were completed by local field crews by early January.

A forest typology including five habitat classes, i.e. closed forest, secondary forest, rattan thicket, treefall gap, and old swidden, was developed for the VMA using the forest-type observations recorded from each inventory plot.

The inventory revealed that the 10 hectare sample of VMA forest contains 253.1 m^3 of timber with *kyilan*, *pankhalaung*, and *sagawa* presenting the highest volumes. In terms of rattan, a total of 3,453 *pyant kyein* canes were recorded, of which 467 canes were of commercial size. *Katkyinya*t and *saythantai* were the most abundant medicinal plants in the VMA, with 570 and 130 stems, respectively.

The general conclusion to be drawn form the VMA inventory results is that there is still an abundance of timber, rattan, and medicinal plants in the forest, but that controlled harvesting and management are sorely needed-especially in the case of timber and rattan to guarantee a continual supply of these important resources for the residents of Shinlonga.

The next steps in the development of community-based natural resource management at Shinlonga include: (1) the initiation of yield studies for timber and rattan, (2) defining sustainable harvest levels based on the existing stock and production of these resources, (3) producing a comprehensive village management plan for the sustainable exploitation of important wild and cultivated plant resources, and (4) implementing periodic regeneration surveys to insure the sustainability of forest exploitation.

Introduction

The collaborative effort between WCS and the Myanmar Forest Department to develop community forestry in the Hukaung Valley Wildlife Sanctuary has proceeded in several stages. Initial efforts in 2006 were focused on an extensive series of village consultations (VCP) conducted in 40 villages, followed by the delineation of village development zones (VDZ) in 22 villages. In May of 2009, more detailed village-level analyses were done to assess the actual supply and demand of local resources and the potential for community-based management. Much of this research was conducted in the village of Shinlonga, the results of which were outlined in *Community-Based Natural Resources Management in the Hukaung Valley Wildlife Sanctuary* (June 2009).

The present report builds on the previous work in Shinlonga and describes the establishment and inventory of a 100 hectare management area. This tract of forest, designated the "Village Management Area", or VMA, provides the resource base from which the sustainable exploitation of timber, rattan, and medicinal plants will ultimately be developed in collaboration with the residents of Shinlonga. It is important to note that **the creation of a designated forest management area at Shinlonga is a major step forward in the development of community-based resource management in the Hukaung Valley**.

The report opens with a brief description of the Survey Team followed by a detailed explanation of the different methodologies used in the fieldwork. An annotated list of the forest resource selected by the villagers to be included in the management area survey is then presented. The results from the participatory forest inventory, one of the first of its kind in northern Myanmar, are then summarized and the total density or volume, merchantable stock, and spatial distribution of each resource group within the management area are discussed in detail. This section represent the core of the report and provides much of the baseline silvicultural data required for management, i.e. how much of a given resource is there in the forest, where is it located, how much of it is of harvestable size, and, most importantly, which resources appear to be maintaining themselves in the forest?

A final section looks at the next steps that need to be taken to continue the development of community forestry at Shinlonga and to produce a comprehensive management plan that includes both the sustainable exploitation of wild populations and the careful propagation of selected resources of importance (e.g. bamboo, palm thatch) in mixed plantings near the village.

Survey Team

The survey team was composed of an inter-disciplinary group of scientists from several different institutions, together with WSC Myanmar Program staff, HVWS Forest Guards, and local villagers. The science staff included:

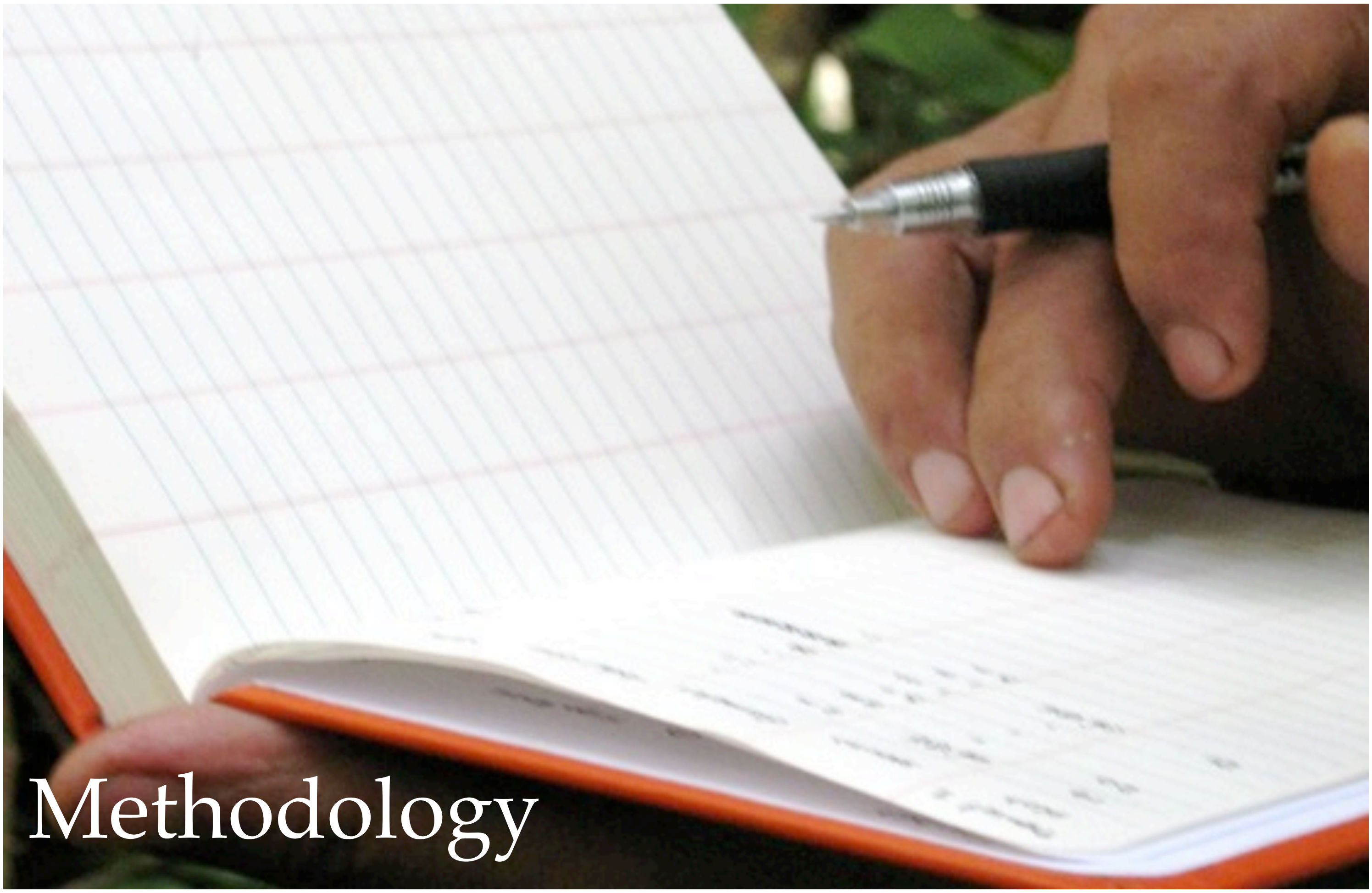
U Zaw Lin is the Range Officer of the Hukaung Valley Wildlife Sanctuary in the Myanmar Forest Department. U Zaw Lin was extremely skilled with both compass and GPS, and he coordinated the crews laying out the baseline and orienting the first two transects. U Zaw Lin was the main reason that we ran straight lines through the forest.

