



Darwin Initiative Second Year Annual Report (April 2006)
“Taxonomic Capacity Building in Support of Biodiversity Conservation in Thailand”

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Darwin Initiative

Annual Report

1. Darwin Project Information

Project Ref. Number	13-003
Project Title	Taxonomic Capacity Building in Support of Biodiversity Conservation in Thailand.
Country(ies)	Thailand
UK Contractor	The Natural History Museum (NHM)
Partner Organisation(s)	Queen Sirikit Botanic Garden (QSBG), Chiang Mai
Darwin Grant Value	£208,722
Start/End dates	1 June 2004 / 31 May 2007
Reporting period (1 Apr 200x to 31 Mar 200y) and annual report number (1,2,3..)	1 April 2005 to 31 March 2006 (2)
Project website	
Author(s), date	Ralph Harbach & Tony Shelley, 28 April 2006

2. Project Background

Thailand's biodiversity is at risk because of human population pressures, and there is an urgent need to assess and monitor endangered insects. A major constraint to developing Thai expertise on insects is the total absence of in-country reference collections essential for their identification. The project fills this gap by building the capacity of key institutions needed to conserve insect biodiversity. It meets GTI and CBD aims by strengthening relevant Thai institutions, provides a linkage between these institutions and the NHM, and seeks means to enable effective use of taxonomic information, as laid out in the Thai National Report on the Implementation of Convention on Biological Diversity (2002). A Protected Area System has been set up in which the principles of the CBD are being implemented in three distinct ecological settings: (1) watersheds, (2) unique natural ecosystems that are sensitive and vulnerable to destruction from human impact, and (3) areas with aesthetic value. The project is based at the Queen Sirikit Botanical Garden (QSBG) at Chiang Mai in northern Thailand, with field work centred in Doi Inthanon National Park (DINP), which has these three ecological settings. Collecting will later be carried out within the extensive grounds (1000 hectares) of the QSBG. The project will be the cornerstone for Thai biodiversity and conservation research on insects by providing a state-of-the-art entomological depository in the QSBG.

3. Project Purpose and Outputs

The project will provide a national depository and identification facility for insects, a prerequisite for generating the biological information needed for effective biodiversity conservation in Thailand. UK expertise is being used to establish a focus to help build and maintain the human resources, systems and infrastructure needed to obtain, collate and curate the biological specimens that are the basis for taxonomic knowledge. A principal aim is to link collection-based research to current and future entomological expertise in Thai universities, other Thai institutions and the NHM. Insects will primarily be collected in DINP and be processed and curated in

QSBG. Databases, websites, training of local staff and implementation of research programmes in collaboration with other institutions will result from the project.

No alterations to proposed outputs or operational plan have been made.

4. Progress

First year summary

During the first year we recruited local staff to the project and provided them with basic field training to collect two insect families (Culicidae and Simuliidae) in DINP. We also provided on site training in dissection, species recognition and curation of the material collected. Training was also provided for local staff at the NHM, London, largely to demonstrate how a modern insect collection is developed and maintained. By the end of the first year, basic equipment had been installed in QSBG, essential consumables purchased, a reprint collection assembled, and monthly routine fieldwork, identification and curation of culicids and simuliids were in place. An image analysis system was purchased in the UK and installed in QSBG, and two Thai entomologists were trained in its use. The asynchrony of the British and Thai (October to September) financial years produced a problem with the purchase of the imaging system, which was resolved by an NHM/DEFRA loan to QSBG for the Thai cost component that was repaid later. Despite the difficulties involved in setting up an entomological facility from scratch in a botanical institution, the project remained on schedule and fulfilled all of its original objectives as a result of good collaboration between Thai and UK team members, support from the Director of QSBG and his Entomology Adviser, and the generosity of Dr Rampa Rattanarithikul, our local coordinator, in providing the training facilities at her private museum until the QSBG laboratory was sufficiently equipped to carry on the work there.

Progress summary during second year

The project has remained on course against the agreed baseline timetable and the logical framework (Annex 1).

Development of the taxonomic infrastructure at QSBG during second year

Overview

The second year of the project started on 1 June 2005 and will end on 31 May 2006. Consequently, this report covers only 10 months of the second year. During the second year the main objectives include the completion of collections of Culicidae and Simuliidae from DINP, completion of species identification, curation and databasing of these two families and use of these data in a GIS facility. The infrastructure will then be ready for the third year of the project when collections will expand to cover other insect families, with emphasis on Coleoptera, Diptera and Lepidoptera.

