

At present, field collections have been made for 73% (19 out of 26) of all the study sites of four *Johannesteijsmannia* species in Thailand and Malaysia. Collections have been subjected to the following analyses: morphometric, molecular, and phylogeny.

Morphometric Analysis. Some preliminary phenograms using morphological characters for each species using the samples have been collected. Most of the populations examined were morphologically indistinguishable. However, differences were observed in the inflorescence morphology for *J. lanceolata* at two study sites. For the plants at the Angsi Forest Reserve (Negeri Sembilan, Malaysia) their inflorescences show more rachillae when compared with those of the Sungai Lalang Forest Reserve (Selangor, Malaysia). Populations in Pahang (Malaysia) will have to be examined before any conclusions could be drawn.

Molecular Analysis. Amplified Fragment Length Polymorphism (AFLP) fingerprinting was carried out for *J. altifrons* from eight populations. Eight primer combinations were screened but only six have been selected for the analysis as they produced more polymorphic bands. A total of 418 bands were scored, of which 316 were polymorphic. Analysis using the software AFLP-SURV 1.0 was carried out to estimate the genetic differences within and among populations. Preliminary results show that the genetic variation among populations can be detected although they are morphologically indistinguishable. Also, cluster analysis was done using the computer programme Multi-Variate Statistical Package (MVSP) version 3.10b. The cluster analysis showed that most of the individuals from the same population are clustered together.

Phylogeny. Interests are in studying the relationships of *Johannesteijsmannia* with its sister group *Licuala* and selected taxa from the same subfamily Coryphoideae. DNA sequencing will be carried out using the three targeted nuclear genes or regions, viz., genes encoding for phosphoribulokinase (*PRK*), the second largest subunit of RNA polymerase II (*RPB2*) and 5S ribosomal DNA. DNA sequencing has been successfully optimised and developed for *PRK* and *RPB2*. Both the genes, *PRK* and *RPB2*, have been amplified. PCR amplification for *PRK* yielded a band of approximately 700 base pairs (bp) and that for *RPB2* yielded a band of approximately 900 bp. Both regions have been cloned into a vector and then sequenced. Next activities to be done will be on trying out the protocol for amplifying and sequencing 5S ribosomal DNA. ■

VIETNAM

Project Title: The study and conservation of bryophyte diversity of Vu Quang Protected Area in Ha Tinh Province

Project Leader: Tran Ninh, National University of Hanoi, Vietnam

Although bryophytes play a significant role in the forest ecosystem and perform a vital ecological role as a whole, the knowledge of Vietnamese on bryophytes is still uneven and fragmentary. Easily accessible mountains such as Tamdao Mountains, Hoang Lien Son mountainous range, have been visited by various expeditions and collectors whereas in large areas of Vietnam including Vu Quang Protected Area no collections have been made yet.

Vu Quang Protected Area is an area of spectacular natural beauty for tourism. It is largely a mountainous area sharing its border along the western side with Laos. It has global importance from the recent discovery of *Psudoryx nghetinhensis* and *Megamuntiacus vuquangensis*, respectively the sixth and seventh large mammals discovered during the past 100 years.

During the first year of the project, about 1500 packets of mosses and liverworts were collected in three expeditions. Preliminary determination of some 200 packets belonging to liverworts and mosses include: four species new to science, namely *Cololejeunea vuquangensis* Pocs; *Colura brevistyla* Herz. var. *vietnamica* Pocs; *Frullania tranninhiana* Pocs and *F. vuquangensis* Pocs; and eight species new to Vietnam, namely: *Cololejeunea madothecoides* (Steph.) Ben; *Dumortia hirsute* ssp. *Nepalensis* (Tay.) Schust.; *Frullania junghunhiana* Gott.; *Heteroscysphus zollingeri* (Gott) Schiffn; *Lejeunea anisophylla* Mont.; *Lejeunea exilis* (Reinw.) Grolle; *Lejeunea obscura* Mitt.; *Plagiochila aff. Javanica* (Swartz) Dum.; and *Plagiochila intergrilobula* Schiffn. More packets need to be identified and classified in the second year of the project.