U Saw Htun is the Coordinator of the Northern Forest Complex for the WCS Myanmar Program. U Saw Htun organized most of the logistics for the trip, conducted and translated the interviews, did the village presentations, and took care of counting and measuring all of the plants on the right side of the transects. U Saw Htun played a critical role in almost every aspect of the survey.

Dr. Charles Peters is the Kate E. Tode Curator of Botany at the New York Botanical Garden. Dr. Peters is a plant ecologist and a forester specializing in the ecology, use, and management of tropical forest resources and he has written extensively on various aspects of community forestry.

Rob Tizard, wildlife biologist, community development worker, and accomplished photographer, is Technical Advisor to the WCS Myanmar Program. Mr. Tizard provided invaluable assistance with logistics, identified all the animals, and counted and measured the sample plants on the left side of the transects.

U Zaw Lin, JonKhume, and Kyaw Zay Ya lay out the first stake on the baseline of the Village Management Area in the forest north of the village of Shinlonga.



Methodology

The overall workflow at Shinlonga was to first finalize the list of important plant resources used by the village and confirm the name of each plant in Kachin and Myanmar language. An appropriate tract of forest for locating a 100 hectare Village Management Area (VMA) was then selected and a baseline cut to demarcate the area and orient the inventory transects. The transects were then laid out and inventoried for all of the resources on the list of important species. The specific details of each of these field procedures is described below.

Selecting the Species

The initial list of the plant resources compiled for Shinlonga contained 30 species organized into six basic resource groups: 1) timber, 2) palm thatch, 3) bamboo, 4) forest fruits, 5) rattan, and 6) medicinal plants. For the purposes of the forest inventory, we were interested in developing a shorter resource list containing only those plants which are fundamental to village life and routinely exploited from the forest. Two meetings were held, one with the Village Management Committee, the other open to the entire village, to review the list of plant resources, to rectify the nomenclature as necessary, and to eliminate species of marginal value or those with population sizes too low to warrant a program of controlled exploitation.

Locating the VMA

Several different locations were considered for the Village Management Area. We needed a forest area of at least 100 hectares in size that was not currently being used for shifting cultivation. Additionally, the area needed to be far enough from the village to avoid disturbance or encroachment, yet close enough to the village that the local management committee could keep an eye on things. Access to the site was also an important criterion, especially as related to the logistics of getting logs and poles back to the village. Three sites were initially proposed for the VMA, one east of the village along the Ledo Road, the other two north of the village All three sites were in areas designated as Production Forest on the original VDZ map. A final consensus about the placement of the Village Management Area was facilitated by project staff working in collaboration with the local Management Committee.

Cutting the Baseline

The first step in establishing the management area was to clear a baseline along the western border of the plot. The 100 hectare VMA measured 2.0 x 0.5 kilometers; the resultant baseline was 2000 m long and oriented due North. The coordinates of each of the four corners of the area were determined by positioning the VMA polygon on the satellite image of Shinlonga using ArcView and a dedicated GIS constructed for the Village Management Area. These coordinates were then used to locate the southwest corner of the VMA using a GPS receiver and to set the first baseline stake.

Using nylon transect ropes with knots to correct for slope, the field crews took a compass bearing and headed magnetic north, i.e. without declination, for 20 meters. Several crew members with machetes went in front clearing the line to a width of about 1 meter to enhance visibility and open the way for the crew member pulling the transect rope. The compass man was continually orienting the line clearers as they moved through the forest. On completing the 20 m segment, a clinometer was used to take a slope reading, and, if necessary, a correction was made to adjust the actual distance traveled to 20 meters. A stake was then cut, planted, and flagged with orange plastic tape on which the stake number had been written in indelible ink.

The baseline proceeded north in 20 m increments; every 100 m a larger, pole-sized stake was set. These stakes represent the stating points for each of the twenty, 500 m long inventory transects that would later bisect the management area running west to east. To facilitate orientation within the area, the 20 transect stakes and the 80 baseline

Stakes and orange flags aligned along the baseline of the Shinlonga Village Management Area. Three flags are visible in this image.

stakes were numbered consecutively in a nested sequence: 1.1, 1.2, 1.3, 1.4, **2** (transect stake), 2.1, 2.2, 2.3., 2.4, **3** (transect stake). Notes were recorded on the condition of the forest and photographs taken as the field crews moved northward through the forest.

Running the Inventory Transects

A series of parallel, 10 meter wide inventory transects was run through the management area. The transects were separated by 100 meters to provide a constant sample intensity of 10%, i.e. 10 hectares of forest were surveyed. Each of the 500 meter transects was divided into twenty-five, 10 x 20 meter contiguous plots. By sub-dividing the transects into individual plots, the survey results provide a much higher degree of resolution about the actual floristic and structural changes encountered in the forest.

Starting from the transect stakes set on the baseline, a bearing of 90˚ was determined with a compass and the transect crews starting clearing the line and pulling the transect rope. After traversing 20 meters, a stake was cut and a clinometer reading was taken to see if a slope correction was needed. The plot stake was then set and flagged; the transect rope was left in place to mark the centerline of the plot. The overall workflow in the inventory was very similar to that used in laying out the baseline.

Within each plot, field crews carefully surveyed each side of the transect line looking for individuals of the species on the survey list. Different types of data were recorded for different resource groups. Medicinal plants were counted, while rattans were counted and also assigned to 1.0 meter height classes. All timber trees ≥ 5.0 centimeter in diameter (DBH) were measured for diameter, and commercial height (to the first branch) was estimated using a clinometer. In the case of border trees, alternate individuals were tallied, i.e. the first trees was recorded, the second tree was considered out. Observations on tree form and condition were recorded as appropriate.

With the objective of producing a forest type map of the Village Management Area, each plot was assigned a habitat class based on the general condition of the forest. The five habitat classes used in the survey were : 1) closed forest (*taw gyi*), 2) secondary forest (*taw nge*), 3) rattan thicket (*kyein taw*), 4) treefall gap (*aw lei*), and 5) old swidden (*taun yan haung*). In the case of a change in forest type within the confines of a single plot, only the dominant habitat class was recorded.

Data Analysis

The plot results from the forest inventory were entered directly into an Excel spreadsheet after finishing all of the transects. To obtain a clearer understanding of the phyto-sociology and distribution of dominance among different tree species on the site, Importance Value (IV) indices were calculated for all of the timber species based on the density, frequency, and basal area of each taxa. [Note: The Importance Value index is an estimate of the relative dominance of a species based on the number, spatial arrangement, and size of the different individuals in it's population (Krebs, 1999)].