Assessment and monitoring

This has been a two-way process in the second year with Thai managers visiting the UK and NHM staff visiting Thailand. Ralph Harbach and Tony Shelley made a two-week visit to QSBG in July 2005 with the main remit being to observe progress in the development of the Darwin project and to set the scene for the integration of Dr Jumnongjit Phasuk, a recently graduated PhD freshwater biologist, into the project. Drs Chaweewan Hutacharern (QSBG scientific adviser) and Dr Nanakorn Weerachai (Director of QSBG) followed this with a visit to the NHM in August to observe the infrastructure of the Entomology Department. They also had discussions with Prof. Quentin Wheeler (Head of Department), Mr Howard Mendel (Head of Curation) and Messrs Martin Brendell (Collections Manager, Coleoptera) and Max Barclay (Coleoptera curation) on future collaboration. Unfortunately, a meeting with the Dr Richard Lane (NHM Director of Science) was cancelled because of the bombing of London on one of the days of their visit. Ralph Harbach and Tony Shelley made separate visits to Thailand in February 2006. The

main objectives in Bangkok were to visit the Department of National Parks (Dr Chaweewan Hutacharen) to discuss future development of the project, the British Embassy in Bangkok to discuss the progress of the Darwin project (Ms Orathai Sanithvong na Ayuthaya), the Natural History Museum at the National Science Museum in Bangkok to assess progress in the Entomology Department (Dr Jarujin Nabhitabhata, Director), and St Gregory's Catholic School (Brother Amnuay Pinratana) to discuss collaboration on Lepidoptera research. In Chiang Mai, two visits were made to the university to discuss third-year collaboration with Dr Vichian Hengsawad (Head of Agricultural Entomology Department, pest management), Prof. Jariya Visitpanich (pest management), Mr Prachawan Sukumolanaen (Hymenoptera), Dr Hans Banziger (Lepidoptera), Dr Roger Beaver (Coleopterist) and Prof. Michael Burgett (Hymenoptera).

Training

Ralph Harbach, Tony Shelley and Malcolm Penn (GIS specialist) from the NHM, accompanied for one day by Dr Chaweewan Hutacharern (QSBG scientific adviser), made a two-week visit was made to QSBG in July 2005 to assess the project. Malcolm Penn explained the relevance of GIS to the Darwin team, reviewed the available data that would be used in the GIS analysis and discussed future work with the QSBG IT specialist, Mr Thanawat Lertprasert. Mr Mark Isenstadt visited the NHM for two weeks in December 2005 for training in the collection, preparation and curation of Coleoptera and Lepidoptera.

Facilities

As a result of the asynchrony of the British and Thai financial years during the first year of the project funding was provided by UK sources to purchase the image analysis system for QSBG. The Thai portion of funds for this purchase was made available in year 2, and the project is on a firm financial footing for its third year. During the year, funds from QSBG were used to make 15 insect cabinets and drawers using the NHM steel cabinets as a model. Steel has replaced wood in major world museums. A further 40 cabinets are included in the next Thai budget for QSBG to allow for expansion of the collection. Also included is a plan for a two storey building to house Entomology, the collections and a small museum. Extra rooms have also been made available to the Darwin project, including further offices for staff, an insectary and two firefly rearing rooms.

Local staff and their career development

Our local coordinator, Dr Rampa Rattarithikul, having launched the project from her private museum and successfully transferred it to QSBG, recently retired and was replaced by Dr Jumnongjit Phasuk who joined the project on 1 August 2005 as a freshwater biologist to work on the Simuliidae. We have been in contact with entomologists at the University of Chiang Mai and have provisional agreements for their collaboration on Hymenoptera, Lepidoptera and Coleoptera and will recruit a postgraduate entomologist from the university to assist during the last year of the project.

Dr Rampa, Darwin entomologist, is a renowned Thai mosquito specialist who has been greatly instrumental in the success of the project so far through her experience in setting up and running her own private museum and her vast knowledge of Thailand through her years of experience in collecting Culicidae throughout the country. She has successfully worked on and supervised the Culicidae research during the project and various publications are anticipated. A publication describing a new genus and species of aedine mosquito from Borichinda Cave in DINP prepared jointly with Dr Harbach was submitted for publication in April 2006.

