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Biodiversity assessment of limestone karst dependent bats in Myanmar (Burma)

Darwin Initiative Final Report, April, 2002 – March 2005

11-019 FR - edited Oct 04

Contents

Darwin Initiative for the Survival of Species

Final Report

1. Darwin Project Information

Project Reference No.	162/11/019
Project title	Biodiversity assessment of limestone karst dependent bats in Myanmar (Burma)
Country	Myanmar (Burma)
UK Contractor	Dr Paul Bates, Harrison Institute
Partner Organisation (s)	Yangon University
Darwin Grant Value	2002/3 £42,677; 2003/4 £39,958; 2004/5 £37,750; Total £120,385
Start/End date	April 2002 - March 2005
Project website	www.harrison-institute.org/Darwin
Author(s), date	Dr Paul Bates, 13 June, 2005

2. Project Background/Rationale

- The project was located in Myanmar and the UK. It was a joint project conducted by the Harrison Institute, Kent and Yangon (Rangoon) University. The laboratory-based training and research component took place at these two facilities. The field component was conducted in the limestone karst areas of Myanmar and involved field work in eight states and divisions, primarily in the east of the country (see page 5).

- In general terms, the project aimed to address the problems associated with the long term isolation of Myanmar's scientific community. Over the years, this has restricted the ability of staff and students in the Zoology Department, Yangon University to (a) conduct research to an international standard and (b) limited their potential to promote and support wildlife conservation within Myanmar.

  It was focused on bat research and sought to address the needs of the bat research and conservation community both within and outside Myanmar. These needs included:
  - training of Yangon University staff and students, with the aim of creating a core group of in-country scientists capable of studying and disseminating data nationally and internationally on a wide range of bat-related research and conservation topics.
  - a lack of data concerning the diversity, echolocation, distribution, ecology and behaviour of bats in Myanmar. This study focused on the bats of the limestone karst areas, with particular reference to those species roosting in caves. Prior to the studies of the Harrison Institute/Yangon University,

Forested outcrops of limestone karst in Mon State, Myanmar. Buildings mark the entrance to Hpa-Paung (Phaboung) cave.

there had been no publications on bats in international journals based on contemporary field studies in the post WWII period.

- In Myanmar, the need for the project was identified in January, 1999, during a visit of Dr Paul Bates to Yangon University with the UK-based Scientific Exploration Society. Professor Daw Tin Nwe of the Department of Zoology invited the Harrison Institute to undertake joint research and training programmes in biodiversity studies and to help train University staff and students. An MoU was signed in June, 2000. This was the first MoU between the Zoology Department and an international institution.

  For the international community, the project reflected the needs of the:
  - IUCN Global Status Survey and Conservation Action Plan for Microchiropteran bats (2001), which identified Myanmar as a priority area for research
  - IUCN Asia Pacific Forum on Karst Ecosystems and World Heritage (2001), which highlighted the need for scientific research in the karst areas of Myanmar.

Prior to the Darwin, several small projects were undertaken by the Harrison Institute in collaboration with Yangon University. These were sponsored by a variety of sources such as the 100% Fund of Fauna and Flora International and resulted in the discovery of four bat species and one family new to the fauna of Myanmar. These included globally endangered and near threatened taxa. The records all came from limestone karst areas and were published in two joint papers in international peer-reviewed journals (Bates *et al*., 2000 & 2001).

Darwin trainee Dr Mar Mar Thi addressing the 13th International Bat Conference in Poland in August, 2004.

From these pre-Darwin studies, it became apparent that Myanmar had an important role to play in the conservation of globally threatened bat taxa, particularly those associated with limestone karst. It was also clear that Yangon University was committed to participate fully in joint studies by contributing staff, students, laboratory facilities and administrative backup. Therefore, the Darwin Initiative project was proposed.

3. Project Summary

- The purpose of the project was to ensure that Myanmar fulfils its potential in conserving limestone karst dependent bat species, including globally threatened taxa.

  Outputs that are completed and contribute to this purpose include:
  - 8 international surveys (and numerous student organised field studies) of bats in Myanmar
  - 2 collections of voucher specimens – one in Yangon University and one duplicate collection in the Harrison Institute
  - 4 papers published in peer-reviewed international journals
  - 4 papers accepted or submitted to international journals
  - 1 identification key for Myanmar bats
  - 1 database of caves
  - 3 reports on surveys and workshops circulated to stake holders
  - 9 species added to the national inventory of bats, including one species new to science (*Kerivoula kachinensis*)
  - 6 PhDs in bat studies completed by Darwin trainees
  - 6 workshops in Myanmar with international delegates
  - 9 oral presentations and 4 posters presented at international conferences in the UK, Ireland, Poland and Vietnam.
  - national bat data from limestone karst and other areas of Myanmar included in the Southeast Asian Mammals Databank of the IUCN
  - links strengthened between the Myanmar and the international research and conservation community
  - aspects of environmental education taught at workshops

  Outputs that are in progress and will contribute to this purpose include:
  - 2 PhDs to be completed in November, 2005
  - 1 illustrated publication summarising the Darwin project and identifying priority bat species and geographical areas for conservation. To include a short action plan for cave bats and a management plan for 'key' limestone karst sites.
  - Lobbying to ensure that bats and limestone karst habitats are given equal status within the Protection of Wildlife and Natural Areas law as other 'priority' species and habitats

- The overall operational plan was not significantly modified. Some minor changes were made and Darwin staff notified, for details see Section 6.

- The project addresses Articles 7, 8, 10, 12, 13, 17 and the Global Taxonomy Initiative of the CBD.

Several colonies of the globally endangered bumble-bee bat, Craseonycteris thonglongyai, the world's smallest mammal, were discovered during the Darwin study.

- The training and research aspects were successful and exceeded the initial objectives. For example, 8 students from Yangon University were trained for three years as opposed to 12 students for only one year each. In consequence, the training was of much higher quality than originally envisaged (for details see Section 4). The objectives concerned with research were also more successful. Several unexpected discoveries were made. For example, a new species of bat for science (*Kerivoula kachinensis*) (Bates *et al.,* 2004b) was described. Also, several colonies of the globally endangered bumble-bee bat (*Craseonycteris thonglongyai*) were discovered (Pereira *et al.* submitted)

However, the conservation objectives were only partially achieved. On the positive side the bat data have already been included in an international database (Southeast Asian Mammal Databank of the IUCN submitted in May, 2004), which will be available to all researchers and conservationists via the internet. However, it proved difficult to build a meaningful dialogue with the Nature and Wildlife Conservation Division of the Forest Department to promote in-situ conservation or to lobby for bats to be considered 'priority species', not least because bats do not appear to be significantly threatened at the moment.

Significant additional accomplishments included:

- o introducing other UK bat scientists (Dr Tigga Kingston, Dr Stephen Rossiter and Matt Struebig) to zoologists from Mandalay University. This has led to the rapid development of a second centre of bat research in Upper Myanmar, which complements that of Yangon in the south.
- o developing links between Yangon University scientists and international biodiversity experts from the UK, India, Malaysia, Australia, Portugal and the USA in a range of study subjects, some concerned with bats, and others with organisms such as birds, molluscs, and palms.

4. Scientific, Training, and Technical Assessment

- **Research**

Harrison Institute staff: Dr Paul Bates and Dr Iain Mackie

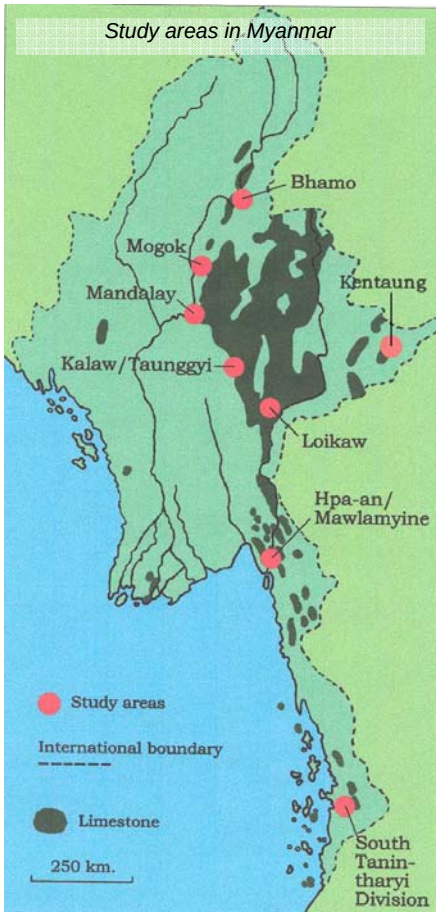
Yangon University staff: Professor Daw Tin Nwe (Head of Department of Zoology)

and Dr Si Si Hla Bu (Associate Professor of Zoology)

- **Methods**

Prior to the Darwin project, a literature review gathered information on Myanmar's bat fauna and a species inventory was made (Bates *et al*., 2000 and 2001). A study of the geological literature was undertaken and the principal areas of limestone karst in Myanmar were identified (Bates and Tin Nwe, 2001).