The commercial volume of each sample tree was calculated from the plot data using the general biometric equation:

Commercial wood volume (m^3) = basal area (m^2) x commercial height (m) x 0.80 form factor

Basal area values were calculated from diameter measurements; commercial heights were taken from the clinometer readings. The form factor coefficient of 0.80 is a representative average for tropical trees (Lamprecht, 1989; Philip, 1994). Size - class histograms were also constructed for the timber trees and rattans, and a height x diameter plot was graphed for the timber trees to inform future efforts at developing a volume table for the IMA [Note: A volume table allows a resource manager to estimate the standing volume of timber tree based solely on diameter measurements (Husch *et al*., 2003)].

Several different maps were constructed to display the distribution of forest types throughout the management area as well as the spatial distribution of timber, rattan, and medicinal plant resources. The maps were created using ArcInfo 9.3 and the plot results from the inventory transects. Habitat classifications, volume estimates, and stem counts were first plotted and the the resultant surface interpolated using the Inverse-Distance Weighted tool in Spatial Analyst.

Crew members in the northern end of the Village Management Area at Shinlonga after setting the final stake on the baseline. Large tree is kyilan (Shorea assamica Dyer.) .

Results

The results from the fieldwork at Shinlonga greatly increase our understanding of the density, abundance, and use of plant resources in the Hukaung Valley Wildlife Sanctuary. The specific findings from the work are presented below in the following order: the names, the management area, and the current stock of resources.

Final List of Species

A total of 23 taxa were included in the final list of important plant resources for the village: 15 timber species, 1 rattan, and 7 species of medicinal plants. These species are listed in the table to the right with the Myanmar name, Kachin name, and scientific (Latin) name, if known. In the absence of voucher specimens, all taxonomic determinations in the table should be viewed as tentative; nomenclature is based on Kress *et al*., 2003; Hundley and Chit KoKo, 1987, and Win Kyi, 1998. That less than half of the species have even been tentatively named points out the great need for a systematic program of botanical collection in the Hukaung Valley.

Several other forest resources were recorded during the ethnobotanical research in Shinlonga, but these were not included in the final list of species because of their marginal utility. In terms of timber trees, for example, *kanasoe (sayu)* and *phetwai (laja)* were also mentioned, but the general consensus was that the wood from these species was not very good. Similarly, the rattans *mokesoema kyein (munggawang ri)* and *myaukchee kyein (hpuchyang ri)* were used by some families for cordage because of their abundance, but most people felt that these rattans were not very strong and, as a result, did not merit a concerted management effort. [NOTE: The Kachin names for these resources are shown in parentheses}.

Nomenclature of important forest resources used in the village of Shinlonga as determined by household surveys and meetings with the village management committee. Taxonomic designations should be viewed as tentative.

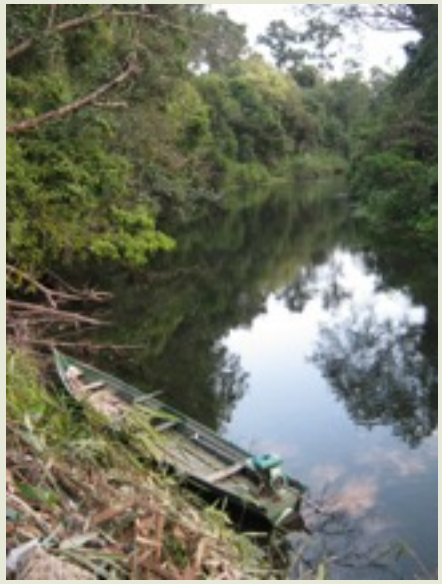
Resource	Myanmar Name	Kachin Name	Scientific Name
TIMBER	Sagawa	Larangjap	*Michelia champaca* Linn.
	Tawpeinne	Yangnoi	
	Pankhalaung	Hkalawng Hpraw	
	Sagasein	Larangsai	
	Laukyahmwe	Hkalawng Hkye	*Schima wallichii* (DC) Korth.
	Kyilan	Rit	*Shorea assamica* Dyer.
	Taungpoezar	Lapyi	
	Yinmar	Ritja	*Chukrasia tabularis* A. Juss.
	Laban	Laban	
	Seiknan	Saneng	
	Kanyin	Salung	*Dipterocarpus* spp.
	Yemane	Maisaw	*Gmelina arborea* Roxb.
	Ma-u	Kashawng	*Neolamarckia cadamba* (Roxb.)
	Taungtamar	Latsai	
RATTAN	Pyant Kyein	Woina Ri	*Calamus palustris* Griff
MEDICINAL	Seegadone	Tsikadung	
	Sindonemanwe	Manoi Ru	*Tinospora cordifolia* Miers.
	Letpankha	Hpun Dawdaw	*Alstonia scholaris (L.)*
	Katkyinyat	Labubula Ru	
	Kyauksetnwe	Lunghkrutmatut	
	Sathantai	Ngakawa	
	Kyaukphauknwe	Lungjungbalen	

Village Management Area

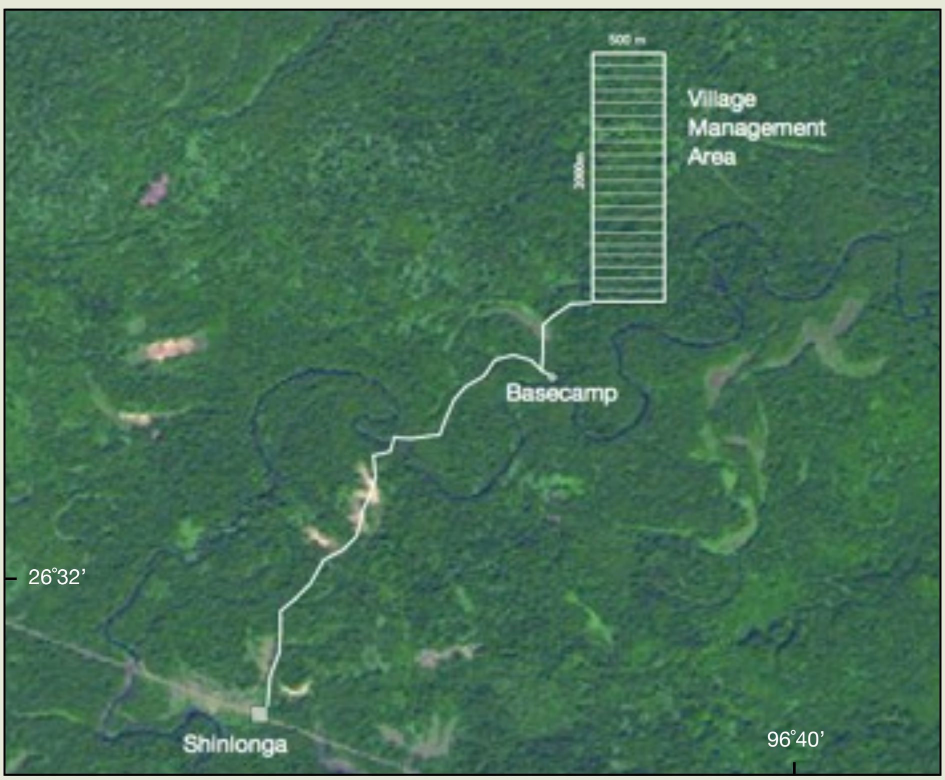
The 100 hectare (2000 meter x 500 meter) Village Management area was established in an area of Production Forest located north of the village at a walking distance of about 2.0 hours. A satellite image showing the location of the area is shown below. During the first two days of the fieldwork, the crews walked out from and back to the village each day. To cut down on the travel time, a base camp was later established on the northern bank of Mawning Stream, a 15 - 20 minute walk from the VMA. Tents, food, and cooking equipment were sent by boat to the base camp from Shinlonga.

