



**Darwin Initiative for the Survival of Species:
Biodiversity of Butterflies in Tropical Rainforests
of Sabah Borneo**

Final Report

**Keith C Hamer, Jane K Hill and Tom N Sherratt
Department of Biological Sciences,
University of Durham, UK**

Contents

1. Darwin Project Information	3
2. Project Background/Rational	3
3. Project Summary	4
4. Scientific, Training and Technical Assessment	4
5. Project Impacts	8
6. Project Outputs	9
7. Project Expenditure	9
8. Project Operation and Partnerships	10
9. Monitoring, Evaluation and Lesson-learning	11
10. Darwin Identity	11
11. Leverage	12
12. Sustainability and Legacy	12
13. Value for Money	12
Appendix I, Project Contribution to Articles under CBD	13
Appendix II, Outputs	15
Appendix III, Publications	17
Appendix IV, Darwin Contacts	18

1. Darwin Project Information

Project title: Biodiversity of butterflies in tropical rainforests of Sabah, Borneo

Country: Sabah Malaysia

Contractor: University of Durham

Project Reference No. 162/7/040

Grant value: £108,912

Starting/Finishing dates: 1 April 1998 – 31 March 2001

2. Project Background/Rationale

The State of Sabah (Borneo) is one of the poorest financially in Malaysia but is among the most species-rich in SE Asia and possesses many endemic species that rely on closed-canopy moist forest. Forestry is very important to Sabah's economy and most of the state's remaining forest is designated to be selectively logged at repeated intervals of around 35 years, although the impact that this will have on forest biota is very poorly understood. Sabah has an obligation under the Biodiversity Convention to develop ecologically sustainable forest management strategies that balance conservation of biodiversity with local community requirements. To meet this obligation, forestry researchers and conservation biologists in Sabah have identified an urgent need to understand both the immediate impacts of selective logging on forest structural and compositional characteristics and biodiversity, and how these features change over periods of forest recovery between logging events. Moreover, local agencies have recognized an urgent priority to develop the knowledge and skills necessary to continue this investigation beyond the time when plots of forest are logged for the second time, the impacts of which could be profound but are completely unknown.

Insects, the most diverse class of animals on earth, respond to disturbance more rapidly than do vertebrates, and butterflies are particularly sensitive in this respect. Forest which is capable of sustaining a diverse and distinctive butterfly community is thus likely to be equally capable of sustaining other taxa. Butterflies are very diverse on Borneo and include many endemic species. They are also highly visible and charismatic, making them important subjects not only as indicators of forest regeneration but also for education and publicity. Our study area is a site of outstandingly high biodiversity surrounding the Danum Valley Forest Research Station in Sabah. Much of the area is reserved as production forest, but there are large plots of undisturbed protected rainforest next to areas of forest which were selectively logged at known times up to 20 year ago (1978), making this an ideal area for comparative investigations.

This project aimed to evaluate changes in butterfly communities following selective logging, to determine appropriate management responses and to leave a legacy of trained local personnel, thereby promoting ecologically sensitive management and enabling essential long-term monitoring. The project worked in close association with the SE

Asian Rainforest Programme (SEARP), which is a major collaboration between UK institutions and the governments of Malaysia and Indonesia. Our work formed an integral part of the Danum Valley Rainforest Research and Training Programme, which has been established through a Memorandum of Understanding between the Sabah Departments of Forestry and Wildlife, the Forest Research Centre Sabah, Universiti Malaysia Sabah and the Royal Society London.

3. Project Summary

The main purposes and objectives of this project were: (i) to carry out comprehensive quantitative inventories of butterfly species in unlogged protected forest and selectively logged forest; (ii) to evaluate changes in rainforest butterfly communities following selective commercial logging; (iii) to describe concurrent changes in forest vegetation structure and plant diversity and so elucidate the causal mechanisms of changes in butterfly biodiversity; (iv) to determine appropriate management responses to changes in forest structural, floral and faunal characteristics following selective logging; (v) to train local forestry researchers and conservation biologists in the application of these techniques and to generate local expertise in butterfly taxonomy, field surveying and identification skills; (vi) to provide instruction in methods of gathering and analyzing ecological data and the management of large biodiversity databases; (vii) to establish a protocol for data gathering, analysis and interpretation; (viii) to provide an educational resource to assist local Education Officers with interpreting rainforest butterflies to schools and the general public in Sabah.