Dr Jumnongjit Phasuk, Darwin entomologist, has worked impressively on the Simuliidae and has nearly completed the curation of the Simuliidae collected from DINP. We do not foresee any publications from this work because it started late for lack of a specialist and because the Thai fauna has until recently been poorly studied and hence is poorly known. A monograph will result at a later date as a satellite project.

Mr Mark Isenstadt, Darwin field biologist, provided his expertise from a previous EU project in Thailand to oversee the logistics of the fieldwork. Now that fieldwork has ended he is assisting

Dr Phasuk in the laboratory and is currently in charge of sourcing and purchasing equipment and reagents for the third year of the project.

Mr Wirat Sommit, a QSBG entomologist, has successfully imaged culicid species in collaboration with Dr Rampa and has started work on fireflies. He is currently rearing three species from QSBG to study their morphology and biology.

Mr Thanawat Lertprasert, an IT specialist at QSBG, set up the database for the Culicidae and Simuliidae and has also been studying GIS analyses of the data with Dr Penn of the NHM.

Mr Raewat Sawkord, a QSBG technician, has been successful in producing large numbers of high quality slides of immature stages of Culicidae in collaboration with Dr Rampa and will work on other insect groups as part of the Darwin team in the third year of the project.

Mr Wichai Seisukkar is concluding his MSc at Chiang Mai University with Mr Luis Hernandez of the NHM as external adviser. Wichai was supported by Darwin funds for his fieldwork at DINP for studies on the morphology and biology of Simuliidae at three adjacent locations. The data will be written up for publication.

Research and curation

Collections of Culicidae and Simuliidae have progressed well and all of the diverse habitats in the DINP have been prospected. Two separate routine monthly collections (one for each family) ended in November 2005, followed by targeted collections as required. Culicidae were collected from all types of larval habitats (temporary and permanent bodies of ground water and artificial and natural containers, such as leaf axils, tree-holes, rock-holes, crab-holes, bamboo internodes, fruit shells, fallen leaves and flower bracts), and reared to adults in the QSBG. Simuliidae were collected only from running water by prospecting submerged vegetation and rocks for immature stages. Larvae were collected into Carnoy's solution for later morphological and cytological studies. Pupae were placed in plastic bags and stored in a cooler with a bag of ice for later rearing to adults in the laboratory. Qualitative man-biting collections were made at each locality into glass tubes containing 70% ethanol to establish which species are anthropophilic. Each collection of Culicidae and Simuliidae was individually recorded in a field notebook with comprehensive data for each locality, which were later entered into the collections database.

In the laboratory, culicid larvae were kept in plastic bowls to the fourth instar and allowed to molt to pupae. Both laboratory reared and field collected pupae were then separated individually into plastic tubes and reared to the adult stage. Some mature larvae from each collection were killed and preserved in 80% ethanol. Larval and pupal skins, and mature larvae, were thus associated with individual adults. Larval and pupal skins were mounted on microscope slides and adults were pinned. The genitalia of some pinned males were dissected to aid species identification. Computer generated images of selected species were then made for the image archive. In the case of Simuliidae, field collected pupae were placed individually in glass, plastic stoppered tubes with damp filter paper until adults emerged. A proportion of adults was individually pinned with their pupal exuviae in a plastic tube filled with glycerin. Others were stored in 70% alcohol for later dissection and slide mounting. Where small numbers of a species were collected preference was given to pinned adults [heads and genitalia of pinned specimens could be subsequently removed and dissected for identification]. Images of the diagnostic morphological features of each species are being prepared.

Data collection for both Culicidae and Simuliidae is now well established. Data sheets were filled in as dissection and identification of each specimen from each locality progresses (Data sheets available on request). These are then provided to the QSBG IT specialist who transfers them to the computer database (see <http://mythanawat.com> [user name: user3; password: userdarwin3]). The provisional format for this database was set up recently by Mr Thanawat at QSBG, and will be revised before it becomes available for data input for general insects and collaborators. Some 366 collections of Culicidae were made in DINP, 2,800 specimens have been pinned and 3,600 slide mounts made of larvae and larval and/or pupal skins. To date, 126 species of mosquitoes have been identified. A few collections of Culicidae remain to be identified by the end of May 2006.