Bryophyte

Project Title: Biodiversity assessment in the Ha Long Bay Heritage Area and proposition of management plans

Project Leader: Nguyen Van Tien and Tu Lan Huong, Hai Phong Institute of Oceanology

Recognised as a World Natural Heritage by UNESCO in 1993, Ha Long Bay is rich in economically valuable resources such as coral reefs, mangroves and seagrasses.

The project aims to conduct an inventory of the species richness, aquatic resources, ecological conditions and their changes of the Bay; assess its marine biodiversity; conduct rapid appraisal of environmental conditions, utilization status, development activities and threats to marine biodiversity; and propose management plans, which include mapping of marine biodiversity zones and involving the community in the management work.

Results of samples obtained from the three field surveys show that the species diversity of organisms in the Ha Long Bay is high. Some 2,099 species of marine organisms were recorded, and included 278 arephytoplankton, 53 foraminifera, 129 seaweed, 5 seagrass, 16 mangrove, 141 zooplankton, 146 corals, 554 zoobenthos, 147 fish, 107 coral fish, 435 plants on islands, 76 seabirds, and 22 mammals on islands. The total number of species obtained from the present surveys was approximately three times (2,099 species) higher than the past records (753 species).

More than 150 species of economic importance were found in Ha Long Bay. These are divided into five groups, namely: species for export; food group; raw material for fine arts; medicine; rare and precious species.

The 32 species for export include seaweeds, gastropods, bivalves, squids, crabs, fishes. The most significant species are: snappers, Epinephelus, mackarels, tunas, Gracilaria, Haliotis, blood ark, pearl shell and oysters, loligo, sepia and sea crabs. There are 36 other species used as food, and these include "Sa Sung" (*Sipunculidae*), "tu hai" (*Lutaria rhinchaena*), "Ngo den" (*Dosinia laminata*), "trung truc" (*Sinovacula constricta*), *Ostrea*, scallop, fish and seaweeds.

Ha Long is a city that is highly urbanised, with an urban population of over 95% that threatens the ecosystem. The Bay area surrounding the City with water surface area of 2,000 hectares and the 50-km coastal areas offer a good site for seafood aquaculture, thus, tidal coastal areas in Cua Luc, Yen Cu, Dai Yen and around Tuan Chau Island have been used extensively for intensive farming and industrial

fishing. The mangrove forests from Cai Dam, Lan Be Gieng Day to Van Yen, Le Loi, Thong Nhat are being devastated. Threats to the coral reefs are overexploitation of branching coral for fine arts in tourism centres and hotels, digging on reefs to find mollusk and capture fishes.

The sustainable use and development management of Ha Long Bay is much needed. The project included recommendations on fishing seasons, gears, exploitative production, governance, and aquaculture. The project finds it worthy to protect specific areas such as Tuan Chau Island, Cong Do, Vung Ha, Ba Cat, Hang Trai, Dau Be, Cai Dam, Dau Moi, Dau Go.

Project Title: Introduction of rare and endangered medicinal plants into the forest gardens of ethnic minorities

Project Leader: Luu Dam Cu, Institute of Ecology and Biological Resources (IEBR), Hanoi, Vietnam

About 3400 species of medicinal plants are known to occur in Vietnam. More than 80% of them are distributed and grow wildly in the mountainous provinces. Harvesting of wild medicinal plants is one of the important sources of economic income for ethnic groups living in the mountainous areas. A large number of the medicinal plants are also used for traditional pharmacies in the whole nation.

The demand for the medicinal plants caused many species to become rare and endangered of extinction. These species include: *Coptis sinensis*, *C. quinquiserta*, *Panax bipinnatifidus*, *Berberis wallichiana*, *Nervilia fordii*, *Valeriana jatamansii*, *V. hardwickii*, *Thalictrum foliolosum*, etc. The research study was thus proposed in order to determine how the introduction and development of medicinal plants in forest gardens of ethnic minority groups would change the present state or condition of the said species in the area.

The project specifically aims to study the *ex-situ* conservation of rare and endangered medicinal plants and develop them to become economic products and regular crops in the forest-gardens. It is hoped that through this project, conservation of these plant species and alleviation of poverty in mountainous areas could be addressed and improved.