These objectives were not modified and all were met within the project period. The project is best described by the following Articles under the Convention on Biological Diversity (see Appendix I): Research and Training (Article 12), Identification and Monitoring (Article 7), In-situ Conservation (Article 8), Public Education and Awareness (Article 13).

4. Scientific, Training and Technical Assessment

Research

This study took place within the Danum Valley Conservation Area (DVCA) and in areas of production forest adjacent to DVCA in the Ulu Segama Forest Reserve in SE Sabah (Fig. 1). DVCA covers 43,800 ha and is the largest area of pristine rainforest remaining in Sabah. The area is remarkably rich in flora and fauna and in 1986 it was gazetted as Class 1 Protection Forest, providing complete protection from commercial exploitation. Adjacent to DVCA is a timber concession area (9,730 km²) licenced to Yayasan Sabah for selective logging at intervals of 30-40 years.

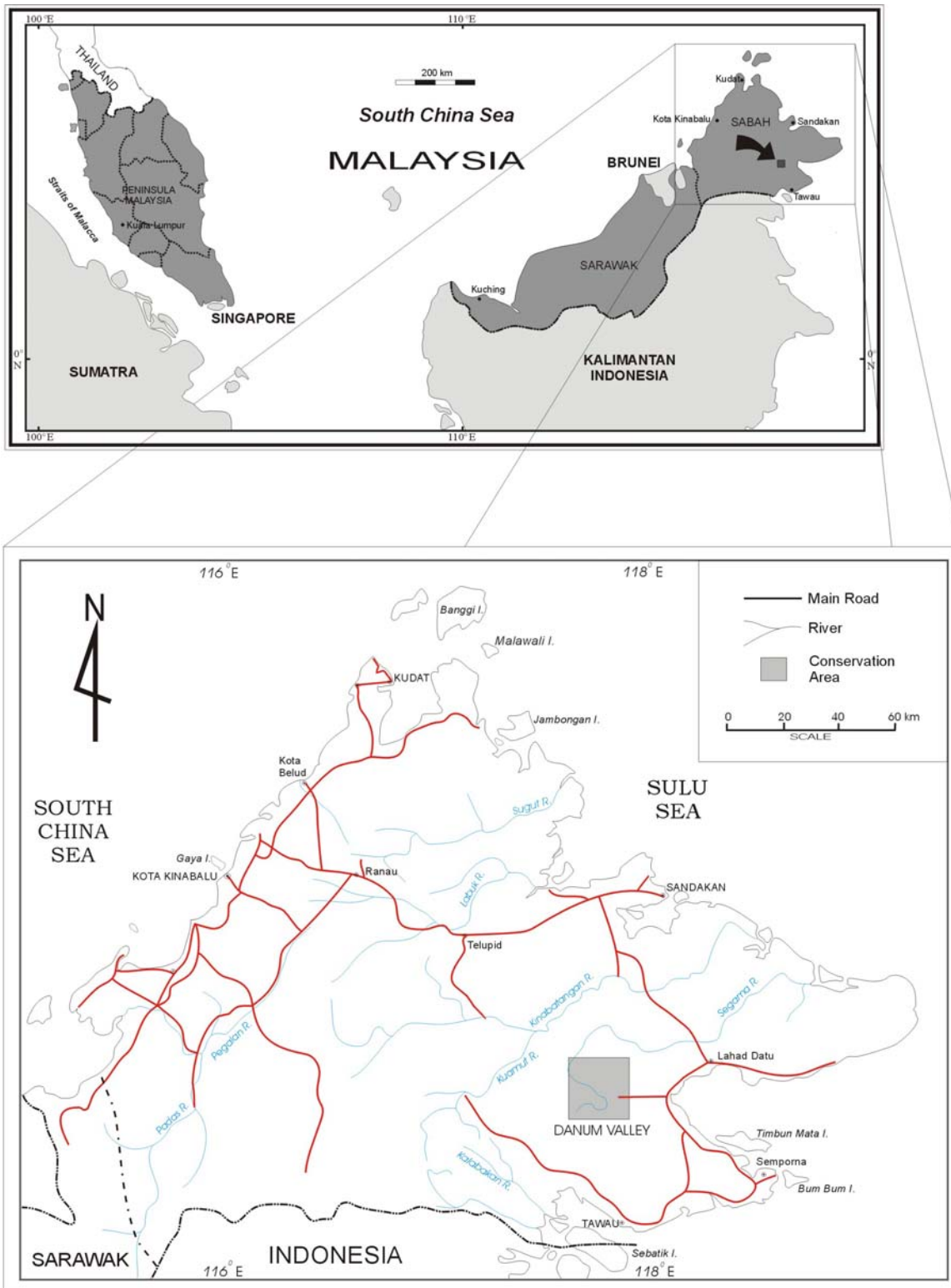


Figure 1 : Location of Danum Valley in Sabah, Borneo

At the beginning of the project in April 1988, we established a total of 80 permanent butterfly sampling plots, positioned at 100m intervals along 8km of existing paths and trails within unlogged forest (40 plots) and forest that had been selectively logged in 1988-89 (40 plots). To characterize vegetation structure, every plot was divided into four quadrants and within each quadrant we measured the distance, height, diameter at breast height [dbh] and point of inversion (site of the first major branch) of the two nearest large trees (dbh > 60cm) and the two nearest small trees (dbh 10-60cm). We also identified these trees as dipterocarp, non-dipterocarp or *Macaranga* sp. (undisturbed rainforest in Borneo is dominated numerically by trees in the family Dipterocarpaceae but disturbance can lead to higher proportions of non-dipterocarps including a number of invasive species in the genus *Macaranga*). In addition, we estimated the percentage cover of vegetation at ground, low (2-5m), understorey and canopy layers, and we measured canopy openness using a spherical densiometer. These data were analyzed by principal components analysis, which condensed the above variables into a small number of independent factors measuring different components of variation in vegetation structure and composition.