A total of 236 collections of Simuliidae have been made from all the geological and vegetation areas in the DINP. All pinned simuliids have now been identified and alcohol-preserved specimens should be completed by the end of May 2006. A total of 40 species has been recorded. Images of the scutal patterns of all species have been captured and archived. A total of 192 microscope slides of 27 of these species have been mounted and this will continue for one more month until all species are completed. Images of morphological characters (apart from scutal patterns) will be made on selected species. The simuliid fauna in Thailand is not well known and hence some difficulty in identification has been encountered. Thus, species of the *ceylonicum* group (*Simulium asakoae*, *S. inthanonense*, *S. sp. nr inthanonense*, and *S. sp. nr sheilae*), *striatum* group (*S. nakhonense* and *S. quinquestriatum*) and *tuberosum* group (*S. doipuiense*, *S. manooni*, *S. rufibasis*, *S. setsukoae* and *S. tani*) are morphologically similar and require further study. This is not within the remit of the Darwin project. Consequently, a morphological analysis of the simuliid species of the DINP will be carried out by Mr Luis Hernandez of the NHM as a satellite project and material will be offered on loan to Prof. Peter Adler (Colorado State University, USA) and his collaborators at Mahidol University, Bangkok for further morphological and cytological studies of suspected species complexes. Labelling of both culicids and simuliids is well advanced and will be complete within one month.

GIS and image processing research is based on a photo montage of seven IKONOS images that represent the land cover of DINP. Each image has been geo-referenced and imported into Erdas Imagine 8. Training sites have been selected within representative vegetation groups and the first ground truthing data have been incorporated. An unsupervised isodata classification has been run to provide input into a supervised max-likelihood classification of the IKONOS 5-metre multispectral image. Data on distribution of Culicidae and Simuliidae have been geo-referenced and are currently being integrated with geological and vegetation data layers within a GIS constructed within ArcGIS.

The database for the Culicidae and Simuliidae (see above) is currently being entered into a web page that will form part of the QSBG website when completed by the end of May 2006.

Web pages for the Darwin project have been completed, but not yet installed in the NHM and QSBG servers (Annex 2). This will be expanded as the project develops.

Purchases have already been made of all the relevant books necessary to identify Thai insects, especially the Coleoptera and Lepidoptera, ready for the expansion of the project beginning on 1 June 2006. Malaise and Intercept traps and Winkler bags are currently being made in Thailand and other small equipment such as light traps is on order from overseas. It is anticipated that the Darwin team will be fully equipped to start work on other insect groups on 1 June 2006. We have also decided to collect these insects in the QSBG rather than DINP because it is appropriate that insects of the QSBG should be well represented and the logistics are easier and costs lower at this site.

The project is on schedule with all systems installed and training completed.

- The second year has had no significant problems.
- No alterations in project design at QSBG have been made. A major development during the second year has greatly strengthened the exit strategy of the project over the last year (details under 6. Partnerships).

Timetable (workplan) for the next reporting period.

- *June 2006.* Collection, identification, curation and databasing of insects at QSBG.
- *July 2006.* Assessment of entomological curation infrastructure at QSBG by Howard Mendel (NHM).
- *July/August 2006.* Coordination and assessment meeting in QSBG – Drs Weerachai, Hutacharern, Vessabutr, Ralph Harbach and Tony Shelley. Organisation of specialists from the University of Chiang Mai for project collaboration – Ralph Harbach and Tony Shelley.
- *August 2006.* Visit by Martin Brendell (NHM) to QSBG for assessment of infrastructure and training in insect collection and curation.

- *February 2007.* Training and fieldwork completed.
- *May 2007.* Database and website functioning for general insects and operational for post-project entry of data on endangered species. Collaborative links and support for continued use of infrastructure completed. Final workshop for all participants and Thai officials and dissemination to media in Thailand and UK.

5. Actions taken in response to previous reviews

We have addressed three points made by the referee. 1. Scientific and Technical Assessment. In this year's report we have given technical details not mentioned in the first annual report. 2. Outputs, outcomes and dissemination. We are aware that there has not been dissemination of the project to a wider (international) scientific audience through the web and meetings. In Thailand the project is well known through our links and those of our Thai counterparts with other entomologists. For the international scene, we have produced web pages (Annex 2), which will shortly "go live". At present we are reticent to advertise our successes because we are only now moving on to the conservation part of the project. Consequently, we feel that if meetings and interviews are held at this juncture there will be the danger of 'going off at half-cock'. We anticipate having these towards the end of the third year as indicated under section 23 of PROJECT OUTPUTS in our Stage 2 application. 3. The discrepancy in grant value has been resolved.