The selected study site for the project is the Ban Khoang, Sapah communes belonging to Sapa district, Lao Cai province. In these communities, there is a primitive forest with high biological and cultural diversity. The ethnic minorities living in the area are Dao (Jiao) and Hmong (Miao) groups who regularly gather medicinal plants in the forest.

For the first year of implementation, 22 rare and endangered medicinal plant species were found/discovered in the primitive forests of Lao Cai province. For the study on introduction, 12 forest gardens were established (five in the Hmong community and seven in the Dao community). The 14 selected medicinal plant species were cultivated in the forest gardens, and all species except for one (*Anoectochylus roxburghii*) were introduced successfully.

As part of the information and education campaign of the project, two training courses were organised and conducted in Taphin and Bankhoang communities with the active participation of local people (Hmong and Dao) on the following topics: a) Techniques on agriculture and biodiversity conservation (gathering, cultivating and managing wild medicinal plants); and b) Techniques for preserving and processing medicinal plants.

These training boost the importance of indigenous knowledge system (IKS) of local communities / ethnic minorities in resource management. Their IKS could indeed support conservation of the medicinal plant species if aptly used or applied. This is the first time in the country where some endangered medicinal plants become economic crops in the forest garden of ethnic minorities.

Project Title: Protection of four endangered species in Upper Stream Gam River

Project Leader: Dr. Le Than Luu, Department of Environment and Aquatic Resources Management and Protection, Research Institute for Aquaculture No.1

The Red River system occupies 134,000 km² and is the biggest system in Northern Vietnam. The river strongly influences the lives of nearly 25 million people living in its basin. Gam River is one of the biggest rivers in the Red river system and accounts for about 20% of its sources. Nowadays, the upper Gam River remains one of the richest in terms of aquatic resources and biodiversity. Recently, the Institute of Aquaculture No.1 has carried out a Situation Appraisal on fish fauna in this region. The Institute reported that although a number of fish species were recorded, the fish resources in the area had critically decreased. Valuable fish species such as *Mastacembelus amatus*, *Bagarius yarrelli*, *Spinibarbus denticulatus*, *Balantiocheilus macracanthus*, *Semilabeo notabilis*, and *Sinilabeo lemossoni* are under great pressure due to over exploitation and degradation of their habitats. These species are caught in all sizes by different fishing methods including electric high voltage traps. At

the same time, bottom sand and stones are mined to screen gold traces. This has seriously degraded the habitats and breeding grounds of fishes. The threatened species identified are *Hemibagrus guttatus*, *Bagarius yarrelli*, *Semilabeo obscurus*, *Spinibarbus denticulatus*.

In terms of research, those that have been carried out include some studies on the distribution and breeding season of these species. However, these studies were not directed towards their protection. The Government decided on building a dam at the lower part of the river and this may seriously affect the aquatic resources particularly the fishes. This research grant project therefore aims to study the biology, ecology and habitats of the threatened species to serve as fundamental base to propose and appropriate conservation measures.

The study sites selected for the study are Nahang – Tuyenquang, Bacme-Hangieng, Baolac – Caobang and Chiemhoa – Tuyenquang. After a year of implementation, important biological characteristics such as distribution, growth rate (age, length, weight), feeding habits, gonad development and breeding grounds of the four endangered species in Upper Stream Gam River were determined and analyzed.

In Gam River, the two-fin-fishes (*Spinibarbus denticulatus* and *Semilabeo obscurus*), and two catfish species - *Bagarius yarrelli* mainly distributed at Bacme to Nahang, and *Mystus guttatus* from Nuido down stream to Tuyenquang - are the focus of this study. With the present river conditions, the growth rate of these four endangered fishes is low and *Semilabeo obscurus* has the slowest growth rate. These fish species will become extinct if overfishing continues.

Spinibarbus denticulatus is a typical omnivorous species. The fish feeds on both vegetable and organic debris, even animal meat. *Semilabeo obscurus* on the other hand, eats mostly algae on rocks' surface. On the other hand, the two catfishes *Mystus guttatus* and *Bagarius yarrelli* are carnivores and prefer to eat small fish, crustaceans and other small aquatic animals.