Butterflies were sampled using two different methods, which were designed to sample different groups of species: (1) Families Nymphalidae (subfamilies Satyrinae and Morphinae) and Riodinidae were sampled using point-counts at observation stations combined with counts of individuals along transects between stations. These taxa contain many species which are shade-dependent, are relatively easy to identify in flight, and can be reliably surveyed at ground-level. Points counts were conducted at every plot on four occasions per month for a full year from March 1999 until February 2000 inclusive (770 hours of sampling over 384km of transects). (2) Fruit-feeding nymphalid butterflies (subfamilies Satyrinae, Morphinae, Nymphalinae and Charaxinae) were sampled using fruit-baited traps, deployed at every plot for six days per month on average for a full year, from October 1999 to September 2000 inclusive (5760 trap-days in total). In addition, traps were placed at a number of locations in the canopy (at heights of 20m and 40m) and in natural gaps created by tree falls within unlogged forest. In most cases, captured butterflies were identified in the field, marked with a unique number or a coloured dot (depending on body size) and released. Individuals of new species, not previously sampled, were collected and preserved.

We recorded totals of 1825 butterflies from 34 species on transects and 3996 individuals from 63 species in fruit-baited traps. There was little difference between logged and unlogged forest in the total number of species recorded. However butterflies in logged forest were dominated numerically by a small number of highly abundant species whereas in unlogged forest, there was a more even distribution of relative abundance. Thus overall diversity of butterflies was higher in unlogged forest than in logged forest. Species with restricted geographical ranges, including endemic species, were slightly more abundant in unlogged forest but were nonetheless present as viable populations in logged forest. There were marked differences between habitats in vegetation structure and tree species composition. In particular, there was a much higher density of vegetation at ground and understorey levels in logged forest and at canopy level in unlogged forest. There was marked vertical stratification of species and strong evidence for a distinctive

gap fauna comprising highly mobile species with broad geographical distributions. Thus habitat modification that opens up the canopy, such as may occur after repeated logging cycles, is likely to result in an increase in these widespread species and a decrease in understorey species with restricted distributions.

Data were also collected on more detailed habitat requirements and temporal variation in abundance of individual species in relation to climatic variables (monthly rainfall, temperature and sunshine). These data indicated marked differences between species in their relative abundances during wet and dry seasons, with those species most abundant during the wet season having more restricted geographical ranges.