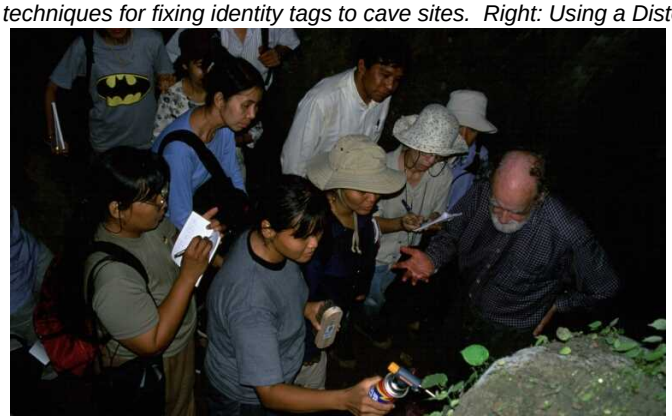
Initially seven areas (Areas 1-7 listed below) located on the western margin of the principal limestone regions of Myanmar were chosen for study. These areas were accessible and according to the literature had the most developed karst scenery, including extensive cave systems, which provide ideal roosting sites for bats.



With the exception of Mogok and Loikaw (Areas 2 and 5), each area was visited at least once by a Darwin team comprising UK staff and Myanmar staff and students (often with additional international researchers and/or trainers). Because of difficulties with permits for foreigners, Mogok in western Shan was not visited during the lifetime of the project (although it was prior to the study) and Kentaung (Area 8) in eastern Shan was substituted in its place. Because of security considerations, Loikaw in Kayah State was visited by Myanmar staff and students only.

Area 1: Bhamo area in southern Kachin State
Area 2: Mogok area in eastern Mandalay Division
Area 3: Mandalay area in Mandalay and eastern Sagaing Divisions and western Shan State
Area 4: Kalaw and Taunggyi areas in southern Shan State
Area 5: Loikaw area in Kayah State
Area 6: Hpa-an and Mawlamyine areas in Kayin and Mon States
Area 7: Southern Tanintharyi Division
Area 8: Kentaung in eastern Shan.

Left: Prof. Elery Hamilton-Smith of the IUCN Asia Pacific Forum on Karst Ecosystems instructs the Darwin trainees in the techniques for fixing identity tags to cave sites. Right: Using a Disto laser measurer to record cave dimensions.



As many caves as possible were surveyed within each limestone karst area. Caves were given a unique identity code and where time permitted small aluminium identity tags were fixed to the cave entrances. Caves were measured using a Disto laser measurer. For half the caves, data were then gathered and entered on individual work sheets, which had the following fields available: *cave name; region; location; altitude; length; depth; recorder; photograph available; date visited; land tenure; cave description; speleothems; archaeology, sediments and other floor features; biodiversity; human uses; condition and integrity; other; cave status; cultural status; bat status; threat status.*

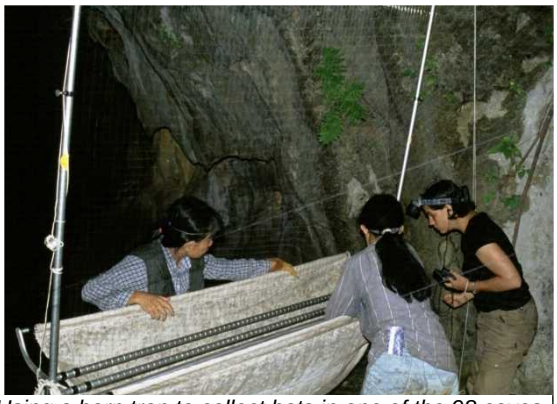
Within each study area, information was gathered on the bat fauna. Bats within the caves and adjacent areas were collected in harp traps, mist nets, flip nets and butterfly nets. The majority of individuals were identified and released. However, some were retained for further studies of:

- Taxonomy
- Echolocation
- Wing morphology
- Diet

Taxonomic studies: specimens for further taxonomic study and prepared as voucher specimens. They are housed in the collections of the Harrison Institute and Yangon University. Most of the specimens are preserved in 70% alcohol with the skulls stored separately. For details of measurements see Bates *et al*. (2004a).

Echolocation studies: bats were removed from nets and the trap and stored for a short period of time in cotton bags. Those of special interest were subsequently released in an enclosed space, typically a guest house bedroom, and their echolocation calls recorded. For details of how the calls were recorded see Mackie *et al*. (submitted).

Other studies: for information on the taking of wing traces and measurements to determine the morphology of the wing see Yin Yin (2004) and for the study of diet see Nyo Nyo (2004).



Using a harp trap to collect bats in one of the 98 caves surveyed during the Darwin project.

Findings:

During the Darwin programme 96 caves were visited in 7 areas. Data sheets are available for 51 of the caves and photographs for 83 caves and/or the surrounding areas. Data is included in a simple database which will also be summarised and published in a forthcoming booklet on bats and karst.

Area 1: Bhamo; caves visited: 4 (with data sheets: 0; with photographs: 4); dates visited: March-April, 2002.

Area 2: Mogok area; caves visited: 1 (with data sheets: 0; with photographs: 1); permission was refused for foreigners to visit this area because of economic considerations [ruby mines]. A brief reconnoitre of the area was made in 2001 by one of the Darwin trainees prior to the Darwin project.

Area 3: Mandalay area; caves visited: 24 (with data sheets: 15; with photographs: 19); dates visited: March, 2003, August, 2003 and December, 2003 (also prior to Darwin in March, 2002).

Area 4: Kalaw and Taunggyi area; caves visited: 17 (with data sheets: 12; with photographs: 10); dates visited: March, 2003, August, 2003 and December, 2003 (also prior to Darwin in March, 2002).

Area 5: Loikaw area; caves visited: 7 (with data sheets: 0; with photographs: 5); off-limits to foreigners for security reasons, it was surveyed by Yangon/ Loikaw University students in 2004-2005.

Entrance to Saddan Cave south of Hpa-an in Mon State.

Area 6: Hpa-an and Mawlamyine areas; caves visited: 25 (with data sheets: 24; with photographs: 21); dates visited: October-December, 2002, plus additional field studies by Yangon University team from 2002-2005 (also prior to Darwin in November, 1999, March, 2001 and November, 2001).

Area 7: Southern Tanintharyi Division; caves visited: 14 (with data sheets: 0; with photographs: 11); date visited: Nov., 2003.

Area 8: Kentaung area; caves visited: 5 (with data sheets: 0; with photographs: 4); dates visited: December, 2003.

Bat taxonomy: ninety-five species of bat are now recorded from Myanmar. They comprise 87 species included in Bates *et al*. (2000). In addition, there is one new species to science, the Kachin woolly bat (*Kerivoula kachinensis*) collected in the forest adjacent to the limestone caves of Bhamo area (Bates *et al*., 2004b) and ten 'first records' for Myanmar, which have been collected since November, 1999. Of these, four were collected before the Darwin project [Horsfield's bat (*Myotis horsfieldi*) included in Bates *et al*., 2000; the bumble-bee bat (*Craseonycteris thonglongyai*); Marshall's horseshoe bat (*Rhinolophus marshalli*); and large myotis (*Myotis chinensis*) and are included in Bates *et al*. (2001)].

Intermediate horseshoe bat (Rhinolophus affinis), one of many rhinolophids collected during the Darwin surveys of Myanmar.

Six 'first records' have been collected during the Darwin project including the Lesser brown horseshoe bat (*Rhinolophus stheno*); acuminate horseshoe bat (*Rhinolophus acuminatus*); and big-eared horseshoe bat (*Rhinolophus macrotis*) which are included in Bates *et al*. (2004a); and the Whiskered bat (*Myotis mystacinus*); great evening bat (*Ia io*) and Chinese pipistrelle (*Pipistrellus pulveratus*) included in Bates *et al.* (submitted).

Three records, included in Bates *et al*. (2000), have now been omitted for lack of supporting data [the hairy faced bat (*Myotis annectans*); common pipistrelle (*Pipistrellus pipistrellus*) and Savi's pipistrelle (*Pipistrellus savii*); for details see Bates *et al*. (submitted)].

Dr Iain Mackie with a bat detector and Khin Mie Mie holding a bat; part of the echolocation study of the Darwin project.

Echolocation: 647 calls were analysed, 86% could be assigned with confidence to one of 23 species of cave dependent micro bats. Results suggest that bat detectors can be used as a reliable and effective tool to monitor insectivorous bat activity in Myanmar and in SE Asia generally (Mackie *et al.,* submitted). This is the first such study in the Old World tropics.

The results of studies on diet, wing osteology, roosting ecology, economic importance of bats to the local community are included in the theses of the 8 Darwin trainees (for details see Training below). For example, the diet of 45 micro-bat species were studied. The families Craseonycteridae, Emballonuridae and Rhinolophidae were the earliest bats to emerge from the caves in search of their major food items such as Diptera (small flies), Lepidotera (moths) and Coleoptera (beetles). The lesser false vampire (*Megaderma spasma*) that feeds on flightless Orthoptera (grasshoppers) was found to be the latest species to emerge from the roosting sites during foraging time. The number of Insects was found to be slightly higher in the dry season than the monsoon but foraging emergence time was more or less similar (Nyo Nyo, 2004).