6. Partnerships

- Collaboration between the NHM and QSBG has continued to be mutually beneficial. The QSBG management is increasingly supporting the development of Entomology as a facility within the botanical garden. This is evidenced by the inclusion of funds in the QSBG 2006/2007 budget for a new two-storey building that will house Entomology (museum, collections and laboratory and offices), an entomologist's salary that can be used by a Darwin entomologist when the project ends, and various items of equipment. Another significant positive step is the inclusion of the Darwin project under the Research Department headed by Dr Suyanee Vessabutr, a botanist with a PhD from Canada. Drs Weerachai and Vessabutr requested a short report from us on how we envisage development of Entomology in QSBG in the near future (report available if required). From this they have included certain items, where feasible, in their budget request for the next Thai financial year that begins in October 2006.

A joint NHM/Cambridge University funded expedition to study the diversity of Lepidoptera and Coleoptera in the national park in Mae Hong Son Province, located west of Chiang Mai, has now been given clearance by the Thai biodiversity conservation authorities. Staff of Dr Hutacharern (QSBG entomology adviser) at the Department of National Parks (DNP) will be trained in the month-long visit. Our field biologist will also be attached to the research team for extra training and to provide logistical assistance. Identified specimens will be deposited in the QSBG and DNP collections, thereby considerably enhancing them. During his visit in July 2006, Howard Mendel (NHM head of expedition; Head of Curation, Entomology, NHM) will review the infrastructure being developed by the Darwin project at QSBG.

Mr Martin Brendell, retired Head of Coleoptera Collections at NHM, will visit QSBG during August 2006, funded by the Darwin project. At this stage general insect collecting will have been ongoing for two months at QSBG. Mr Brendell will fine-tune the collecting and curatorial techniques. During the third year of the project we will recruit, on an *ad hoc* basis, insect specialists based in Thailand to assist and train our Darwin team in accurate species identification of insects being deposited in the QSBG National Collection.

- A National Science Foundation grant of US\$649,999.00 was recently awarded to Prof. Mike Sharkey at the University of Kentucky, USA. About 70 people will be involved in this major three-year project based in Thailand. The objective of the project is to produce an inventory of insects collected in the Thai National Parks and provide training for Thai scientists, technicians and students. The Thai counterpart of the project is Dr Hutacharern. Contacts

have been made with Mike Sharkey, who will be basing his project at QSBG and will be using the infrastructure set up by the Darwin project for deposition of specimens and their local data management.

A link with scientists at Mahidol University, Bangkok, and Prof. Peter Adler at Clemson University, USA, to study simuliid species complexes using material from the National Collection at QSBG is envisioned for the third year.

7. Impact and Sustainability

- Dr Hutachareern, as Director of Research at the DNP, has disseminated information about the Darwin project nationally and has facilitated our collaboration with specialists who will assist with insect identification in the third year of the project. At the international level, as a member of SUBSSTA of the CBD, she has discussed the importance of the project for Southeast Asia and the possibility of using the Darwin project at QSBG to develop an entomological hub for training in insect taxonomy and conservation in the region.
- The project is well known at all relevant Thai institutions and contacts are ongoing.
- The Thai government is currently studying the laws governing biopiracy of plants and animals (especially insects). The Darwin project provides the only National Collection where reference material for insects can be deposited as a prerequisite to conservation projects that are likely to develop from new legislature. Our exit strategy will increasingly develop during the third year as government policy is defined. Inevitably, the University of Kentucky project will continue and expand the Darwin legacy, but a clear definition of the precise events in our exit strategy cannot yet be given.

8. Outputs, Outcomes and Dissemination

- There are no differences in actual outputs against those agreed in the initial 'Project Implementation Timetable' and the 'Project Outputs Schedule'.
- These have come from the top down. As a representative for Thailand and the CBD, Dr Hutachareern at the DNP has effectively disseminated information on the Darwin project, and this same mechanism will continue after the Darwin project terminates.

• Table 1: Project Outputs

Code No.	Description	Year 1 Total	Year 2 Total	Year 3 Total	Year 4 Total	TOTAL
4C	6 postgraduate students (Thai)	4	0			
4D	20 training weeks	14	2			
8	24 weeks	10	10			
9	1 management plan	0	0			
10	2 field guides	0	0			
11B	6 papers to be submitted	0	0			
12A	2 databases for host country	0	2			
13A	1 completed reference collection	0	0			
14A	6 workshops and co-ordination meetings	2	2			

15A	1 press release in host country	0	0
17A	1 dissemination network	0	0
18B	1 national TV documentary, UK	0	0
19A	1 national radio interview, Thailand	0	0
20	£20,000	£20,000	0
21	1 permanent research facility	0	0

Table 2: Publications.