We also examined the longevity and dispersal of larger species, which we could mark individually. There was no difference between habitats or sexes but both dispersal and longevity differed between species in relation to body size and subfamily. The maximum distance moved by an individual was 4.7km and the maximum recorded adult lifespan was 175 days (substantially longer than lifespans of temperate species).

Data collected by this project were presented in four separate MSc theses (see Training and Capacity Building below) which were subject to independent peer review by external examiners. In addition, the project has so far produced three papers (one in press, two in review), with many more in preparation for publication in peer-reviewed scientific journals (see Appendix 3).

Training and Capacity Building

Four Darwin Fellows were appointed to the project for a period of two years each (two from July 1998 until June 2000; two from April 1999 until March 2001). They were all recent graduates in Biological Sciences at Universiti Malaysia Sabah with excellent academic records and a strong interest in biological conservation. They were appointed in consultation with our Sabahan partners at Universiti Malaysia Sabah and the Forest Research Centre Sabah. All four Fellows studied for an MSc by Research in Biological Sciences at the University of Durham, UK. At the start of their training, each Fellow attended classes for 10 weeks at Durham in Population and Community Ecology, Ecological Census Techniques and Statistics. They also received practical training in techniques for preserving and displaying butterflies and moths, in insect identification methods, including dissection and mounting of genitalia, and in public speaking. Each Fellow then received a total of six months of further training in the field, including vegetation sampling, butterfly survey methods, design and construction of butterfly traps, mark-release-recapture techniques and butterfly identification. At the end of their data collection, each Fellow then returned to Durham for a further 10 weeks to receive further training in statistics and scientific writing, and to complete their MSc theses.

Following submission, each thesis was critically examined by an external examiner (an acknowledged expert in the field, not connected with the University of Durham) and an internal examiner (a member of academic staff in the Department of Biological Sciences at Durham, not connected with the project). Darwin Fellows I and II (Mr Mahadi

Dawood and Mr Joseph Tengah) submitted their theses in July 2000 and passed forthwith. Darwin Fellows III and IV (Ms Suzan Benedick and Ms Nazirah Mustaffa) submitted their theses in March 2001. They are currently awaiting the outcome of the examination process but initial indications are very promising and we do not anticipate any difficulties.

In addition to training of Darwin Fellows, we also provided one week of training to the Education Officer at DVFC in the biology and ecology of rainforest butterflies. This included butterfly identification and use of the Education Pack that we produced for the project (see Appendix II). We also provided one week of training in insect survey and identification skills to two Sabahan field assistants at DVFC.

5. Project Impacts

There is currently much debate within Sabah as to the most appropriate management strategy for selectively logged forest, with increasing pressure being applied to convert large areas of such forest into commercial (principally oil palm) plantations. In support of this strategy, palm oil producers and plantation managers have suggested that selectively logged forest has little conservation value, and so there is no argument for retaining such forests in terms of protecting biodiversity. Data collected by this project have made a substantial contribution to this debate because we have demonstrated very clearly that in fact, selectively logged forest retains a large potential for supporting biodiversity (see Research above). This information has been forwarded to the Sabah Foundation (Dr Waidi Sinun) and the Sabah Department of Forestry (Dr Sining Unchi) in our Project Report and will inform future discussions regarding the most appropriate policy for commercial production forest.

This project has in particular helped the host country to meet its obligations under Articles 7, 8, 12 and 13 of the Convention on Biological Diversity (see Appendix I). Through training of Darwin Fellows, establishment of permanent study plots and reference collections and publication of research papers, the project has promoted research contributing to the conservation and sustainable use of biological diversity in Sabah (Article 12). Through our Project Report to the Sabah Foundation and the Sabah Department of Forestry, the project has promoted protection of habitats and provided guidelines for management of protected areas (Article 8) and assisted with identifying and monitoring components of biological diversity (Article 7). Through our provision of educational material for use by Education Officers at DVFC, we have assisted in promoting public education and awareness (Article 13).