Eight papers have been prepared to date based on data collected during the Darwin Initiative project.

Papers already published in peer-reviewed journals include:

1: Bates, P.J.J., Mar Mar Thi, Tin Nwe, Si Si Hla Bu, Khin Mie Mie, Nyo Nyo, Aye Aye Khaing, Nu Nu Aye, Thida Oo and I. Mackie. 2004a. A review of *Rhinolophus* (Chiroptera: Rhinolophidae) from Myanmar, including three species new to the country. Acta Chiropterologica, 6(1): 23-48.

2; Bates, P.J.J., M.J. Struebig, S.J. Rossitor, T. Kingston, Sai Sein Lin Oo and Khin Mya Mya. 2004b. A new species of *Kerivoula* (Chiroptera: Vespertilionidae) from Myanmar (Burma). Acta Chiropterologica, 6(2): 219-226.

3: Pearch, M.J., Khin Mie Mie, P.J.J. Bates, Tin Nwe, Khin Maung Swe and Si Si Hla Bu. 2003. First record of bats (Chiroptera) from Rakhine State, Myanmar (Burma). Natural History Bulletin of the Siam Society, 51(2): 241-259.

4: Teeling, E.C., M.S. Springer, O. Madsen, P. Bates, S.J. O'Brien and W.J. Murphy. 2005. A molecular phylogeny for bats illuminates biogeography and the fossil record. Science. 307 (5709): 580-584.

Those accepted for publication in peer-reviewed journals include:

5: Struebig, M.J., S.J. Rossiter, P.J.J. Bates, T. Kingston, Sai Sein Lin Oo, Aye Aye Nwe, Moe Moe Aung, Sein Sein Win and Khin Mya Mya. Results of a recent bat survey in Upper Myanmar including new records from the Kachin forests. Accepted for publication by Acta

Chiropterologica.

Those submitted for publication in peer-reviewed journals or being revised include:

6: Bates, P.J.J., Tin Nwe, Si Si Hla Bu, Khin Mie Mie, Khin Maung Swe, Nyo Nyo, Aye Aye Khaing, Nu Nu Aye, Yin Yin Toke, Naing Naing Aung, Mar Mar Thi and Iain Mackie. A review of the genera *Myotis, Pipistrellus, Arielulus* and *Ia* (Chiroptera: Vespertilionidae) from Myanmar (Burma), including three species new to the country. Submitted to Acta Chiropterologica.

7: Pereira, M.J.R., H. Rebelo, E.C. Teeling, S.J. O'Brien, Tin Nwe, Si Si Hla Bu, Khin Maung Swe, Khin Mie Mie, P.J.J.Bates. Conservation implications for the world's smallest mammal the bumble-bee bat (*Craseonycteris thonglongyai*) in Myanmar. Submitted to Oryx.

8: Mackie, I.J, Tin Nwe, Khin Mie Mie, Naing Naing Aung and P.J.J. Bates. Good Vibrations: bat detectors can be used as a conservation tool to assess cave dependent bat diversity in Myanmar (Burma). Submitted to Biological Conservation.

Additional references included in the text above

Bates, P.J.J. and Tin Nwe. 2001. Myanmar: an atlas of karst conservation. International Caver, 2001: 36-39.

Bates, P.J.J., Tin Nwe, M.J. Pearch, Khin Maung Swe, Si Si Hla Bu and Thanda Tun. 2000. A review of bat research in Myanmar (Burma) and results of a recent survey. Acta Chiropterologica, 2(1): 53-82.

Bates, P.J.J., Tin Nwe, Khin Maung Swe, Si Si Hla Bu. 2001. Further new records of bats from Myanmar (Burma), including *Craseonycteris thonglongyai* Hill 1974 (Chiroptera: Craseonycteridae). Acta Chiropterologica, 3(1): 33-41.

Nyo Nyo, 2004. Distribution and diet of some insectivorous bat species of Myanmar in relation to insect availability. Unpublished PhD, Yangon University, 105 pp.

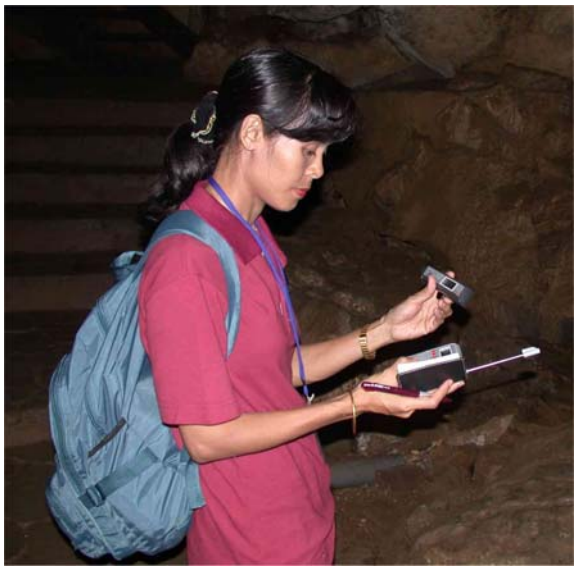
Yin Yin Toke, 2004. An analysis of wing morphology of some Myanmar echolocating bats. Unpublished PhD, Yangon University, 121 pp.

Training

A core group of eight students from Yangon University were selected as Darwin trainees. They were picked jointly by Professor Daw Tin Nwe of the University of Yangon and Dr Paul Bates and Dr Iain Mackie of the Harrison Institute. Selection criteria were:

- Existing interest in bats (including participation in pre-Darwin Harrison Institute/University of Yangon research) and a wish to further their postgraduate studies
- Ability to cope with working in the field
- Ability to speak and write English

With the exception of Mr Khin Maung Swe all the students were female. This reflects the nature of the Zoology Department, which is practically exclusively staffed by women and where women comprise more than 90% of the student population. This is a result of social and economic considerations in Myanmar. There are currently no employment opportunities in zoology outside the university system and university wages are insufficient to support a family.



Ms Aye Aye Khaing gathering data on cave humidity and temperature for her study of the 'Comparative roosting ecology of some cave-dwelling Myanmar bats'.

Each student undertook a PhD study. In the case of Mr Khin Maung Swe and Mrs Mar Mar Thi, their studies had commenced prior to the Darwin. Training was given by Dr Iain Mackie and Dr Paul Bates in a range of subjects, including: systematics, echolocation, wing morphology, diet analysis, roosting behaviour, and interaction between man and bats. Training took place in Yangon University and in the field during the eight survey trips undertaken by the Harrison Institute/Yangon University team and was often supported by a range of other international experts, who were included on the expedition teams. Supervision of the students from the UK was conducted by e-mail. In addition, two students, Mr Khin Maung Swe and Ms Khin Mie Mie received intensive training in systematics and bat acoustics during a three month study visit to the UK in 2002, where they studied at the Harrison Institute and Aberdeen University.

Copies of the six PhDs completed by the Darwin trainees are available for inspection. One has been submitted as an example with this report. The two remaining PhDs will be completed in November, 2005. Details of all eight theses are included below.

1: Mr Khin Maung Swe, 2002. A practical guide to current survey and identification methods for bats (Mammalia: Chiroptera); a case study for Myanmar. 151 pp.

2: Mrs Mar Mar Thi, 2003. Structural patterns of the bat wing osteology and its phylogenetic implication. 145 pp.

3: Ms Khin Mie Mie, 2004. Echolocation behaviour of some Myanmar bats. 124 pp.

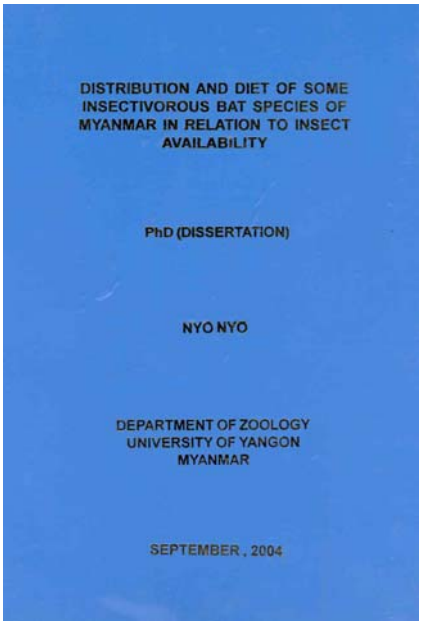
4: Ms Nyo Nyo, 2004. Distribution and diet of some insectivorous bat species of Myanmar in relation to insect availability. 105 pp.

5: Ms Yin Yin Toke, 2004. An analysis of wing morphology of some Myanmar echolocating bats. 121 pp.

6: Ms Naing Naing Aung, 2005. Monitoring some cave dependent echolocating bats in Myanmar by using frequency division bat detector. 174 pp.

7: Ms Aye Aye Khaing, PhD to be completed. Comparative roosting ecology of some cave-dwelling Myanmar bats.

8: Ms Nu Nu Aye, PhD to be completed. Aspects of the ecology and economic importance of *Tadarida plicata* in Myanmar



One of six PhDs completed by the Darwin trainees. Two more are scheduled to be written up by November 2005.