Spinibarbus denticulatus, *Mystus guttatus* and *Bagarius yarrelli* mature at 4 years of age and reproductive capacity is highest at the ages of 7 or 8, while *Semilabeo obscurus* develops gonad after 2 years. Breeding season of the two catfishes and *Semilabeo obscurus* is during heavy rainy season from June to September, whereas *Spinibarbus denticulatus* breeds from April to June and September to October. The exact breeding ground of the two catfishes is not yet known, although some evidences of fry appearance, gonad development, and breeding grounds were found in Noido, Nahang town and Tuyenquang (where

high fish concentration can be found). *Semilabeo obscurus* migrate to caves for breeding, four of which are in Thantuong, Thuyloa and Bacme.

Based on their growth rate, feeding, living habitat and strong resistance to diseases, the investigated fishes, except *Semilabeo obscurus*, indicate that they can be good pond-cultured species.

Baseline information on the biological characteristics of these threatened species were used to recommend conservation and development measures such as:

- a) Building species areas. Reserved zones for the natural recovery and development of the fish species should be established. In Gam River, the parts of Nahang to Bacme are desirable for building species areas. However, it is the centre of the planned reservoir of the government. Other suggested areas are Babe National Lake, Nang River and the upper stream at Baolac. Biodiversity is considered rich/high in these areas because the distribution of inhabitants is scattered and the impacts from human activities on natural resources are minimal.
- b) Improving management and regulation. Over-fishing is the main threat to these species. Local authorities need to control fishing activities and protect/conservate the aquatic resources through effective enforcement of existing laws.
- c) Community-based management. Local people should be organised and educated in managing their aquatic resources.
- d) Developing aquaculture. Aquaculture plays a very important role in mountainous areas as it creates food supply, employment and income-generating activities. The aquaculture practice in these areas lacks technical 'know-how', resulting in the outbreak of diseases and pollution in ponds. They do not know the causes of fish death and slow growth rate of fishes. Technology transfer and training are necessary for the proper establishment and management of fish-ponds.

Project Title: Investigation on the insect biodiversity of Bach Ma National Park in Thua-Thien, Hue Province

Project Leader: Dr. Le Trong Son, Faculty of Science, Hue University

One of the seven national parks in Vietnam, Bach Ma is located in Thua Thien Hue province (Phu Loc and Nam Dong Districts) on the eastern edge of the Annamite mountain chain. The mountain chain forms



Coleoptera

the natural boundary between Vietnam, Laos and Cambodia. Estimates as to the size of the park vary from 18,900 to 25,000 ha, although the official figure is 22,030 ha. The estimated altitudinal range within the park is from 50 to 1,448 meters above sea level (asl). Floristically, this conforms to the three habitat ranges of lowland (0-700 m asl), transitional (700-1,100 m asl), and lower montane (1,100 -1,500 m asl).

In recent years, some entomological studies have been done, and some authors have made a preliminary report on the general ecological investigation with reference to biotopes of insect biodiversity in Bach Ma National Park. In July and August 1993, five members of St. Catherine's College, Oxford and three Vietnamese scientists investigated the diversity of *Formicidae* and *Sphingidae* within the national park and assessed the suitability of the latter as an indicator of habitat diversity. The study of Bach Ma's moths fauna has a potential role in monitoring the effect of conservation strategies in the area.

The project's overall goal is to provide the basis for the management of insect biodiversity in Bach Ma National Park. The study focused on two major orders, namely: *Coleoptera* and *Lepidoptera*. After a year of implementation, the project found 721 species, 237 genera, 82 families and 16 orders of insects, of which 8 orders, 41 families and 280 species are new. These specimens will be analysed during the remaining months of the project. It is expected that at the end of the project, a field guidebook of insects in BMNP shall have been published.