At the end of their Darwin Fellowships, Darwin Fellow I (Mahadi Dawood) obtained a position as a Lecturer in Conservation Biology at the Institute of Tropical Biology, Universiti Malaysia Sabah, and Darwin Fellow II (Joseph Tengah) became a Senior Conservation Officer at the Forest Research Centre Sabah. These are both permanent posts. Darwin Fellows III and IV (Suzan Benedick and Nazirah Mustaffa) have both obtained posts as researchers on conservation biology projects in Sabah. These

appointments have all considerably increased the capacity for further work in the field of biodiversity in Sabah. All four Fellows are actively using the knowledge and transferable skills that they obtained during their Darwin Fellowships in their new posts. Mahadi Dawood is also using his training to train further undergraduate students in ecology and conservation at Universiti Malaysia Sabah.

This project has substantially enhanced the collaboration between UK and local partners and has already provided a catalyst for one further successful funding application (see Leverage below). It has also helped to forge stronger links between Universiti Malaysia Sabah and the Forest Research Centre Sabah.

In terms of social impact, the main beneficiaries of the project were the four Darwin Fellows. However, the project also provided support for infrastructure and staff at DVFC and provided occasional employment for technicians and field assistants.

6. Project Outputs

The main outputs from the project are described in Appendix II. These do not differ from the agreed schedule, except that the planned educational videos were replaced, after consultation with local Education Officers, with an educational pack containing 35mm colour transparencies, pamphlets (in English and Malaysian) and additional information.

Publications and material that can be publicly accessed are described in Appendix III. Information relating to project outputs and outcomes has been disseminated through research papers and reports, through workshops and seminars in the host country and the UK, and through the establishment of a project website. This will continue in the future through publication of further research papers in international peer-reviewed journals, through presentations at further conferences, workshops and seminars in the host country, the UK and internationally, and through regular updating of the project website. Where appropriate, any costs resulting from these activities will be met by the University of Durham.

7. Project Expenditure

This is detailed in the table below. There are two items for which variation in annual expenditure is more than 10% of the original budget agreed in the Project Schedule. The first is that university tuition fees were originally budgeted to be charged in full at the beginning of each Darwin Fellow's program of research (£4800 for each Darwin Fellow). In practice, fees were levied annually (£2400 for each Fellow each year). Hence the actual expenditure on fees was £4800 lower than expected in Year1 of the project (1998/9) and £4800 higher than expected in Year 3 (2000/2001). The second item of variation is that both our Sabahan partners were originally budgeted to visit the UK during Year2 of the project whereas in practice, one partner (Dr Chey vun Khen) visited in Year2 and the other (Prof Maryati Mohamed) in Year3. Hence the actual expenditure

on visits by Sabahan partners was £1400 less than expected in Year2 and £1400 more than expected in Year3. The combined effect of these changes was that actual expenditure was £4800 less than budgeted in Year1, £1400 less than budgeted in Year2 and £6200 more than budgeted in Year3. However total expenditure was in accordance with the Project Schedule.

8. Project Operation and Partnerships

There were two main local partners in the project: Professor Maryati Mohamed (Universiti Malaysia Sabah) and Dr Chey vun Khen (Forest Research Centre Sabah; see Appendix IV). Both have important roles in biodiversity issues in Sabah; Professor Maryati is Director of the Institute for Tropical Biology and Conservation at Universiti Malaysia Sabah and represents the Institute on a number of prominent and influential committees within Sabah; Dr Chey is Head of Entomology at the Forest Research Centre Sabah. Both were closely involved in the project from early in the planning stage, and both were actively involved throughout the project, including initial selection of Darwin Fellows, training in entomological techniques, provision of library and computing facilities and day-to-day logistic support in Sabah.

During the project lifetime, there was no formal collaboration with similar projects elsewhere in Sabah, but members of other projects were invited to seminars and workshops given as part of this project. In addition, UK staff, Darwin Fellows and local partners met members of other projects informally on a number of occasions, especially during fieldwork at DVFC. This greatly facilitated exchange of ideas and information between projects. There was no Biodiversity Strategy Office in Sabah during the lifetime of the project but the role of such an office was largely fulfilled by the Sabah Foundation, with whom we met for consultation at least twice per year throughout the project. There were no international partners in this project.

Local partners have continued to be highly active after the end of the project, including successful development of further projects (see Leverage below) and organization of a Darwin Initiative Conference to be held at Universiti Malaysia Sabah in September 2001 (see Darwin Identity below).