5. Project Impacts

- The project purpose was 'to ensure that Myanmar fulfils its potential in conserving limestone karst dependent bat species including globally threatened taxa'. Evidence that the project achievements have led to the accomplishment of this include:
    - The karst dependent bats of the principal cave systems of Myanmar have been surveyed and identified
    - Roosting sites of endangered species have been identified
    - Potential threats to karst dependent bats have been identified

Part of the Yangon University Darwin team identifying bat specimens at Hanoi University during an international conference in Vietnam on the conservation of limestone karst (geology and biodiversity).

    - A core group of in-country scientists have been trained who can study and assess the status of the bats
    - The potential role of Myanmar in supporting the global conservation of bat diversity, including endangered species is now recognised internationally
    - Myanmar zoologists from both Yangon and Mandalay Universities have close links with the international bat community and exchange study visits have been been undertaken to the UK and Malaysia
    - Data concerned with a range of systematic, ecological and behavioural aspects of bat biology have been and are in the process of being published in international journals in eight scientific papers
    - Data concerned with limestone karst bats have been disseminated at international conferences in the UK, Ireland, Poland and Vietnam
    - Data of bats from Myanmar (both within and outside the limestone karst areas) has been submitted to an IUCN database

Impacts that were not anticipated at the outset of the project include a desire for closer scientific links between Thailand and Myanmar. Paul Bates will facilitate meetings between a delegation from Thailand, including the Dean of Science of Prince of Songkla University (PSU) and senior members of Yangon University including the Professor Daw Tin Nwe, head of the department of zoology. This visit of 1-6 July, 2005 will seek to promote cross-border Thai-Myanmar bat research and the training of Myanmar postgraduate students at the PSU in southern Thailand. Funding of over £250,000 for two joint Thai-Myanmar

projects has already been secured, for details see below.

- The project has achieved its purpose in respect of research and raising the profile of bats, including globally endangered species in Myanmar. It has contributed significantly to Articles 7, 12, 13 and 17 of the CBD, which are primarily concerned with aspects of biodiversity identification, monitoring, training, awareness and information exchange. It has contributed less to those aspects of the CBD, such as Article 8 that are concerned with practical conservation measures in the field.

  Yangon University has plans to embark on two follow-up projects, which will draw directly on the skills and research findings of the Yangon university bat team:
  - One is concerned with the globally endangered bumble-bee bat (*Craseonycteris thonglongyai*) in the limestone karst areas of SE Myanmar and Thailand. The project leader is Dr Emma Teeling, of University College, Dublin, who is working in conjunction with Yangon University, Dr Paul Bates of the Harrison Institute and Dr Sara Bumrungsri of Prince of Songkla University, Thailand. Entitled 'A molecular investigation into the population dynamics and conservation status of the world's smallest mammal *Craseonycteris thonglongyai*', it is supported by the Science Foundation of Ireland (ID05/RFP/GEN0056) and has a budget of 162,000 euros (approx £110,000)
  - The second project is concerned with the interaction of man and bats. Entitled 'Conserving the southeast Asian guano bat – sustaining livelihoods across borders', this is a Darwin project (13th Round award), which has a budget of £142,000 and is co-ordinated by Dr Iain Mackie of Aberdeen University. It primarily involves staff and students from Thailand but includes a Myanmar component. Much of the research work will take place in limestone karst areas.

  In addition:
  - proposals have been submitted (March, 2005) to Total E&P Myanmar, for sponsorship and permissions to conduct surveys for bats by both Harrison Institute and Yangon University staff in the new Tanintharyi Pipeline Nature Reserve, which is jointly sponsored by Total and Petronas Oil of Malayasia
  - a joint field survey of Yangon University/Harrison Institute and the Scientific Exploration Society, UK to the Kachin forests is planned for November, 2005. This expedition will survey for bats in the forests of the limestone karst areas near Bhamo, from where the endemic Kachin woolly bat (*Kerivoula kachinensis*) was recently collected.

Evidence for the improved local capacity in Myanmar includes:
- Eight Darwin students/staff trained in bat research techniques, who are in turn training the next generation of students
- Bat research equipment to the value of £4700 donated to Yangon University
- Close links developed with the international bat community

The project supervisor Dr Si Si Hla Bu and all the Darwin trainees are still employed by the Ministry of Higher Education. Six trainees have been transferred to other universities. However, this has not prevented them from completing (or planning to complete) their PhD studies on schedule and taking part in workshops hosted in

Yangon University or in field studies, which have formed part of the Darwin project. On the contrary, it has enabled them to disseminate to a wider university audience within Myanmar information on bat research methods. At the same time, the 'Bat group' maintains its sense of identity and meets up when either Drs Bates or Mackie visit the country. The students have collaborated with international bat specialists in writing a series of papers that have been published, or are in the process of being published, in international journals.

Dr (Ms) Si Si Hla Bu, Darwin project co-ordinator, assistant professor at Yangon University, involved in many Yangon University/international initiatives, bat and otherwise.

Dr (Mr) Khin Maung Swe, PhD completed, assistant professor at Yangon University: currently supervising two PhD students on fish studies but planning to write a book on Myanmar bats.

Dr (Mrs) Mar Mar Thi, PhD completed, assistant professor at the University of Distance Education, Yangon: currently researching aspects of bat systematics and supervising one student on bat taxonomy.

Dr (Ms) Khin Mie Mie, PhD completed, lecturer at Yangon University, currently supervising 4 PhD students on aspects of bat echolocation and diet.

Dr Khin Mie Mie and her four postgraduate students, who are working on aspects of bat research.

Dr (Ms) Nyo Nyo, PhD completed, transferred from Yangon University to University of Veterinary Science, Yezin, where she is a lecturer and conducts studies of bat diet.

Dr (Ms) Yin Yin Toke, PhD completed, transferred from Yangon University to Dawei University, where she is a lecturer. In her spare time, she conducts her own field work on bats with her sister Dr Naing Naing Aung (see below).

Dr (Ms) Naing Naing Aung, PhD completed, transferred from Yangon University to Hinthida University, where she is a lecturer. Conducts her own field work on bats with her sister Dr Yin Yin Toke (see above).

Ms Aye Aye Khaing, PhD to be completed, transferred to Myeik University, writing up her PhD.

Ms Nu Nu Aye, PhD to be completed, lecturer at Yangon University, writing up her PhD

The Darwin project has helped engender a sense of trust and appreciation between UK and Myanmar scientists. The staff and students of the Department have now worked with a range of UK professional and amateur bat scientists. There is also a much greater appreciation by the Myanmar scientists of the importance of scientific collaboration with a wide range of UK and international experts.

Left to right: Darwin trainees, Dr Khin Maung Swe, Dr Yin Yin Toke, Dr Naing Naing Aung, Dr Mar Mar Thi and Mar Mar Thi's student Ms Thida Oo.

Publications and reports have been forwarded to Myanmar government ministers and contact has been made between the British Embassy and the Minister of Foreign Affairs and Ministry of Forestry relating to the project. Paul Bates made a presentation to Myanmar student journalists on an environmental course being run by the British Embassy and the project was used as a training tool. Unfortunately, there are no civil society groups in Myanmar, so the impact has to be seen in terms of supporting students and staff within Yangon University and to a lesser extent Mandalay University.

The project has probably had only a limited impact on the village communities adjacent to the bat caves and limestone karst. However it has an impact on the social structure of the Zoology Department. Previously, this appeared to be rather rigid, with great respect but little questioning of the views of senior staff. Much postgraduate education was still based on the principal of taught classes and there seemed to be a lack of individualism and initiative taking to produce really good science. Contact with the two UK Darwin staff and with other foreign scientists brought in under the umbrella of the Darwin project appears to have contributed towards a more egalitarian approach to study. Students and junior staff have learnt to be more proactive in their approach and are prepared to think up and carry out their own research projects with confidence and growing professionalism. This must auger well for the development of the zoological sciences within Myanmar.

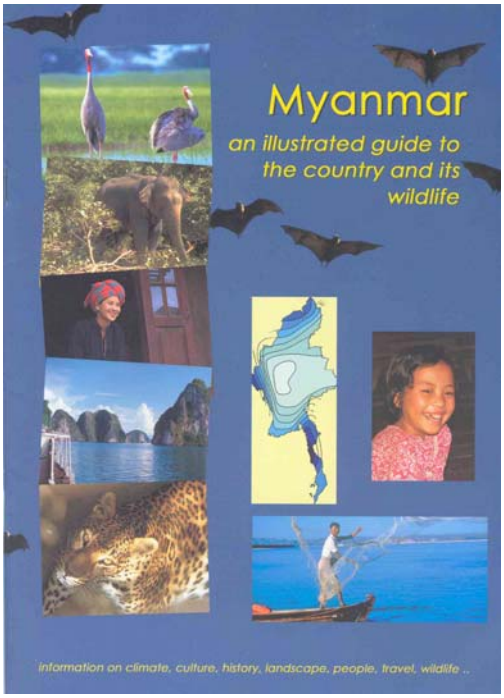
6. Project Outputs

- As noted above, differences in actual outputs against those in the agreed schedule included:
    - Training fewer students, eight as opposed to twelve, but in much greater depth, leading to PhD qualifications as opposed to MSc.
    - Bat data were submitted to an IUCN sponsored South-East Asian

mammal database (at the SAMD meeting in Thailand in May, 2004) and published in a series of scientific papers rather than being stored in a Myanmar only bat database

Dr Paul Bates and Dr Sara Bumrungsri submitting data on Myanmar and Thai bats respectively to the IUCN database at the SAMD workshop in Thailand.

