

Technical Report for Second Six Month Period
and
Annual Report

Covering Period 1 October 1993 - 30 September 1994

Submitted to the Office of the Science Advisor
U.S. Agency for International Development

POPULATION BIOLOGY AND MANAGEMENT OF
SEASONAL EVERGREEN RAINFOREST IN ASIA

Principal Investigator: Dr. Peter Ashton
Grantee Institution: Harvard Institute for International Development

Collaborator: Sarayudh Bunyavejchewin
Institution: Silvicultural Research Division,
Royal Thai Forest Department, Thailand

Project Number: 11.574
Grant Number: HRN-560-G-00-3053-00

A.I.D. Grant Project Officer: Dr. John A. Daly

Project Duration: 30 September 1993 - 30 September 1996

Executive Summary

The overall aim of the program of the Center for Tropical Forest Science (CTFS) of the Smithsonian Tropical Research Institute (STRI) and Harvard Institute for International Development (HIID), within which this project is set, is to develop means to sustainably manage tropical evergreen forests, either for optimal production of goods and services, or for conservation of biodiversity. The objective of this project is to better understand the dynamic interrelationships between dry evergreen and mixed deciduous forests with one another and their site conditions in Thailand, in order to more effectively manage them for conservation of biodiversity. The specific purpose of the grant is to complete a large demographic plot in these two forest types, undertake seedling experiments and, in so doing, train Thai forest scientists in appropriate field and analytical techniques.

This project, originally scheduled for AID funding in 1991, had been initiated then but was continuing at a reduced level. The project continues to run very satisfactorily under the direction of Sarayudh Bunyavejchewin. The first census was completed in July. Mapping of tree positions was completed in August. Four Thai graduates in forestry have acted as team

leaders, and in so doing have become fluent in level survey, forest inventory and mensuration techniques, and in field identification of native tree species. Data input is proceeding.

Patrick Baker (Yale School of Forestry and Environmental Studies) has been continuing phenological observations on population samples of selected mixed deciduous and dry evergreen forest tree species, and has initiated seed collection for seedling experiments with five species. Baker carried out a preliminary soil survey during April-June.

Section I

A. Research objectives

Overall aim. The overall aim of the program, within which this project is set, is to develop means to sustainably manage tropical evergreen forests in Asia, either for optimal production of goods and services, or for conservation of biodiversity.

Eventual scientific objectives. (1) To understand the dynamic interrelationships between seasonal evergreen and moist deciduous forests in Thailand in order to formulate means to regenerate the former in the absence of fire. (2) To determine how species richness and patterns of commonness and rarity within forest types relate, on the one hand to overall patterns of forest composition, and on the other hand to environmental factors, especially moisture.

Immediate objective. To initiate long-term monitoring of a large forest sample, supplemented by associated sample of seeds and seedlings, so as to identify environmental correlates of species' performance. To test the following hypotheses: (1) that species of the seasonal evergreen forest will successfully establish in the moist deciduous forest, but not vice-versa; (2) that species of the seasonal evergreen forest variably invade the

moist deciduous forest, in the absence of fire, in spatial patterns correlating with soil moisture; (3) that performance of species' populations in adjacent stands in the seasonal evergreen forest and the moist deciduous forest is correlated with variation in soil moisture, thus influencing stand composition and species richness.

B. Research accomplishments

The overall aim of the program of the Center for Tropical Forest Science (CTFS) of the Smithsonian Tropical Research Institute (STRI) and Harvard Institute for International Development (HIID), within which this project is set, is to develop means to sustainably manage tropical evergreen forests, either for optimal production of goods and services, or for conservation of biodiversity. The objective of this project is to better understand the dynamic interrelationships between dry evergreen and mixed deciduous forests with one another and their site conditions in Thailand, in order to more effectively manage them for conservation of biodiversity. The purpose of the grant is to complete a large demographic plot in these two forest types, undertake seedling experiments and, in so doing, train

Thai forest scientists in appropriate field and analytical techniques.

The project continues to run very satisfactorily under the direction of Sarayudh Bunyavejchewin. This project, originally scheduled for AID funding in 1991, had been initiated then but was continuing at a reduced level. The first census, in which all trees ≥ 1 cm dbh were girthed, tagged and numbered, given preliminary identifications, and vouchered where unknown, was completed in July. Mapping of tree positions was completed in August. Data input is proceeding, albeit slowly. The level survey data have all been entered and, with collaboration from geographical information system (GIS) technicians at the Thailand Development Research Institute (TDRI), a series of computer graphics, including a 1 m contour map, a three-dimensional topographic map and slope maps have been prepared. Altogether, about 150,000 trees have been censused, including an estimated 320 species.