The tract of forest selected appears to satisfy all of the criteria set for the management area. It is far enough from the village to avoid disturbance, close enough that you can easily walk out to it and back, and located sufficiently close to a navigable river for log transport. After several weeks of walking to the VMA and traversing the baseline to get to the transects, the trails are quite open.

The VMA area was laid out with a compass and, as such, it is oriented magnetic north which should facilitate transect re-location in future fieldwork. [NOTES: The twenty inventory transects are depicted as parallel, horizontal white lines on the satellite image; the 2000 meter baseline is the western vertical line. Open areas are active rice fields; old swiddens appear greyish-brown in color. Old river meanders are visible on the satellite image as curved lines].



Site of base camp along Mawning Stream near the Village Management Area.



Location of the100 hectare Village Management Area (VMA) near the village of Shinlonga in the Hukaung Valley Wildlife Sanctuary.

Forest Typology

The Village Management Area contains a course mosaic of the five different habitat classes recorded in the inventory. The overall distribution of different habitats throughout the area is shown in the forest type map below. Secondary Forest, representing 51% of the total area, is the most common habitat class followed by Rattan Break (20%) and Closed Forest (16%). Old Swidden and Treefall Gap represent 11% and 2% of the area, respectively.

Forest type map of Village Management Area (VMA). Map based on results from 20 parallel transects.

The forest typology of the VMA highlights several points of relevance to community forestry in the Hukaung Valley Wildlife

Sanctuary. It is clear that the these forests have been cut, burned, farmed, and exploited in various ways by local populations for a considerable period of time. Within the Secondary Forest class, for example, there is a whole chrono-sequence of areas that range in age from several years to several decades old. These forests continue to be periodically cut - and they continue to grow back, albeit with subtle, changes in the structure and composition of the original stand.

In terms of community dynamics, most of the forested tracts in the Village Management Area pertain to the Gap or Building Phase (*sensu* Whitmore, 1998). Light levels are relatively high, nutrients are gradually being released by the slow decomposition of tree trunks and branches, and woody species are actively growing to re-establish biotic control over the site. These are exactly the growth phases that a conscientious program of forest management strives to emulate. These rapidly growing tracts of forest are also immobilizing considerably higher amounts of carbon than that exhibited by closed forests where carbon fixation and release are more closely balanced. The VMA is not pristine forest, and, from a management perspective, this is good news. This forest is clearly adapted to periodic disturbance. **The role of management here will be to tailor the nature and intensity of disturbance to facilitate the growth and regeneration of the forest resources required by the village.**

Timber Resources

The timber resources in the Village Management Area can be analyzed from several different perspectives. A table summarizing the main ecological characteristics of the 11 timber species recorded in the inventory as ranked by Importance Value is shown below. [NOTE: These data represent the results from a 10 hectare sample of the Village Management Area. To obtain an estimate of the total density or volume of a species within the VMA, the tabular values should be multiplied by 10, e.g there are an estimated 60 *sagawa* trees representing a total volume of 261 cubic meters in the entire Village Management Area].

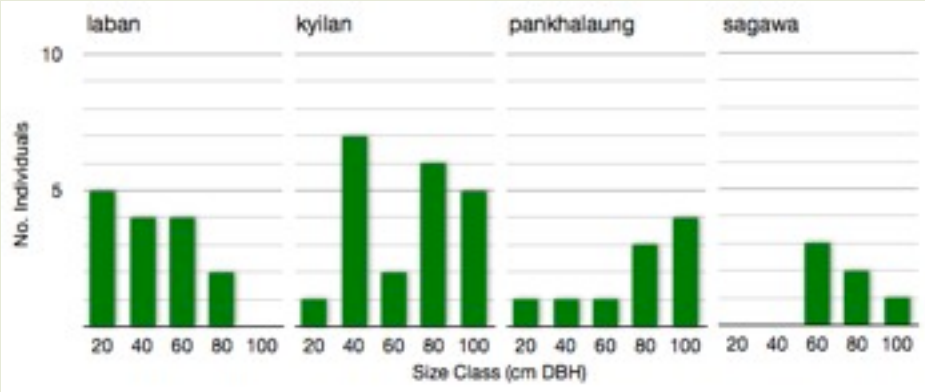
As is shown in the table, *kyilan* is by far the most most abundant timber resource in the VMA forest. This species has the highest density, the highest Importance Value, and contains the largest volume of wood. *Laban* exhibits the second highest Importance Value, primarily because of its high density, although the trees of this species are of smaller size and the total wood volume is less than that of other species with smaller IV rankings [NOTE: The exact taxonomic identity of *laban* has not been determined]. *Pankhalaung*, for example, the third ranked timber species, has almost five times the wood volume of *laban*. The preferred timber for house construction in Shinlonga, *sagawa*, is ranked fifth in Importance Value, yet exhibits a higher wood volume than all other species with the exception of *kyilan*. There are fewer *sagawa* trees in the VMA, but all of these individuals are over 40 centimeters DBH. Taken together, 80 timber trees containing over 250 cubic meters of wood were recorded in the 10% sample of the VMA.

The timber resources in the VMA can also be assessed by looking at the degree to which different species are replacing themselves in the forest. This information is very important from a management standpoint because it provides some indication about what future yields might look like, and can also highlight those species which are in greatest need of a management interventions to insure a continual flow of resource.

Size-class histograms for four of the most abundant timber species are shown at the top of the following page. The first histogram, for *laban*, depicts a species whose population structure most closely resembles a negative exponential distribution, i.e. with more individuals in the smaller classes than the larger classes. [NOTE: A negative exponential distribution is considered by some authors (e.g. Leak, 1964; Peters 1996) to be the ideal for stable, self-regenerating plant populations]. Regeneration for this species appears to be occurring on a continual basis. The size distribution for *kyilan* suggests a different recruitment dynamic. This species appears to be regenerating, but only sporadically, and there are

Ecological characteristics and volume of important timber species in Village Management Area. Values represent results from 10.0 hectares of forest inventory; expand by 10 to estimate total density or volume of a species within the entire VMA.