- Annual newsletters were posted on the web at www.harrison-institute/Darwin rather than produced in a paper format
- The draft national action plan and formal management plans for the karst areas were not written. It was considered that links were insufficiently developed with the Forest Department and that such plans might provoke 'turf-war' hostility between the universities and the Forest Department rather than lead to the implementation of conservation initiatives. In view of this, three new approaches have been adopted:
  - Further funding has been received for detailed research in the most important areas, one centred on the bumble-bee bat and the other on the guano producing free-tailed bats (for details, see above).
  - A more 'popular' style of publication is currently being produced with information on karst and its importance, the role of bats in the ecosystem, and the role of the Darwin project in promoting wildlife conservation. It is believed that such report will have more impact with decision makers. This was the case with a previous popular publication produced by the Harrison Institute and Yangon University entitled *Myanmar: an illustrated guide to the country and its wildlife*, which was circulated to the President and all his ministers.



The Harrison Institute and Yangon University have tried to use more popular style publications to raise the profile of wildlife conservation in Myanmar.

  - Neil Furey of FFI Vietnam who has considerable experience of working on conservation programmes in limestone karst areas in

Vietnam is being encouraged by Dr Paul Bates to undertake his PhD research on bats in the limestone karst areas of Myanmar. This would provide a good opportunity to exchange ideas and information about bats and limestone karst.

Additional achievements included:

- Eight rather than four papers published, or in the process of being published, based on data collected during the Darwin project, including one in the journal Science.
- Greatly expanded field studies with many international experts involved, not only with an interest in bats but also birds, molluscs, palms, and geology.

The bird watching team, off Lampi Island in Tanintharyi Division in southern Myanmar.

- Increasing the international exposure of the team by taking nine students to a conference on karst in Vietnam (August, 2004).
- Tissue samples donated to the Barcodes of Life project www.barcodinglife.com

Dissemination of outputs has been aimed at a target audience of:

- Local Myanmar scientists through local symposia at the university level and scientific publications.
- Local education authorities through articles in Ministry of Education publications.
- International scientific audience through scientific publications and presentations and posters at international scientific meetings, symposia, conferences and workshops.
- International conservation community through scientific publications, presentations and unpublished reports.
- Multi-national business community in Myanmar through discussions and submission of reports.

THE MYANMAR TIMES™
A WEEKLY REVIEW
TOMORROW'S PAPER TODAY
http://www.mmtimes.com
March 28 - April 3, 2005
Myanmar's first international weekly ©

» Content
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» Internation Flight Schedule

NEWS

Joint bats project shows rewards of collaboration

By Ba Saing

MYANMAR can play a vital role in conserving rare bat species, a British specialist on the mammals said last week.

The comment was made by Dr Paul Bates, the director of the British-based Harrison Institute, which has been involved in biodiversity research, wildlife conservation, scientific training and field surveys in collaboration with the Zoology Department of Yangon University since 2000.

The Kachin woolly bat, one of the eight species previously unknown in Myanmar until the joint surveys began in 2000.

The bumble-bee bat. Until it was discovered in Myanmar in 2001 it was known to live only in Thailand.

Dr Bates said surveys conducted since then had recorded 94 species of bats, or about 10 per cent of the total found throughout the world.

He said one of the most significant achievements of the surveys had been finding eight species previously unrecorded in Myanmar. The most important discovery was the tiny bumble-bee bat, which until it was recorded in Mon and Kayin states in 2001, was known to live only in Thailand.

Dr Bates said the bumble-bee bat, which weighs only two grams, is the world's smallest mammal.

One of a number of reports in the Myanmar press (here printed from the internet) concerned with the Darwin project. Please note that the caption under the orange bat is incorrect.

- General audience in Myanmar through talks to local interest groups, newspaper reports and radio interviews.
- General audience in the UK through presentations and talks to local naturalist groups.

- o Diplomatic audience (such as the British and German Embassies) through discussions and short presentations.

Future dissemination includes contributions to specialist publications such as the Birdlife International's '*Myanmar's: investment opportunities in conservation'*.

7. Project Expenditure

Included below is the three year summary of the budget and expenditure of the Darwin project. There were no changes, agreed or otherwise, in excess of 10%.

Item	Budget	Expenditure	Balance

8. Project Operation and Partnerships

- As outlined in the initial proposal local partners included:
  - o Wildlife Conservation Society (WCS, Myanmar): discussions were held on an irregular basis with WCS staff and reports and publications were donated to their Yangon office library. University students and staff regularly borrow books and articles from this library, which is better stocked than that of the University. WCS also distribute small grants to university students to conduct biodiversity studies. WCS staff agreed to include members of the 'Bat Group' in appropriate future field studies.
  - o The Forest Department: discussions and a workshop was organised to see how the outputs of the Darwin project could be fashioned to meet the needs of the Forest Department and the conservation community. In Myanmar, the university system and the Forest Department, although not antagonistic, do not appear to co-operate on projects. The university system is concerned with research and the Forest Department is mostly concerned with commercial forestry and to a much lesser extent practical conservation. There seems little impetus within Myanmar to integrate the roles and thereby help develop a strategic approach to conservation. Although some meetings with Forestry officials took place, a number of others were cancelled by the Forestry Department at the last moment.

  Initially, there were no similar university-based projects taking place in Myanmar. Discussions were held with Dr Chris Wemmer of the Smithsonian Institution who had experience of working with the Forestry Department. Subsequently, a second Darwin project was awarded to Myanmar. Contact was maintained through e-mail with Jonathan Eames (the project co-ordinator) and a report on the project

has been submitted to a forthcoming publication by Dr Eames' team entitled '*Myanmar: investment opportunities in conservation'* No consultation took place with the Biodiversity Strategy Office.

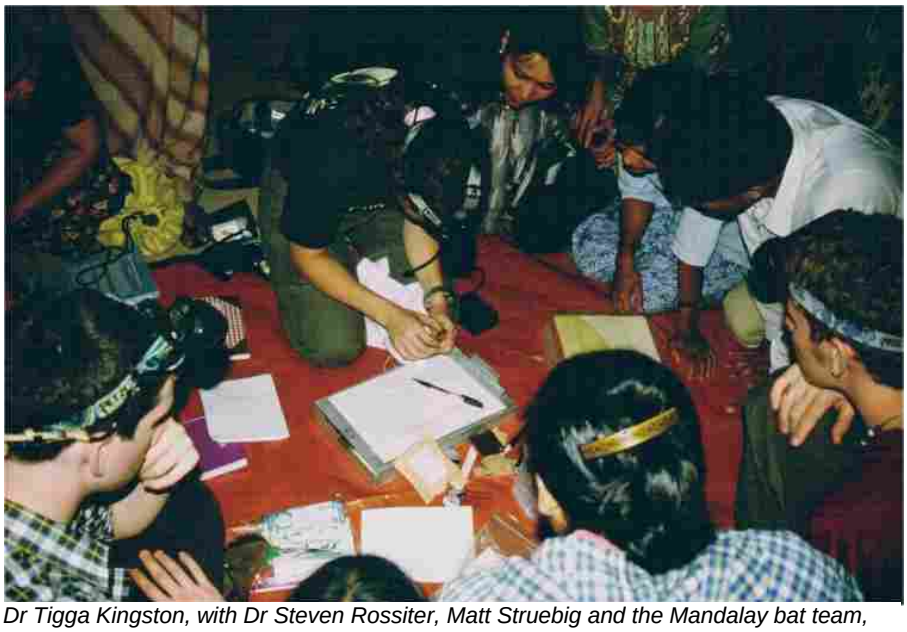
Principal international partners are included below. In addition, visiting scientists from the Bat Conservation Trust (UK) and the Forest Research Institute, Malaysia and a wildlife consultant from India all contributed to the research and training elements of the study.

- Prof. Elery Hamilton-Smith, Chair of the Asia and Pacific Region IUCN Cave and Karst Working Group who undertook training (theoretical and practical) in limestone karst studies.

- Maria João Ramos Pereira (Lisbon University) and Hugo Rebelo (Oporto University): collaboration on bumble-bee bat (*Craseonycteris thonglongyai*) studies; results published jointly with Paul Bates, Iain Mackie and some of the Myanmar team (see below).

- Dr Emma Teeling of University College, Dublin/ Laboratory of Genomic Diversity, Maryland, USA, conducted phylogenetic studies on *Craseonycteris* tissue collected during the field work programme. The results were published jointly with Paul Bates in the journal *Science* (see listing below).

- Dr Charles Francis of the National Wildlife Research Centre, Canadian Wildlife Service. Tissue from voucher specimens was donated to the gene bank of South-East Asian bats – part of the Barcodes of Life project www.barcodinglife.com



Dr Tigga Kingston, with Dr Steven Rossiter, Matt Struebig and the Mandalay bat team, recording bat data in Sagaing Division.