Project Title: Study on ant biodiversity in Vietnam

Project Leader: Dr. Bui Tuan Viet, Institute of Ecology and Biological Resources

Ants are important components of ecosystems because they constitute a great part of the animal

biomass and act as ecosystem engineers. Ants are ideal bio-indicators because they are diverse and abundantly found in almost every habitat in the world. Ant biodiversity is extremely high, particularly in the tropical rainforest. Many ant species are highly sensitive to microclimate and habitat structure and respond rapidly to environmental changes. These organisms are highly responsive to human impacts, which reduces their richness.

In Vietnam, there are few foreign scientists who have interests in collecting ants. This project, which promotes taxonomy and systematics, provides a reference collection of ants and basis for inventory and monitoring of this diverse group in the country.

After a year of project implementation, the research team collected 2,500 ant specimens from six sites: Ba Vi National Park, Cuc Phuong National Park, Sa Pa, Nha Trang and Ho Chi Minh City, Huong Son Forest, Bai Tu Long National Park, and identified 170 ant species belonging to 60 genera and 8 subfamilies. The collection is still in the initial stage but it is virtually the first ant fauna collection in Vietnam.

Most of the specimens were identified up to the genera level, and others up to the species level. The ant specimens were sorted into genus using the key book of Bolton



Pheidole

(Identification Guide to the Ant Genera of the World). The identification of ants into species was done in Kagoshima University, Japan. Most of the genera of ants were checked into species by Prof. Seiki Yamane; the genus *Pheidole* by Dr. Katsyuki Eguchi; the genus *Myrmecina* by Mr. Okido Hirofumi (Kyushu University); the genus *Polyschachis* by Rudolf J. Kohout; the genus *Dorylus* by Mr. Stefanie M. Berghoff, Department of Animal Ecology and Tropical Biology, Biozentrum, Am Hubland, University of Wuerzburg. From this project, two new *Myrmica* species (*M. titanica* and *M. yamaneii*) and one species new to Vietnam were found.

The project successfully conducted the 3rd International Workshop on Ants at the Institute of Ecology and Biological Resources, Hanoi, Vietnam, and was attended by 26 foreign delegates (from Australia, Germany, Korea, Japan, Malaysia, Sri Lanka and Thailand) and 24 Vietnamese scientists. ■

INDONESIA

Project Title: Research and conservation of the hawksbill turtle (*Eretmochelys imbricata*) in Indonesia

Study Leader: Dr. Matheus H. Halim, Fauna & Flora International Indonesia Programme, Bogor, Indonesia

Introduction. The hawksbill (*Eretmochelys imbricata*) is one of six species of marine turtles occurring in Indonesia. The others are leatherback (*Dermochelys coracea*), olive ridley (*Lepidochelys olivacea*), green (*Chelonia mydas*), loggerhead (*Caretta caretta*), and flatback (*Natator depressus*). All of these species are highly migratory, often passing through territorial and international waters, from feeding to nesting grounds and back. The turtles are likely to come from an area within a radius of 2,500 kilometers around the nesting area (Limpus 1993). Stark (1992) reported that a tagged leatherback from Irian Jaya, Indonesia was discovered in Cebu, Philippines; this shows that the sites of tagging and recovery were separated by some 1,900 km.

The post nesting migration of five female green turtles monitored by satellite tracking from Redang Island, Malaysia showed movement into Indonesian territory in Belitung, Tambelan and Natuna, after being released 28 days (1,153 km), 16 days (714 km) and 13 days (669 km), respectively. Information on the migration of green and leatherback turtles mentioned above indicates that the hawksbill turtle in Indonesia has the possibility of migrating to neighbouring countries, but so far there has been no information on the migration of the hawksbill population from this region. There has yet been no intensive study that would determine the migration patterns of this marine turtle in Indonesia.

The hawksbills occur widely with low nesting densities throughout the Indonesian archipelago. For instance, in the Segamat rookeries (ca. six hectares and two hectares), only 150 nests were found per year. Salm and Halim (1982) recorded 143 nesting sites throughout Indonesia. Some 80 nesting sites were used by hawksbills for laying their eggs and most of these rookeries are located in very remote areas with very poor accessibility. Hawksbill and green turtles have the most depleted turtle species populations in Indonesia due to over harvesting for a long time, including egg harvesting and the utilization of their flesh, carapace, bones, etc. Although the Indonesian government issued Government