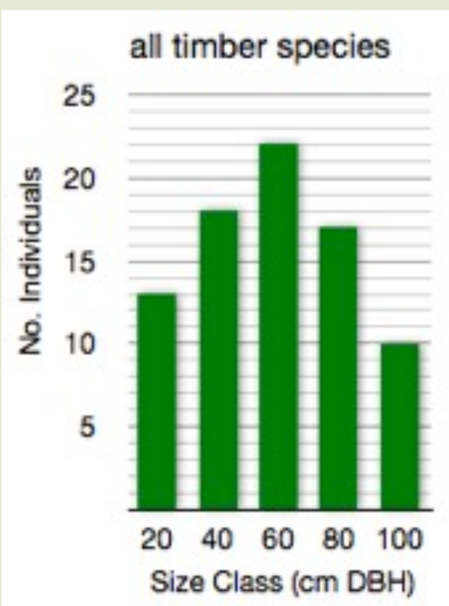
Species	Density	Basal Area (m^2)	Frequency	ImportanceValue	Volume (m^3)
Kyilan	21	6.34	16	26.97	99.95
Laban	15	1.97	15	16.43	15.32
Pankhalaung	10	4.30	10	16.16	69.62
Tawpeinne	10	1.70	10	11.62	13.49
Sagawa	6	1.98	6	8.65	26.14
Taungtamar	4	0.82	4	4.90	9.88
Sagasein	4	0.55	4	4.43	3.50
Yinmar	3	0.84	3	4.06	8.60
Laukyahmwe	4	0.11	3	3.29	1.62
Seiknan	2	0.09	2	1.89	0.83
Kyakhalaung	1	0.44	1	1.56	4.16
TOTALS:	**80**	**19.17**	**74**	**100**	**253.14**



Size-class distribution of abundant timber species in Village Management Area. Data are from a 10% sample of the area; expand by a factor of 10 for size class totals/species for the entire area.

distinct peaks and valleys in the size-class histogram. The last two species, *pankhalaung* and *sagawa*, both exhibit size-distributions with more big trees than small trees, i.e. the rate at which these species are regenerating has apparently decreased over time. *Pankhalung* seems to be able to recruit a few individuals into its population every couple of years, while the total lack of trees in the smaller size classes for *sagawa* suggests that the regeneration of this species has been drastically curtailed.

Combining all of the timber species into one size-class histogram provides a useful overview of the wood resource in the VMA. Such a histogram is shown below. Although the distribution is not a negative exponential, each size class contains a reasonable number of individuals and it looks like a continual supply of timber - irregardless of the species - can be maintained on the area with very little effort. [NOTE: When expanded to represent the total 100 hectares of the management area, each size class contains from 100 to 200 timber trees]. Molding the species composition of the timber resource to more closely account for village demand, however, will require a concerted management effort.



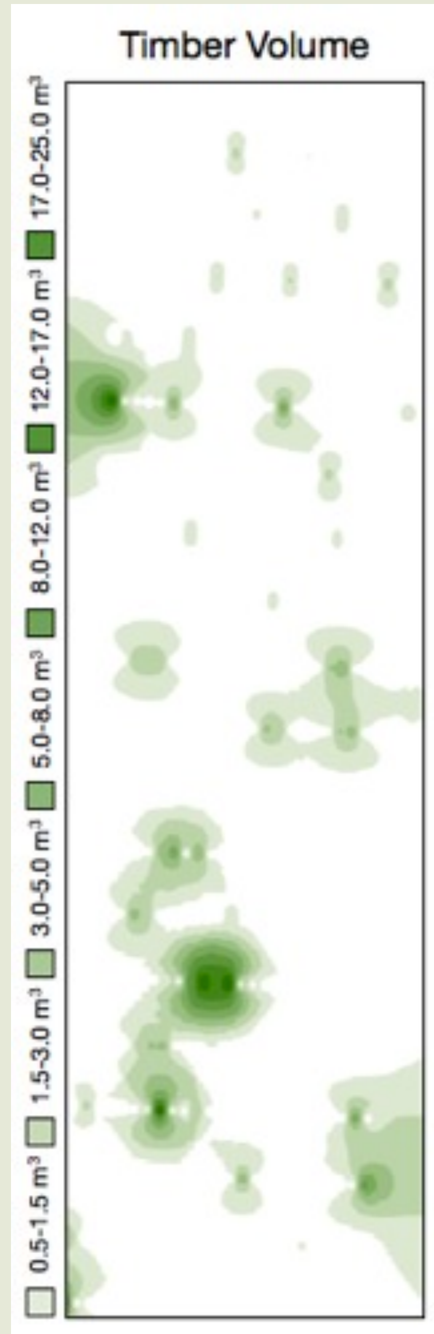
Composite size-class diagram of all timber species in the VMA. Data are from a 10% sample of the area; expand by a factor of 10 for size class totals for the entire area.

A final way to evaluate the existing timber resources in the VMA is to look at the spatial distribution of wood volume throughout the area. By taking the volume totals from each of the sample plots (N=500; 25 plots/transect x 20 transects), plotting the values in the management area GIS, and then interpolating between the points using Spatial Analyst, a timber map showing contours of wood volume was constructed. As can be appreciated in the map shown to right, there is a foundation of low timber volume (0.5 - 1.5 cubic meters; shown in white) extending throughout the Village Management Area interspersed with islands of higher volume (usually clumps of large trees). The densest patches may contain up to 25 cubic meters of wood.

Of special interest is the location of higher volumes of wood in the lower half of the VMA. These pockets of volume are closer to Mawning Stream and, as a result, the logistics of getting the logs out of the area are greatly simplified. Similarly, the existence of several volume peaks on the western side of the VMA near the baseline also facilitates log removal. Although there are clearly logistic difficulties that need to be addressed about timber harvesting and log removal from the VMA, knowing where the wood is located - and in what quantity - is a useful first step in developing operational solutions.

The preceding analyses have all focused on the current *stock* of forest resources in the VMA. From a sustainability perspective, however, a parameter of even greater importance is the growth or annual *yield* of timber from the forest. How much new wood is produced by the timber trees in the 100 hectare management area each year? How does this volume increment vary from species to species and what effect does harvesting have on the growth of residual trees? The answers to these questions will ultimately be used to define a sustainable rate of harvest from the management area at Shinlonga.

As a first approximation of what the annual yield of timber might be from VMA, a simple stand table projection was performed using the inventory data and a height x diameter curve



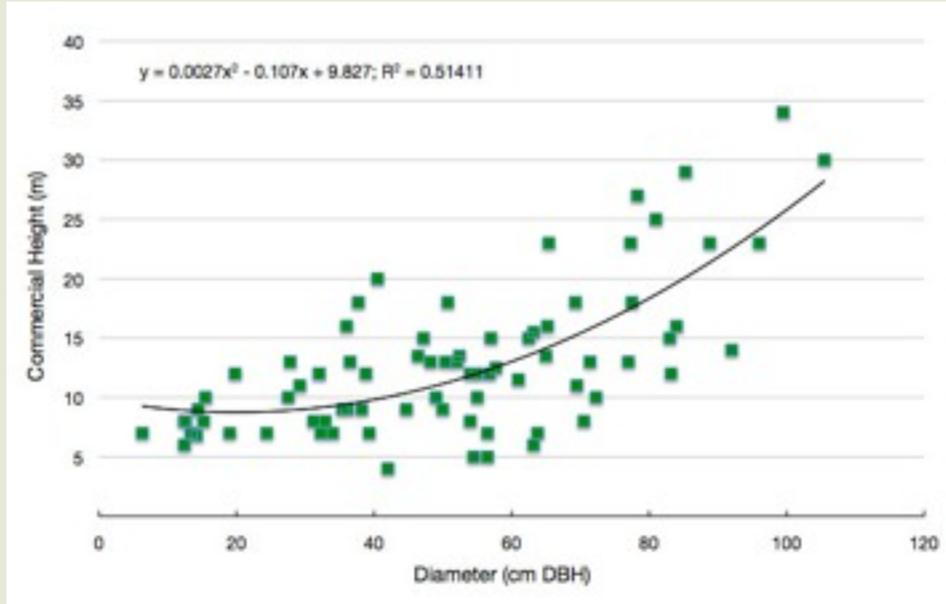
Spatial distribution of timber volume throughout the 100 hectare Village Management Area.