9. Monitoring and Evaluation

The progress of the project was monitored by UK staff via evaluation meetings held every six months, using the indicators and milestones set out in the initial Project Schedule agreed with DETR, and coinciding with the production of interim (six-monthly and annual) project reports for DETR. Progress was additionally monitored via meetings with local partners in Sabah every six months. The work carried out by the project was externally evaluated through independent peer review of MSc theses and research papers.

The key lesson to be drawn from the experience of this project was the great importance of having strong links with local partners from an early stage. This greatly facilitated planning and instigation of the project and contributed immensely to ensuring that the project fulfilled all its major objectives.

10. Darwin Identity

Strenuous efforts have been made during the project to publicise the Darwin Initiative. The Darwin Initiative logo has been used extensively on posters and leaflets (copies enclosed with this report), websites, reports and at workshops and seminars, and is prominently displayed on each butterfly case and on the catalogue of the Darwin Initiative Butterfly Collection at Universiti Malaysia Sabah, where the collection will be permanently housed in purpose-built accommodation. In addition, an international Darwin Initiative conference has been organized for September 2001 at Universiti Malaysia Sabah, with presentations from all five current and past Darwin Initiative projects based in Sabah. This conference will be widely publicized including national press and television coverage. During the project we produced several hundred postcards of Sabahan forest butterflies with the Darwin logo and brief information about the project on the reverse (copies enclosed with this report). These were distributed widely in Sabah and internationally, and were donated for sale at various outlets in Sabah, thus drawing the project to the attention of a wider audience. All four Darwin Fellows were proud to use these titles and habitually did so.

Within Sabah, the Darwin Initiative is familiar to staff in the Sabah Foundation, the Forest Research Centre Sabah and Universiti Malaysia Sabah. They generally recognize the Darwin Initiative as a scheme to provide funding for biodiversity projects in developing nations and many have a more detailed knowledge. Our particular project was clearly recognized as a distinct project with its own identity.

11. Leverage

During the lifetime of the project, a further £107,000 was awarded from the Darwin Initiative (Round 9) for a related but distinct project on Molecular Tools for Promoting Biodiversity in Rainforest Fragments of Borneo, which grew in part out of discussions and data gathered during the current project. Both local partners visited the UK during the project, at the invitation of UK project staff, in order to strengthen their links with Darwin Initiative staff and to learn more about other possible sources of funding, especially the European Union.

The project also provided leverage in forming part of the supporting case for the establishment of the new Institute for Tropical Biology and Conservation at Universiti Malaysia Sabah (Director: Professor Maryati Mohamed), the establishment of which has hugely increased the profile and status of biodiversity within Sabah.

12. Sustainability and Legacy

The most enduring achievement of the project is likely to be a continued contribution by the four Darwin Fellows to work on biodiversity in Sabah. Other enduring achievements include permanent additions to the published literature and the availability of reference collections and permanent study plots for use by future workers. We are maintaining frequent contact with all four Darwin Fellows and both local partners in connection with writing of further research papers, management of our latest Darwin project (see Leverage above) and development of further projects for the future.

13. Value for Money

We consider that this project represents excellent value for money and we hope that our reasons for reaching this conclusion are evident from this report

Keith Hamer, Jane Hill & Tom Sherratt
July 2001

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

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 which integrate conservation and sustainable use.
7. Identification and Monitoring	25	Identify and monitor components of biological diversity, particularly those requiring urgent conservation; identify processes and activities which have adverse effects; maintain and organise relevant data.
8. In-situ Conservation	25	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		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	40	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	10	Promote understanding of the importance of measures to conserve biological diversity and propagate these

Awareness		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		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