Type * (e.g. journals, manual, CDs)	Detail (title, author, year)	Publishers (name, city)	Available from (e.g. contact address, website)	Cost £
0	–	–	–	–

9. Project Expenditure

Table 3: Project expenditure during the reporting period (Defra Financial Year 01 April to 31 March)

Item	Budget (please indicate which document you refer to if other than your project schedule)	Expenditure	Balance

10. Monitoring, Evaluation and Lessons

- Apart from our biannual visits to Thailand, we receive monthly reports on scientific and financial matters. We are in constant email contact and occasional telephone contact with the Scientific Adviser. Scientific progress is assessed through the number of specimens and quality of material collected, and the efficiency of curation.
- Involvement with senior decision-making officials at both institutional and ministerial levels is paramount to the development of the project on schedule, and this will continue in the future.

11. Outstanding achievement during the reporting period

The linking of a major US-funded biodiversity project, which aims to provide an inventory of Thai insects as a basis to their conservation (see second bullet point under **Partnerships** above), to the Darwin project at QSBG provides the evidence for both national and international recognition of the need for a National Collection of Insects in Thailand, and demonstrates that its development is attainable through the keystone provided by this Darwin Initiative project. This upshot is a very good omen for the future.

■ **I agree for ECTF and the Darwin Secretariat to publish the content of this section**

Annex 1. Report of progress and achievements against Logical Framework for Financial Year 2005/2006.

Project summary	Measurable Indicators	Progress and Achievements April 2005-Mar 2006	Actions required/planned for next period
<p>Goal: To draw on expertise relevant to biodiversity from within the United Kingdom to work with local partners in countries rich in biodiversity but poor in resources to achieve</p> <ul style="list-style-type: none"> • The conservation of biological diversity, • The sustainable use of its components, and • The fair and equitable sharing of the benefits arising out of the utilisation of genetic resources 			
<p>Purpose To establish capacity in Thailand for developing and maintaining national reference collections and identification facilities for insects in support of biodiversity conservation and research in Thailand.</p>	<p>Infrastructure and collections of model insect groups established at QSBG, and training for NSM staff. Thai capacity established for continued development and curation of insect reference collections to support biodiversity and conservation research.</p>	<p>Collections of model insect groups completed with concomitant field and laboratory training of QSBG staff. Collaborative research project on blackflies linked with MSc student at the University of Chiangmai.</p>	<p>General insect collecting will start and local specialists have been enlisted to train the Darwin team in relevant procedures for collection and curation of other insect groups. Further purchase of insect cabinets.</p>
<p>Outputs</p>			
<p>Keystone insect reference collections.</p>	<p>Culicid, simuliid and endangered species collections completed.</p>	<p>Collections of culicid and simuliid species of DINP established at QSBG as foundation for building a Thai national reference collection.</p>	<p>Focus on collection, identification and curation of other insect groups and endangered species.</p>
<p>Expandable taxonomic database.</p>	<p>Data collection and entry completed; database functional.</p>	<p>Database for ecological data associated with culicid and simuliid collections created and largely populated.</p>	<p>Development of database by IT employee of QSBG would have benefited from guidance by NHM experts. Structure of database to be modified before going live and being used for national reference collection.</p>
<p>Expandable interactive website facility.</p>	<p>Functional website of integrated data, images and identification keys.</p>	<p>Images of numerous simuliid and culicid species captured for entry into website once developed.</p>	<p>Overly ambitious as it is not possible to include identification keys at this stage. Website to be developed excluding identification keys.</p>

Application of remote sensing and GIS techniques.	GIS data and maps linking collections, species and land cover ecology.	GIS images and collections of simuliids and culicids geo-referenced; integration of the latter with geological and vegetation data underway.	GIS processing to be completed and integrated into interactive website.
Training of Thai museum staff and partners.	At least 6 individuals trained in field methods, information and collection management practices, and/or GIS.	Four QSBG staff and an MSc student trained in field, laboratory and curatorial methods.	On site training at QSBG to be extended to personnel from National Science Museum, Bangkok.