constructed from the sample trees measurements. [NOTE: A stand table projection uses the existing stock of timber in a forest and then "grows" it for a year. The difference between the original volume and the volume calculated for YEAR 1 represents the estimated growth of the stand (Husch *et al*., 2003)]. An estimated annual diameter increment of 0.3 centimeters was assumed for all species; height growth was estimated by calculating commercial height for the new diameter of each tree using the equation derived from the height x diameter curve (shown to the right). A YEAR 1 volume was then calculated using the new diameter and commercial height of each tree.

The results from the stand table projection suggest that the 100 hectare Village Management Area could produce about 200 cubic meters of wood per year. Based on a small sample of house poles measured in Shinlonga, 1.0 cubic meter of wood contains approximately four to five 18 foot poles. The estimated volume growth of the VMA forest, therefore, is roughly equivalent to 800 house poles, or enough poles to construct 88 nine-pole houses or 67 twelve-pole houses. [NOTE: Larger houses in Shinlonga are framed using 12 poles].

It is important to emphasize that these rough estimates are subject to several sources of error. The assumed growth rate of 0.3 centimeter/year, while reasonable, even somewhat conservative for tropical trees (Lamprecht, 1989), may be an overestimate - or even an underestimate given the open canopy condition of most of the stand. Additionally, the diameter x height curve displays a considerable amount of variability for each diameter class, as indicated by the low coefficient of determination (R^2) of the polynomial fitted to the points. It is clear that the diameters and heights of a larger number of timber trees need to be measured and that the actual size-specific diameter growth of all timber trees in the VMA needs to quantified over several years. Of special importance is monitoring the growth response of different species to harvesting.

These caveats notwithstanding, the results from the stand table projection are of interest because they highlight the great management potential of the Village Management Area. The area contains a considerable amount of timber, these resources could be harvested and silviculturally treated to produce a sustained-yield flow of material, and 100 hectares seems to be an appropriately-sized resource base to satisfy the annual wood demand of the residents of Shinlonga.



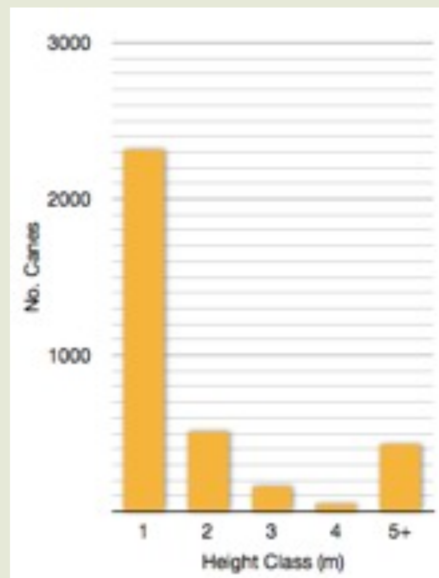
Relationship between commercial height and diameter of the 80 timber trees in the VMA. The line fitted through the points is a second order polynomial.

Rattan

There is a lot of rattan in the Village Management Area. Unfortunately, much of this material is from species of limited use to villagers, e.g. *myaukchee kyein* or *mokesoema kyein*, or of small, unharvestable size, i.e. ≤ 4 meters tall. In fact, the procedure that ultimately controlled how fast the transects could be run was the quantity of rattan that had to be cut through. Much of the forest comprising the VMA has been disturbed, and rattan species seem to grow best in these types of habitats. As was shown previously on the Forest Type map for the VMA, roughly 20% of the entire area is a rattan thicket.

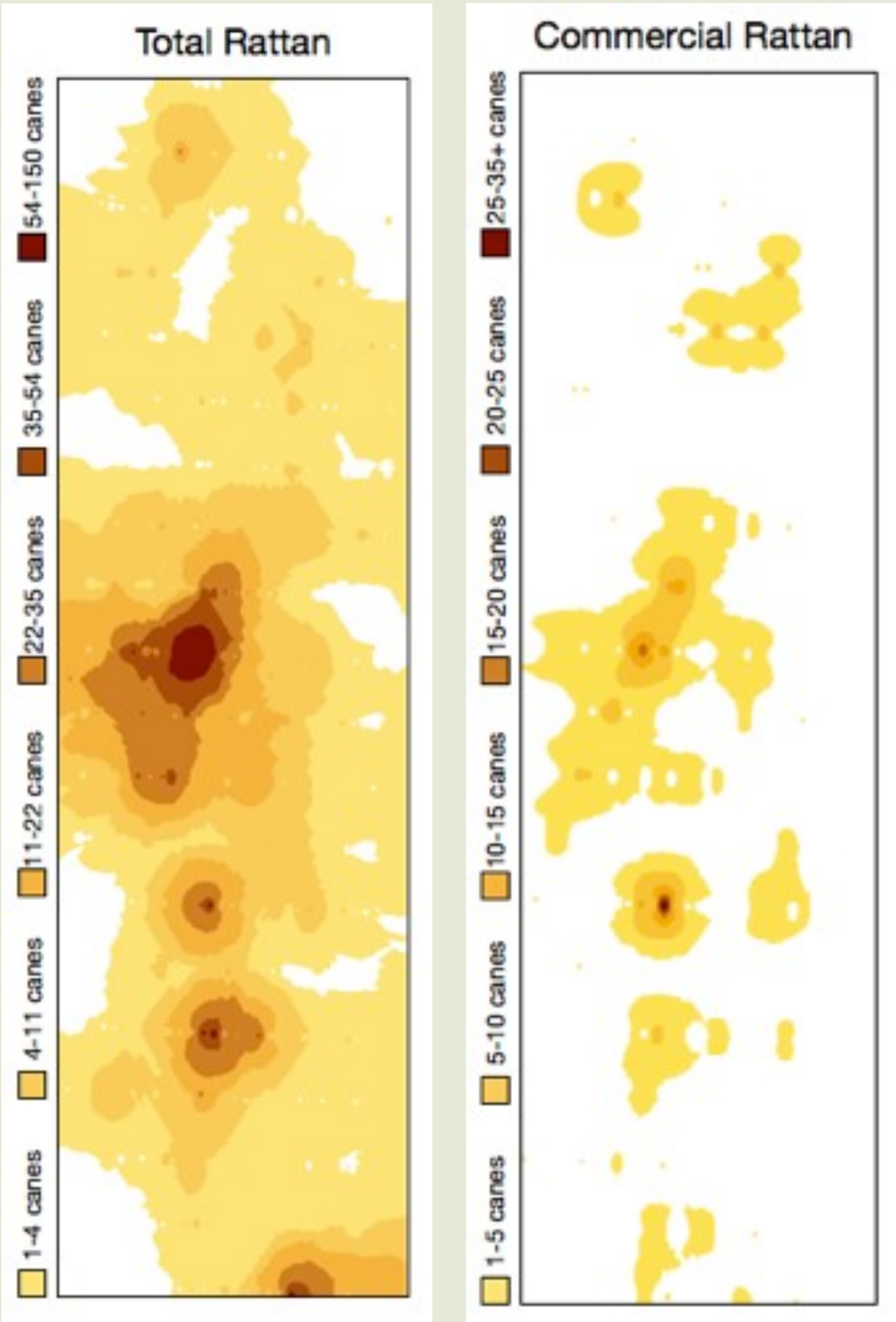
The only useful rattan included in the inventory, *pyant kyein*, was recorded at a density of 345.3 canes/hectare, i.e. 3,453 canes were counted. Sample plots from all five habitat classes contained *pyant kyein*, but over 70% of all the canes recorded were in plots classified as Secondary Forest. Only a small percentage of these canes were of commercial size. As is shown in the size-class histogram to the right for *pyant kyein*, less than 15% of the rattan canes encountered were longer than 4 meters. The shape of the size-class distribution for *pyant kyein* closely conforms to a negative exponential ; the peak at the 5+ class is an artifact of lumping all of the canes longer than 5 meters into a single class.