- Dr Stephen Rossiter and Matthew Struebig of Queen Mary, London University and Dr Tigga Kingston of Boston University. Collaborative studies are taking place on the molecular systematics of Myanmar horseshoe bats. Two papers have been prepared in conjunction with Mandalay University on the bats of Upper Myanmar, including a description of the new species *Kerivoula kachinensis.*

- Emmanuel Houzard of Total E&P Myanmar for the study and conservation of the bat fauna of the new Yadana Pipeline Nature Reserve in Tanintharyi Division

- Dr J.L. David Smith, University of Minnesota, co-ordinator of the 'Tennasserim Range Transboundary project: an open conservation model' – an international conservation project for Tanintharyi Division.

- Gianluca Catullo, Institute of Applied Ecology, Rome for the dissemination of data on South-East Asian mammals. Bat data submitted to the databank at a workshop in Thailand in May, 2004 – entitled '*Towards sustainable practices and effective biodiversity management: a databank and network for conservation and monitoring of Southeast Asian Mammal Biodiversity'.*

The bat group in Yangon University maintains links with the private sector through its involvement with Total E&P Myanmar. Interaction with WCS and a range of international collaborators continues.

9. Monitoring and Evaluation, Lesson learning

- Student progress was monitored by their participation in field studies and ultimately by the production of their respective PhDs.

  Progress in research was monitored by the production of papers, which were accepted for publication in peer-reviewed international journals.

  The quality of bat data collected was assessed by peer scientists when it was submitted to international databases.

  The value of the project in terms of social development was demonstrated by the strong support received from the British Embassy

  The value of the project in terms of linking wildlife conservation to business and the community was demonstrated by the financial support received from a number of multinational and local companies, including Total E&P Myanmar, Premier Oil, Thai Air, Myanmar Airways, and Orient Express.

  The scientific value of the project was demonstrated by the additional financial support received from grant giving bodies such as the Linnean Society and the Systematics Association.

- There were no major problems associated with the project. There were some minor ones:
  - There was some professional jealousy between Yangon and Mandalay Universities. Yangon University initially resented support (from UK scientists and the Royal Geographical Society) being given to another university department. The Mandalay bat group was seen as a threat and a rival rather than a complementary group that would further help promote bat research and conservation in Myanmar. This feeling has subsided to some extent.

  - It proved impossible for one Darwin trainee to attend an international conference in Dublin because of visa problems. Ireland is not represented diplomatically in Myanmar. A similar problem was overcome when taking two members of the Department to Poland through negotiations with the Polish

Embassy in London.

- The lack of positive interaction with the Forest Department was a disappointment, which despite our best endeavours was only partly overcome (see above).

- The project leaders, Prof Daw Tin Nwe, Dr Si Si Hla Bu and Dr Paul Bates were all a subject of hate mail from an unknown source, probably from within the University, which tried to discredit them personally and undermine the project. This was overcome by being ignored!

- We thought that there might be a problem caused by the transfer of Darwin trainees from Yangon to other universities in Myanmar. However, this has not been the case since they were given leave by their new employers to complete their studies and participate in field work. It also provided an opportunity to disseminate information and research techniques to a wider audience.

There was no formal external evaluation (outside the peer-reviewing of publications), although scientists visiting the project gave useful advice about the aims, objectives and outputs of the project.

Key lessons include:

- The tensions that exist between individuals within a university department and between departments in different universities should not be underestimated. This is especially the case in a society such as Myanmar's where everyone is outwardly polite and obliging.
- It is best to avoid at all costs becoming involved in any aspect of intra-and inter-departmental politics!
- It is important to drive through one's ideas about being inclusive even if at first these ideas are strongly resisted.

10. Actions taken in response to annual report reviews (if applicable)

- The reviews were circulated to our host country collaborators. We were pleased that in both annual reviews no substantive concerns were raised.

11. Darwin Identity

- The Darwin logo was included on all presentations. Also, a brief description of the Darwin Initiative's aims and objectives was included in most presentations. The Darwin Initiative was also acknowledged in all reports and scientific publications. Darwin stickers were applied to computers and other equipment purchased for use in Myanmar and are clearly visible in the Department of Zoology, Yangon University.
- Senior staff in the University, especially the head of the Zoology Department, Prof Daw Tin Nwe and Associate Professor Dr Si Si Hla Bu clearly understood the role and importance of the Darwin Initiative. However, some of the students appeared to underestimate its significance, mistakenly believing that all foreign researchers have sufficient funding. This was reflected in the acknowledgement sections of the six PhDs completed to date. The Harrison Institute was thanked on all six occasions but the Darwin Initiative was only acknowledged in two. We will try to ensure that the Darwin Initiative is included in the final two PhD submissions.
- As mentioned above, the role of the Darwin Initiative was fully appreciated by senior university staff. It is also understood by several senior government ministers. However, there was a danger in publicising too widely within the university system the size of the grant since it tended to excite professional

jealousy and more seriously accusations that senior staff 'must be' profiting personally from the fund. Also technically, all funds for work in Myanmar should have been processed through the University administration office. However, this would have led to large losses in an 'unreal' conversion rate of the currency and unwarranted administrative charges. In practice, all funds were distributed on a needs basis by the Harrison Institute staff.

Within Myanmar, the Darwin project is a distinct one with a clear identity. It will be remembered by many as the first such project in the post-WWII history of Yangon University. Within South-East Asia, it is one of a number of large projects that are focusing on the biodiversity of limestone karst areas.

12. Leverage

Additional funds, amounting to £34914 (including funds in kind) were received from a range of sponsors.

Substantial sponsorship monies were received from two commercial companies: Total E&P Myanmar and Premier Oil.

Sponsorship in kind was received from commercial companies (ie free or discounted air tickets/ discounts at hotels): Thai Air, Myanmar Airways, Air Mandalay, Orient Express and Kandawgyi Palace Hotel.

Sponsorship was also received from the 'Friends of the Harrison Institute' whose participation in a number of surveys helped contribute funds towards the purchase of equipment and the participation of other students from the Department in a range of field studies.

Grants were received from charitable trusts including the Royal Geographical Society, Systematics Association/Linnean Society, Ghar Parau Foundation, and Kent Bat Group.

Time was donated by a range of international scientists to train students – some of these international scientists were in turn supported by other grant giving bodies. For example, Hugo Rebelo and Maria Joao Ramos Pereira were supported by the BP Conservation Programme and Dr Tigga Kingston, Dr Stephen Rossiter and Matt Struebig by the Royal Geographical Society.

To date, fund raising has been the responsibility of the UK contingent. Funding applications by Myanmar staff were on a small scale and aimed at local donors such as the WCS Myanmar office. There is still a need for local staff to take more responsibility in applying for international grants.

13. Sustainability and Legacy

The achievements that are most likely to endure include

- the publications
- the bat data which have already been included in an international database
- the Darwin trained Myanmar staff
- the equipment which is available for future researchers in Myanmar
- a national and international interest in the bats and limestone karst of Myanmar

Outputs, in terms of research techniques have been applied both in Yangon and Mandalay University. However, active conservation projects have not been widely applied in the field, although two forthcoming projects will maintain the momentum of the field studies and it is hoped that should measures be needed in the future to promote bat conservation, information relevant to this is now available.

The continuity of the research programme is assured since two additional grants to the value of £250,000 have been secured with a specific element of bat research in Myanmar (see above). To this end, international and local partners will keep in contact and new links will be formed.

14. Value for money

- We believe that much has been achieved thanks to the investment by DEFRA. Achievements include not only things that can be measured but also things that can only be sensed when walking round or talking to members of the Zoology Department of Yangon University. The Department, its staff and students have been indelibly changed by the experience of this first Darwin project.
- The scientific ethos of the Zoology Department has been transformed, with a much more proactive approach to research
- Students within a previously isolated country now have an international, outward looking attitude to science
- Eight students have been trained to PhD level and have maintained an ongoing professional interest in the subject
- Ten staff and students from Yangon University have attended and/or made presentations at international conferences in the UK, Poland and Vietnam
- Eight international field studies and many smaller ones have been undertaken
- Yangon University has excellent equipment to undertake further bat research
- The success of the Darwin project has helped lever a further £250,000 of research grants, a proportion of which will be spent on in-country training and bat research.

Logical framework. Please enter the details of your project onto the matrix using the note at Annex B of the Guidance Note.