Phenological observations on population samples of 37 species totalling 400 individual trees were continued along a designated trail set up in March. Nineteen ninety four proved to be a year of heavier than usual flowering, and yielded abundant seed for the planned seedling experiments. Seed has so far been

collected from *Pterocarpus macrocarpus* (a rosewood), *Terminalia mucronata*, *Holarhena antidysenterica*, *Firmiana colorata*, *Miliusa* sp., *Litsea* sp., and *Hopea odorata*, and germinated. The *Firmiana* seeds suffered fungal attack and were lost, but the others are growing well in the shade house which was built in March-April.

A preliminary soil survey was undertaken during April-June. The relationship between soil and forest type proves to be complex. Broadly, mixed deciduous forest is associated with freely draining coarse sands, dry evergreen forest with sandy loams which become hard and impenetrable by roots during the dry season. Both soils become dry at depth during the hot dry season, April-May, but some moisture is retained in the first tertiary centimeters in the mixed deciduous forest soils, presumably because the trees do not transpire significantly when not in leaf.

Whereas fire, spreading in from burning dry rice stubble in 1993, moved widely through the sanctuary and ascended the highest hills, it was less widespread in 1994 perhaps because there were unseasonal rains in April. A ground fire entered one corner of the research plot in 1993, but not in 1994.

C. *Scientific impact of collaboration*

The project director, Sarayudh Bunyavejchewin, has been active throughout the project. He has been responsible for vehicle acquisition, other local acquisition, supervision of building the base camp, directing the plot survey and census, and hosting and advising Patrick Baker, the U.S. field participant.

Baker arrived in Thailand on 26th February, having taken tuition in the Thai language, which is difficult. He is making excellent progress in all respects. He interacts well with Director Sarayudh and with the in-country team. His research on phenology and the seedling experiments progress well in collaboration with Royal Thai Forest Department (RFD) tree physiologist Dr. Jesada Luangjame and his research assistant Sombhoon Kiratiyaprayoon for the seedling work, and Forest Ranger Seuh, Chief of the Khao Khaeo station for the phenology.

The plot set-up and census has been implemented by teams led by four young forestry graduates from Kasetsart University, Messrs Yung, Dio, Mu and Moo.

Principal Investigator Ashton visited the project in July, and will do so again in October. Accompanying him were Sarayudh, Baker (in residence), and Dr. Elizabeth Losos, Director of the Center for Tropical Forest Science of the Smithsonian Tropical Research Institute, in whose global program this project forms a

component (see "Overall Aim," above). Progress in the field and with data management were reviewed, and shortcomings discussed and decisions made to overcome them (see IF, II B, below).

CTFS/HIID Regional Coordinator Dr. James LaFrankie, based at Nanyang Technological University, Singapore, visited in April and in October.

D. Project impact

Results from project research cannot be expected before termination of the grant period, and no impact from them can be expected before then. The project, and the permanent facilities that it is installing, are acting as a magnet for other research which, wherever desirable, is being integrated to broaden the scope and applicability of the project research. These include:

- population genetic research on the numbered and mapped *Hopea odorata* population within the plot, and possibly other indigenous tree species, is being initiated by RFD researchers as part of a regional collaborative program of the Center for International Forestry Research, Bogor, Indonesia, an institution within the Consultative Group for International Agricultural Research;

- litterfall monitoring within the plot has started as part of productivity and carbon sequestration research being pursued by Sarayudh and colleagues in Kasetsart University;
- the base camp is also used by the Tree Flora of Northwest Thailand, a project also supported by USAID. One to three botanical artists are generally in residence now, preparing technical illustrations of the tree species from fresh material as it is brought in from the plot census;
- a census of small carnivores, under Mr. Saksit Sincharoen, is in progress, and another on nesting birds by Mr. Seuh.