From a management standpoint, the situation with rattan in the VMA is relatively straightforward. There is an abundance of *pyant kyein* on the site, but most of the commercial stock has already been removed. [NOTE: There is still an estimated stock of 46 commercial canes per hectare]. The species, however, appears to be continually regenerating itself in response to different types of disturbance, and there are almost 100 canes per hectare of pre-commercial size that will soon be harvestable.



Size-class distribution of pyant kyein cane recorded in the VMA inventory.

The management of the rattan resource in the VMA is simplified somewhat because the resource occurs almost everywhere throughout the site. Using the plot result and the Village Management Area GIS, rattan maps (such as was previously presented for timber) were constructed for the 100 hectare management area. These maps, one for all rattan stems and the other only for rattan stems ≥ 4.0 meter long, are shown at the top of the next page. As can be appreciated, there are very few areas inside the VMA that do not contain some *pyant kyein* canes. There is one particularly dense clump with over 100 canes per plot located slightly to the west of



Spatial distribution of pyant kyein rattan throughout the 100 hectare Village Management Area. Commercial rattan is limited to canes ≥ 4.0 m long.

the center of the VMA in a tract of Secondary Forest. The concerted management of rattan could be initiated here, or in almost any other sector of the VMA. The main management objective would be to continually promote the establishment of new seedlings and/or the clustering of adult plants.

The map showing only the commercial *pyant kyein* is very useful for orienting the current exploitation of this species. There is not a lot of commercial length rattan in the management area, but there are still a few clumps which could be harvested in a controlled fashion to meet village needs. {NOTE: Controlled harvesting of a clustering rattan like *pyant kyein* would involve, for example, not clearing all of the stems to gain access to the merchantable cane, and always making sure to leave several healthy pre-commercial canes per clump (Dransfield, *et al.*, 2002)]. With the management of *pyant kyein*, in combination with the selective removal of several timber trees each year and the resultant canopy opening that occurs, the patches of commercial rattan cane in the VMA should enlarge and gradually start to coalesce.

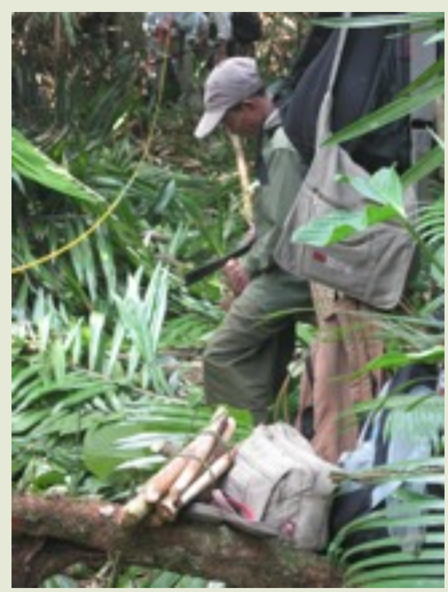
Medicinal Plants

The inventory results for medicinal plants in the Village Management Area are shown in the table below. *Katkyinat* was the most frequently encountered medicinal followed by *saythantai*. No individuals of *seegadone* were recorded in the survey. This could either reflect that the species is indeed very rare in the VMA, or alternatively, that in the dense undergrowth and rattan thickets that characterized many plots *seegadone* stems were overlooked. The fact that this medicinal plant was one of the most commonly used remedies recorded in the household surveys would suggest the latter.

Medicinal Plant	Number
Katkyinat	570
Saythantai	130
Sindonemanwe	89
Kyauksetnwe	17
Letpankha	3
Kyaukphauknwe	2

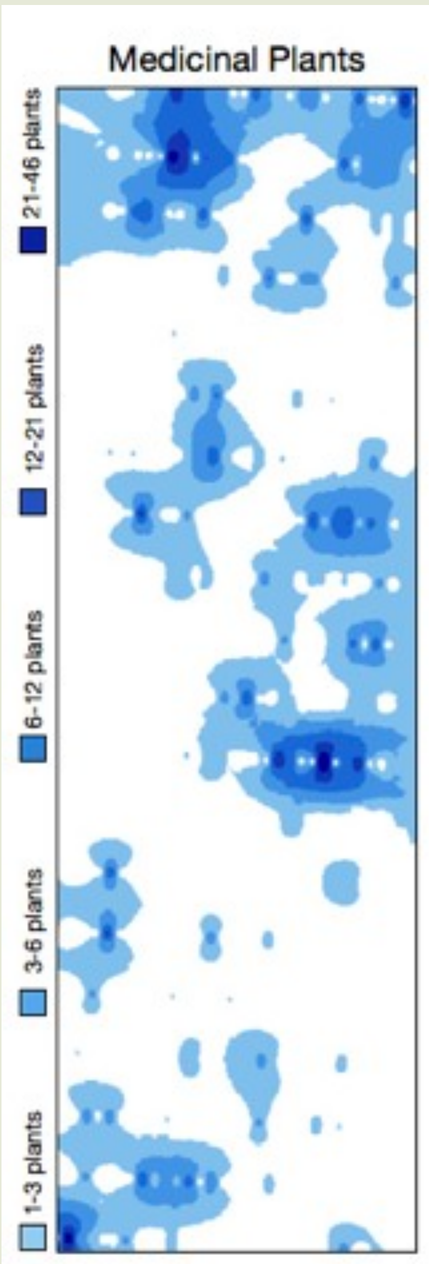
Medicinal plants recorded in 10 hectare (10%) sample of Village Management Area.