Project summary	Measurable indicators	Means of verification	Important assumptions
Goal *To assist countries rich in biodiversity but poor in resources with the conservation of biological diversity and implementation of the Biodiversity Convention*		long term monitoring of bat populations in limestone karst habitats	wildlife conservation remains a priority of the Myanmar government
Purpose To ensure that Myanmar fulfils its potential in conserving limestone karst dependent bat species, including globally threatened taxa there are 92 bat species recorded from Myanmar, including endangered limestone dependent taxa, such as Craseonycteris	that bats and limestone karst habitats are given equal status within the Protection of Wildlife and Natural Areas law as other 'priority' species and habitats (such as large mammals and forest habitats). Darwin trainees continue to promote bat conservation based on authorative	the conservation of karst ecosystems is included as an objective of the National Commission for Environmental Affairs and is included in the Protection of Wildlife and Natural Areas Law karst ecosystem conservation is included in the proposals of the Nature and Wildlife Conservation Division of the Forest Department	Forest Department continues to work with Yangon Univ on assessing conservation priorities
Outputs A national database of bats from limestone karst areas - for national and international circulation Action Plan for cave bats and management plans for key karst areas A core of Myanmar graduates trained in biodiversity survey work Identification key for Myanmar bats	Publication of databases and dissemination of action plans. Graduation of MSc trainees.	Incorporation of database and management plan recommendations in the publications of the Asia-Pacific forum on Karst Ecosytems . Incorporation of data into future IUCN Chiroptera action plans	Forest Department accept recommendation of Action Plans.
Activities Survey of cave dependent bats in limestone karst areas of Myanmar. Train Myanmar students in research and survey techniques. Carry out programme of environmental education. Write key and booklet to Myanmar bat species.	Finance: Year 1: £42677 Year 2: £39958 Year 3: £37750 Time of UK and Myanmar personnel and Darwin trainees.	Expenditure will be verified by detailed financial accounts. Time will be verified by monthly reports from Yangon Univ. Annual reports will detail field survey results. Publications will be prepared.	Field work can be carried out (previous experience since 1999 shows that this is the case) Trainees will be available (already known)

15. Appendix I: Project Contribution to Articles under the Convention on Biological Diversity (CBD)

Please complete the table below to show the extent of project contribution to the different measures for biodiversity conservation defined in the CBD Articles. This will enable us to tie Darwin projects more directly into CBD areas and to see if the underlying objective of the Darwin Initiative has been met. We have focused on CBD Articles that are most relevant to biodiversity conservation initiatives by small projects in developing countries. However, certain Articles have been omitted where they apply across the board. Where there is overlap between measures described by two different Articles, allocate the % to the most appropriate one.

Project Contribution to Articles under the Convention on Biological Diversity		
Article No./Title	**Project %**	**Article Description**
6. General Measures for Conservation & Sustainable Use		Develop national strategies that integrate conservation and sustainable use.
7. Identification and Monitoring	30%	Identify and monitor components of biological diversity, particularly those requiring urgent conservation; identify processes and activities that have adverse effects; maintain and organise relevant data.
8. In-situ Conservation	5%	Establish systems of protected areas with guidelines for selection and management; regulate biological resources, promote protection of habitats; manage areas adjacent to protected areas; restore degraded ecosystems and recovery of threatened species; control risks associated with organisms modified by biotechnology; control spread of alien species; ensure compatibility between sustainable use of resources and their conservation; protect traditional lifestyles and knowledge on biological resources.
9. Ex-situ Conservation		Adopt ex-situ measures to conserve and research components of biological diversity, preferably in country of origin; facilitate recovery of threatened species; regulate and manage collection of biological resources.
10. Sustainable Use of Components of Biological Diversity	5%	Integrate conservation and sustainable use in national decisions; protect sustainable customary uses; support local populations to implement remedial actions; encourage co-operation between governments and the private sector.
11. Incentive Measures		Establish economically and socially sound incentives to conserve and promote sustainable use of biological diversity.

12. Research and Training	35%	Establish programmes for scientific and technical education in identification, conservation and sustainable use of biodiversity components; promote research contributing to the conservation and sustainable use of biological diversity, particularly in developing countries (in accordance with SBSTTA recommendations).
13. Public Education and Awareness	10%	Promote understanding of the importance of measures to conserve biological diversity and propagate these measures through the media; cooperate with other states and organisations in developing awareness programmes.
14. Impact Assessment and Minimizing Adverse Impacts		Introduce EIAs of appropriate projects and allow public participation; take into account environmental consequences of policies; exchange information on impacts beyond State boundaries and work to reduce hazards; promote emergency responses to hazards; examine mechanisms for re-dress of international damage.
15. Access to Genetic Resources		Whilst governments control access to their genetic resources they should also facilitate access of environmentally sound uses on mutually agreed terms; scientific research based on a country's genetic resources should ensure sharing in a fair and equitable way of results and benefits.
16. Access to and Transfer of Technology		Countries shall ensure access to technologies relevant to conservation and sustainable use of biodiversity under fair and most favourable terms to the source countries (subject to patents and intellectual property rights) and ensure the private sector facilitates such assess and joint development of technologies.
17. Exchange of Information	15%	Countries shall facilitate information exchange and repatriation including technical scientific and socio-economic research, information on training and surveying programmes and local knowledge
19. Bio-safety Protocol		Countries shall take legislative, administrative or policy measures to provide for the effective participation in biotechnological research activities and to ensure all practicable measures to promote and advance priority access on a fair and equitable basis, especially where they provide the genetic resources for such research.
Total %	**100%**	**Check % = total 100**

16. Appendix II Outputs

Please quantify and briefly describe all project outputs using the coding and format of the Darwin Initiative Standard Output Measures.

Code	Total to date (reduce box)	Detail (←expand box)
Training Outputs		
1a	Number of people to submit PhD thesis	8 Darwin students
1b	Number of PhD qualifications obtained	6 (two additional PhDs will be submitted in November)
2	Number of Masters qualifications obtained	0
3	Number of other qualifications obtained	0
4a	Number of undergraduate students receiving training	0
4b	Number of training weeks provided to undergraduate students	0
4c	Number of postgraduate students receiving training (not 1-3 above)	0
4d	Number of training weeks for postgraduate students	80 (in-country, UK and e-mail training from Dr Iain Mackie) 50 (in-country, UK and e-mail training from Dr Paul Bates)
5	Number of people receiving other forms of **long-term** (>1yr) training not leading to formal qualification(i.e not categories 1-4 above)	0
6a	Number of people receiving other forms of **short-term** education/training (i.e not categories 1-5 above)	10 (other Myanmar students who received training during international field studies during the course of the Darwin – including training in birds, palms, molluscs…)
6b	Number of training weeks not leading to formal qualification	30 weeks (10 individuals x 3 weeks)
7	Number of types of training materials produced for use by host country(s)	1 (field key to bats)
Research Outputs		
8	Number of weeks spent by UK project staff on project work in host country(s)	39
9	Number of species/habitat management plans (or action plans) produced for Governments, public authorities or other implementing agencies in the host country (s)	1 (currently in preparation; this will be a booklet highlighting the most important karst areas and bat species for conservation – it is anticipated that this will have more impact than a formal management plan)
10	Number of formal documents produced to assist work related to species identification, classification and recording.	1 (key to species) and 8 scientific papers published or in preparation
11a	Number of papers published or accepted for publication in peer reviewed journals	5
11b	Number of papers published or accepted for publication elsewhere	0

Code	Total to date (reduce box)	Detail (←expand box)
12a	Number of computer-based databases established (containing species/generic information) and handed over to host country	1 (database of caves, including information on location, status, threats etc)
12b	Number of computer-based databases enhanced (containing species/genetic information) and handed over to host country	1 (bat data from Darwin study contributed to Southeast Asian Mammal Databank – will be available on line)
13a	Number of species reference collections established and handed over to host country(s)	1 (voucher specimens from Darwin surveys)
13b	Number of species reference collections enhanced and handed over to host country(s)	1 (voucher specimens from Darwin surveys)

Dissemination Outputs		
14a	Number of conferences/seminars/workshops organised to present/disseminate findings from Darwin project work	1 (one four-day international workshop at Yangon University with 19 delegates from 6 countries [UK, Myanmar, Australia, India, Malaysia and Portugal]. 7 additional smaller workshops at various locations in Myanmar
14b	Number of conferences/seminars/ workshops **attended** at which findings from Darwin project work will be presented/ disseminated.	10 – in UK (6), Ireland (1), Poland (1), Thailand (1) and Vietnam (1)
15a	Number of national press releases or publicity articles in host country(s)	3 (in each year of the project)
15b	Number of local press releases or publicity articles in host country(s)	0
15c	Number of national press releases or publicity articles in UK	0
15d	Number of local press releases or publicity articles in UK	0
16a	Number of issues of newsletters produced in the host country(s)	3 (web based)
16b	Estimated circulation of each newsletter in the host country(s)	Not known - web based
16c	Estimated circulation of each newsletter in the UK	Not known - web based
17a	Number of dissemination networks established	0
17b	Number of dissemination networks enhanced or extended	0
18a	Number of national TV programmes/features in host country(s)	1 (MRtv-3 transmission)
18b	Number of national TV programme/features in the UK	0
18c	Number of local TV programme/features in host country	0
18d	Number of local TV programme features in the UK	0
19a	Number of national radio interviews/features in host country(s)	1 (Radio Free Asia)
19b	Number of national radio interviews/features in the UK	0
19c	Number of local radio interviews/features in host country (s)	0
19d	Number of local radio interviews/features in the UK	0
Physical Outputs		
20	Estimated value (£s) of physical assets handed over to host country(s)	£4700
21	Number of permanent educational/training/research facilities or organisation established	0
22	Number of permanent field plots established	0
23	Value of additional resources raised for project	£34914

17. Appendix III: Publications

Provide full details of all publications and material that can be publicly accessed, e.g. title, name of publisher, contact details, cost. Details will be recorded on the Darwin Monitoring Website Publications Database that is currently being compiled.