E. Strengthening of developing country institutions

The project is achieving this in several ways:

- Mr. Sarayudh will be the principle user of the research data, and in charge of its analysis;
- The young graduate team leaders have acquired skills in level survey, tree mensuration, and field identification of indigenous species;
- Dr. Jesada and Mr. Sombhoon have agreed to undertake physiological research on comparative reaction to waterstress of the seedlings used in Baker's field experiments, using a

Scholander pressure bomb and Licor photosynthetic apparatus in their lab;

- A regional technical workshop will be organized by LaFrankie in Singapore, in November, to train collaborating researchers in computerized data management, and initial data analysis. Two participants from Thailand are invited. (Funded by UNESCO).
- Facilities provided include an automatic weather station (separately funded), a four-wheel-drive van for site access and without which the research would be impossible; and upgraded computer facilities for data entry, management and analysis (but see IF, II B, below).

F. Future work

The project is on schedule, except for data input which is still hampered owing to a shortage of computers in the office of Mr. Sarayudh at the Silviculture Section of the Forest Department (see section II B, below). At this time, the initial set-up phase is completed. Still to implement are:

- Training workshop (November 1994);
- Formal identification (January-February 1995);
- Outplanting of seedling experimental plots (October-December 1994);

- Monitoring of seedlings (continuing);
- Seedling watering experiments (April-May 1995);
- Soil water content measurements (January-June 1995, 1996);
- Plot recensus (January-June 1996);
- Analysis and publication (1996; continuing).

The CTFS program is committed to seeking funding to continue collaborative research at Huai Kha Khaeng, including five-yearly plot recensuses.

Section II

A.

The management of the project has proceeded extremely smoothly and amicably; so much so, that Sarayudh and Professor Tem Smitinand, formerly Deputy Director-General of the Royal Thai Forest Department (RFD) have requested us to extend our collaborative research to other forest types in Thailand.

Funding will not be easy to find!

The single management deficiency has been the inadequacy of computers in the Silviculture Section of RFD for data input. Two clerical staff are employed for this, but one further IBM-compatible computer is needed to complete data input and cleaning in timely fashion by the end of 1995. Because the Time Domain Refractometer, budgeted for precise monitoring of changes in soil water content, was found to be impractical under the rigorous field conditions at Huai Kha Khaeng, it is possible to acquire this computer for RFD within the budget (see IIB, below).

B. *Budget*

Spending has been within budget limits. We are waiting for approval from USAID to rebudget funds from soil moisture to computer analysis equipment.

C. *Special concerns*

None.

D. *Collaboration, travel, training and publications*

In view of the nature of the project, all collaboration is in the fields of scientific research and training, and has been described under Section I, C, D and E. No travel by in-country personnel or formal training has been undertaken during this first year. US participants traveling to the site were Mr. Patrick Baker, who arrived February 26th and is due for annual leave in December; Dr. James LaFrankie, who visited in November of 1993, and April and August of 1994, and will next visit between January and February of 1995; and Dr. P.S. Ashton, who visited in July of 1994, with a following visit planned in October of 1994.

Scheduled activities between October 1st 1994 and March 1995 include:

- Short visit by P.S. Ashton, for consultations; October 1994;
- Data management and analysis seminar/workshop, CTFS regional office, Singapore (two Thai collaborators, LaFrankie, and STRI/CTFS staff; November 1994);
- Formal identification of tree herbarium vouchers at RFD, Bangkok (LaFrankie; January-February 1995);
- Leave for P. Baker from mid-December 1994 until mid-January 1995;
- Mr. Sarayudh has been invited by the Smithsonian Tropical Research Institute to its Tupper Research Building in Panama to initiate analyses with STRI/CTFS collaborator and quantitative ecologist Rick Condit. We expect this to take place when the data are cleaned and ready, in 1996.

E.

There are no requests for AID or BOSTID actions.

Population Biology and Management
of Seasonal Evergreen Rain Forest
ACCT # 421-7012
421-7016

	Expenses thru 9/94	Budget	Balance
Graduate Research Associate Stipend	5,941.59	33,713	27,771.41
Travel and Per Diem	5,052.00	16,608	11,556.00
Equipment	0.00	10,000	10,000.00
Other Direct Costs	2,400.49	11,594	9,193.51
Subcontract to the Royal Thai Forestry Department	38,380.00	55,390	17,010.00
Subtotal	51,774.08	127,305	75,530.92
Amount Subject to Overhead	13,394.08	62,410	49,015.92
Overhead @ 26%	3,482.46	16,227	12,744.54
Total Expenses	55,256.54	143,532	88,275.46
	55,256.54		

Cash Receipts

3/21/94	4,846.88
6/30/94	4,717.26
6/30/94	66.53
9/21/94	6,031.36
9/21/94	38,313.47

total 53,975.50

cash balance 1,281.04

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