The spatial distribution of medicinal plants throughout the VMA is shown in the map on the following page. The greatest abundance of these resources seems to occur in three discrete clusters



Bundle of kyauksetnwe (in foreground) collected during inventory operations.

in the northern, eastern, and southwestern sectors of the management area. This aggregation provides a useful spatial basis for orienting the management of medicinal plant resources within the area. For example, by referring back to the timber (page 8) and rattan (page 10) maps, it can be appreciated that these same areas are relatively sparse in merchantable timber and rattan cane. The controlled harvesting and enrichment of the medicinal plants on these sites would provide management foci for gradually increasing the spread of medicinal plants over the entire area.



Spatial distribution of medicinal plant resources throughout the 100 hectare Village Management Area.

Next Steps

The selection, delineation, and inventory of the Village Management Area provide a strong foundation for the development of community forestry at Shinlonga. We now know quite a bit about the density, size-class distribution, and spatial distribution of the most important local forest resources, and we have some glimpses of the rate at which these resources may be replenished. Effective forest management, however, requires more than information about the current stock of resources and rough estimates of productivity. For forest use to be truly sustainable over the long term, we need to actually quantify the annual yield of the resources that we want to exploit, and outline a plan in which only the annual productivity of these resources is harvested each year. By documenting the annual growth of a resource and confining exploitation each year to only this amount, the basic tenets of plant ecology - as well as several hundred years of silviculture - tell us that a forest resource can be exploited on a sustained-yield basis for perpetuity. This, in essence, is the goal of the CBNRM project.

With this objective in mind, there are, at least, four next steps that need to be accomplished in the community forestry project at Shinlonga:

1. Initiate **yield studies** of important timber species and *pyant kyein* rattan. These studies should quantify the size-specific diameter growth for the timber trees, and the size-specific height growth and production of new shoots for rattan. [NOTE: *Calamus palustris* Griff. is a clustering rattan, yet little is known about the rate at which sucker shoots are formed or the relationship between harvest intensity and the production of new shoots (Dransfield and Manokaran, 1994)}. Growth studies for timber should utilize stainless-steel dendrometer bands to measure diameter growth (Liming, 1957), while yield studies for rattan should be based on the periodic re-measurement and stem counts of marked clumps.

2. Based on the growth data collected for timber and rattan, **annual harvest rates** should be defined for each of these resource groups. Depending on the initial management objective for each resource, e.g. enhance regeneration, maintain population size, stand improvement, allowable harvest level may equal or be less than measured growth rates (e.g. Davis, 1966; Peters, 1994). Preliminary harvest rates should be developed after completing one year of growth measurement, with the understanding that harvest levels may change as new data are collected. [NOTE: There is a very good possibility that growth rates for both timber and rattan will increase in response to the canopy opening and reduction in competition caused by harvesting].

3. Working in collaboration with members of the village management committee, develop a **comprehensive, written plan** for the sustainable exploitation of timber, rattan, and medicinal plants from the Village Management Area. This plan should include detailed prescriptions about harvest volumes, species, and logistics, allocation of resources among community members, delineation of harvest areas, sanctions for not following the plan, operational responsibilities, and long-term yield predictions and overall management objectives for the VMA. This management plan should be submitted for review/approval to the Myanmar Ministry of Forestry and the Warden of the Hukaung Valley Wildlife Sanctuary.

4. **Monitor** resource harvests and implement periodic regeneration surveys to maintain the sustainability of resource exploitation and

insure the long-term conservation of the forest. All timber and rattan resources should be marked in the field and located on a map of the VMA prior to harvest. Timber trees should be painted at both DBH and stump height; all merchantable rattan canes should be marked. After harvest, all resources should be counted and/or measured and recorded. Selected harvest trees and rattans should be spot checked to make sure there are no unmarked stumps or damaged rattan clumps.

At five to ten year intervals, low intensity regeneration surveys (*sensu* Peters, 1996) should be conducted to assess seedling and sapling densities of important timber species. Notable reductions in seedling abundances should be discussed and appropriate management responses (e.g. reduction in harvest levels, enrichment planting) implemented as necessary. These regeneration surveys, although time consuming and tedious, are the mechanism that ultimately controls the sustainability of forest exploitation by adjusting harvest rates to existing levels of seedling recruitment.

In addition to the work with forest resources in the VMA, village management activities should also proceed with the production of palm thatch and bamboo. As was outlined in the previous report (see *Report of Research, June 2009*), it is recommended that the traditional Kachin practice of planting bamboo and *tawhtan* (*Livistonia jenkinsiana* Griff.) around the perimeter of rice fields be promoted and facilitated by the CBNRM project. Village nurseries to assist with this effort are already being developed at Shinlonga (see image below), and these efforts should be expanded as more planting stock becomes available. In addition to *tawhtan*, the nurseries could also produce seedlings of timber trees for enrichment planting in the Village Management Area.

References

Davis, K.P. 1966. *Forest Management: Regulation and Valuation*. Second Edition. McGraw-Hill Book Company, NY.

Dransfield, J. and N. Manokaran. 1994. *Rattans*. Plant Resources of South-East Asia No. 6. Bogor.

Dransfield, J., F.O. Tesoro and N. Manokaran. 2002. *Rattan: Current research issues and prospects of conservation and sustainable development*. Non-Wood Forest Products No. 14. Food and Agriculture Organization of the United Nations, Rome.

Hundley, H.G. and U Chit Ko Ko, 1987. *List of Trees, Shrubs, Herbs, and Principal Climbers, Etc*. Fourth Revised edition. Swe Dan Oo Press, Rangoon Forest Department.

Husch, B., T.W. Beers, and J.A. Kershaw, Jr. 2003. *Forest Mensuration*. Fourth Edition. John Wiley & Sons, Inc.

Krebs, C.J. 1999. *Ecological Methodology*. Addison-Welsey Publishers, Inc.

Kress, W.J., R.A. DeFilipps, E. Farr and Daw Yin Yin Kyi. 2003. A Checklist of the Trees, Shrubs, Herbs, and Climbers of Myanmar. *Contributions from the U.S. National Herbarium* 45:1-590.

Lamprecht, H. 1989. *Silviculture in the Tropics*. Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ), Federal Republic of Germany.

Leak, W.B. 1964. An expression of diameter distribution for unbalanced, uneven-aged stands and forests. *Forest Science* 10:39-50.

Liming, F.C. 1957. Homemade dendrometers. *Journal of Forestry* 55:575-577.

Peters, C.M. 1994. *Sustainable Harvest of Non-timber Plant Resources in Tropical Moist Forest: An Ecological Primer*. Biodiversity Support Program. Washington, DC.

Peters, C.M. 1996. *The Ecology and Management of Non-timber Forest Resources*. World Bank Technical Paper No. 322. Washington, DC.

Philip, M.S. 1994. *Measuring Trees and Forests*. Second Edition. CAB International , UK.

Report of Research. 2009. *Community-Based Natural Resource Management in the Hukaung Valley Wildlife Sanctuary*. The New York Botanical Garden/Wildlife Conservation Society. New York.

Whitmore, T.C. 1998. *An Introduction to Tropical Rain Forests*. Second Edition. Oxford Press.

Win Kyi. 1998. Market study on Myanma lesser-used timber species. Forest Research Institute, Yesin.

Village nursery at Shinlonga. Seedlings are tawhtan (Livistonia jenkinsiana Griff).