Mark (*) all publications and other material that you have included with this report

Type * (e.g. journals, manual, CDs)	**Detail** (title, author, year)	**Publishers** (name, city)	**Available from** (e.g. contact address, website)	**Cost £**
Journal			Harrison Institute	
Journal* (see Paper 4 in the collection of Scientific papers submitted with this report)	Bates, P.J.J., Mar Mar Thi, Tin Nwe, Si Si Hla Bu, Khin Mie Mie, Nyo Nyo, Aye Aye Khaing, Nu Nu Aye, Thida Oo and I. Mackie. 2004. A review of *Rhinolophus* (Chiroptera: Rhinolophidae) from Myanmar, including three species new to the country.	*Acta Chiropterologica, 6(1): 23-48.*	Harrison Institute/Yangon University hzm@btinternet.com profzooyu@mptmail.net.mm	free
Journal* (see Paper 5 in the collection of Scientific papers submitted with this report)	Bates, P.J.J., M.J. Struebig, S.J. Rossitor, T. Kingston, S.S. Lin Oo and K. Mya Mya. 2004. A new species of *Kerivoula* (Chiroptera: Vespertilionidae) from Myanmar (Burma).	*Acta Chiropterologica, 6(2): 219-226.*	Harrison Institute/Yangon University/Mandalay University hzm@btinternet.com profzooyu@mptmail.net.mm	free
Journal* (see Paper 6 in the collection of Scientific papers submitted with this report)	Pearch, M.J., Khin Mie Mie, P.J.J. Bates, Tin Nwe, Khin Maung Swe and Si Si Hla Bu. 2003. First record of bats (Chiroptera) from Rakhine State, Myanmar (Burma).	*Natural History Bulletin of the Siam Society, 51(2): 241-259.*	Harrison Institute/Yangon University hzm@btinternet.com profzooyu@mptmail.net.mm	free
Journal* (see Paper 7 in the collection of Scientific papers submitted with this report)	Teeling, E.C., M.S. Springer, O. Madsen, P. Bates, S.J. O'Brien and W.J. Murphy. 2005. A molecular phylogeny for bats illuminates biogeography and the fossil record.	*Science. 307 (5709): 580-584.*	Harrison Institute/Yangon University hzm@btinternet.com profzooyu@mptmail.net.mm	free

Journal* (accepted for publication in June, 2005) (see Paper 8 in the collection of Scientific papers submitted with this report)	Struebig, M.J., S.J. Rossiter, P.J.J. Bates, T. Kingston, Sai Sein Lin Oo, Aye Aye Nwe, Moe Moe Aung, Sein Sein Win and Khin Mya Mya. Results of a recent bat survey in Upper Myanmar including new records from the Kachin forests.	*Acta Chiropterologica*	Harrison Institute/Mandalay University hzm@btinternet.com profzooyu@mptmail.net.mm	free
Journal* (submitted in February, 2005) (see Paper 9 in the collection of Scientific papers submitted with this report)	Bates, P.J.J., Tin Nwe, Si Si Hla Bu, Khin Mie Mie, Khin Maung Swe, Nyo Nyo, Aye Aye Khaing, Nu Nu Aye, Yin Yin Toke, Naing Naing Aung, Mar Mar Thi and Iain Mackie. A review of the genera *Myotis,Ia, Pipistrellus, Hypsugo*, and *Arielulus* (Chiroptera: Vespertilionidae) from Myanmar (Burma), including three species new to the country.	*Acta Chiropterologica.*	Harrison Institute/Yangon University hzm@btinternet.com profzooyu@mptmail.net.mm	free
Journal* (submitted in May, 2005) (see Paper 10 in the collection of Scientific papers submitted with this report)	Mackie, I.J, Tin Nwe, Khin Mie Mie, Naing Naing Aung and P.J.J. Bates. Good Vibrations: bat detectors can be used as a conservation tool to assess cave dependent bat diversity in Myanmar (Burma).	*Biological Conservation*	Harrison Institute/Yangon University hzm@btinternet.com profzooyu@mptmail.net.mm	free
Journal* (submitted in May, 2005) (see Paper 11 in the collection of Scientific papers submitted with this report)	Pereira, M.J.R., H. Rebelo, E.C. Teeling, S.J. O'Brien, Tin Nwe, Si Si Hla Bu, Khin Maung Swe, Khin Mie Mie, P.J.J.Bates. Further discoveries of the bumble-bee bat (*Craseonycteris thonglongyai*) in Myanmar: its relationship to the Thailand population and conservation implications for the world's smallest mammal.	*Oryx*	Harrison Institute/Yangon University hzm@btinternet.com profzooyu@mptmail.net.mm	free
PhD thesis (not included but available on request)	Khin Maung Swe, A practical guide to current survey and identification methods for bats (Mammalia: Chiroptera); a case study for Myanmar. 151 pp.	Yangon University	Harrison Institute/Yangon University hzm@btinternet.com profzooyu@mptmail.net.mm	£22 to cover photocopying and postage

PhD thesis (not included but available on request)	Mrs Mar Mar Thi. Structural patterns of the bat wing osteology and its phylogenetic implication. 145 pp.	Yangon University	Harrison Institute/Yangon University hzm@btinternet.com profzooyu@mptmail.net.mm	£22 to cover photocopying and postage
PhD thesis* (submitted as an example)	Ms Khin Mie Mie, PhD completed – Echolocation behaviour of some Myanmar bats. 124 pp.	Yangon University	Harrison Institute/Yangon University hzm@btinternet.com profzooyu@mptmail.net.mm	£22 to cover photocopying and postage
PhD thesis* (submitted as an example)	Ms Nyo Nyo, PhD completed – Distribution and diet of some insectivorous bat species of Myanmar in relation to insect availability. 105 pp.	Yangon University	Harrison Institute/Yangon University hzm@btinternet.com profzooyu@mptmail.net.mm	£22 to cover photocopying and postage
PhD thesis (not included but available on request)	Ms Yin Yin Toke, PhD completed – An analysis of wing morphology of some Myanmar echolocating bats. 121 pp.	Yangon University	Harrison Institute/Yangon University hzm@btinternet.com profzooyu@mptmail.net.mm	£22 to cover photocopying and postage
PhD thesis (not included but available on request)	Ms Naing Naing Aung, PhD completed – Monitoring some cave dependent echolocating bats in Myanmar by using frequency division bat detector. 174 pp.	Yangon University	Harrison Institute/Yangon University hzm@btinternet.com profzooyu@mptmail.net.mm	£22 to cover photocopying and postage
CD-Rom* (Word file on the general CD)	Key to the bats of Myanmar	Harrison Institute	Harrison Institute/Yangon University hzm@btinternet.com profzooyu@mptmail.net.mm	£5 to cover cost of CD and postage
CD-Rom* (Excel file on the general CD)	Limestone Caves of Myanmar	Harrison Institute	Harrison Institute/Yangon University hzm@btinternet.com profzooyu@mptmail.net.mm	£5 to cover cost of CD and postage
CD-Rom* Word and picture files	Abstracts of Bat workshop: research and conservation – October, 2002	Harrison Institute	Harrison Institute/Yangon University hzm@btinternet.com profzooyu@mptmail.net.mm	£5 to cover cost of CD and postage
Unpublished* report	Bat Workshop and Field Survey of Kayin and Mon States, 2002. Bates, P.J.J.	Harrison Institute	Harrison Institute/Yangon University hzm@btinternet.com profzooyu@mptmail.net.mm	£5 to cover cost of printing and postage

Unpublished* report	Conservation status of the bat and bird fauna of the limestone karst areas of Kayin and Mon States, Myanmar (Burma), 2003. Bates, P.J.J. ed. 110 pp.	Harrison Institute	Harrison Institute/Yangon University hzm@btinternet.com profzooyu@mptmail.net.mm	£15 to cover cost of printing and postage
Unpublished* report	Caves of Myeik, Tanintharyi Division, 2003. 2004. Bates, P.J.J. ed	Harrison Institute	Harrison Institute/Yangon University hzm@btinternet.com profzooyu@mptmail.net.mm	£15 to cover cost of printing and postage
Guide* Published by members of the Darwin team but not officially part of the Darwin project	Myanmar: an illustrated guide to the country and its wildlife. 2002. Si Si Hla Bu and P.J.J. Bates.	Yangon University	Harrison Institute/Yangon University hzm@btinternet.com profzooyu@mptmail.net.mm	£5 to cover cost and postage
CD-Rom*	(7 oral presentations and 4 poster presentations from a variety of international conferences and meetings)	Harrison Institute	Harrison institute hzm@btinternet.com profzooyu@mptmail.net.mm	£5 to cover cost of CD and postage

18. Appendix IV: Darwin Contacts

To assist us with future evaluation work and feedback on your report, please provide contact details below.

Project Title	Biodiversity assessment of limestone karst dependent bats in Myanmar (Burma)
Ref. No.	**162/11/09**
UK Leader Details	
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