Appendix II Outputs

Code	Total to date (reduce box)	Detail (←expand box)
Training Outputs		
1b	Number of PhD qualifications obtained	
2b	Number of Masters qualifications	4: Ms Suzan Benedick, Mr Mahadi Dawood, Ms N. Mustafa, Mr Joseph Tangah. All of Sabahan nationality
3b	Number of other qualifications obtained	
4a	Number of undergraduate students receiving training	
4b	Number of person weeks of training provided to undergraduate students	
4c	Number of postgraduate students receiving training (not 1-3 above)	
4d	Number of person weeks of training for postgraduate students	176
5	Number of people receiving other forms of long-term (>1yr) training not leading to formal qualification(i.e not categories 1-4 above)	
6a	Number of people receiving other forms of short-term education/training (i.e not categories 1-5 above)	3
6b	Number of person weeks of training not leading to formal qualification	3
7	Number of types of training materials produced for use by host country(s)	1: Education Pack on studying Sabahan butterflies donated to Ms Sylvia Yorath, Education Officer, Innoprise Corps, Sabah
Research Outputs		
8	Number of weeks spent by UK project staff on project work in host country(s)	74
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: Project Report given to local staff (Sabah Foundation, Innoprise Corps, Dept Forestry and Wildlife, Forest Research Centre Sabah)
10	Number of formal documents produced to assist work related to species identification, classification and recording.	1: Catalogue of the Darwin butterfly collection at Universiti Malaysia Sabah.
11a	Number of papers published or accepted for publication in peer reviewed journals	1: See Appendix III. Two more currently in review. Many more in preparation
11b	Number of papers published or accepted for publication elsewhere	
12a	Number of computer-based databases established (containing species/generic information) and handed over to host country	3: Databases for (i) Satyrinae and Riodinidae; (ii) fruit-feeding Nymphalidae; (iii) forest vegetation characteristics handed to staff at Universiti Malaysia Sabah
12b	Number of computer-based databases enhanced (containing species/genetic information) and handed over to host country	
13a	Number of species reference collections established and handed over to host country(s)	1: Darwin butterfly collection established at Universiti Malaysia Sabah

Code	Total to date (reduce box)	Detail (←expand box)
13b	Number of species reference collections enhanced	1: Butterfly collection at Forest Research Centre Sabah enhanced
Dissemination Outputs		
14a	Number of conferences/seminars/workshops organised to present/disseminate findings from Darwin project work in host country	2: Darwin workshop at Universiti Malaysia Sabah, Sep 2000. Major Darwin Initiative conference at UMS, Sep 2001.
14c	Numbers of conferences/seminars/workshops attended at which finding from Darwin project work have been presented/disseminated in the host country	6: Seminars at Sabah National Museum and Danum Valley Research Centre.
15a	Number of national press releases or publicity articles in host country(s)	2: Sabah Times, Oct 2000 & Sep 2001
15b	Number of local press releases or publicity articles in host country(s)	
15c	Number of national press releases or publicity articles in UK	
15d	Number of local press releases or publicity articles in UK	
16a	Number of issues of newsletters produced in the host country(s)	
16b	Estimated circulation of each newsletter in the host country(s)	
16c	Estimated circulation of each newsletter in the UK	
17a	Number of dissemination networks established in host country	1: World Wide Web site established to disseminate information on project (http://www.dur.ac.uk/Ecology/darwin.htm)
17c	Number of dissemination networks enhanced/extended in host country	
18a	Number of national TV programmes/features in host country(s)	3: One interview with Dr Jane Hill, two with Prof Maryati Mohamed
18b	Number of national TV programme/features in the UK	
18c	Number of local TV programme/features in host country	
18d	Number of local TV programme features in the UK	
19a	Number of national radio interviews/features in host country(s)	
19b	Number of national radio interviews/features in the UK	
19c	Number of local radio interviews/features in host country (s)	
19d	Number of local radio interviews/features in the UK	
Physical Outputs		
20	Estimated value (£s) of physical assets handed over to host country(s)	Commercial value of butterfly collections probably in excess of £10,000. Text-books of combined value £120 purchased for Darwin Fellows and for library at DVFC
21	Number of permanent educational/training/research facilities or organisation established	
22	Number of permanent field plots established	80
23	Value of additional resources raised for project	

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 which 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	Hill, J.K., Hamer, K.C., Tangah, J. & Dawood, M. (2001). Ecology of tropical butterflies in rainforest gaps. <i>Oecologia</i> 128: 294-302	Springer-Verlag	http://link.springer.de/link/service/journals/00442/index.htm	
Website			http://www.dur.ac.uk/Ecology/darwin.htm	
MSc Thesis	Tangah, J. (2000). Impacts of Selective Logging on Tropical Butterflies in Sabah, Malaysia	Durham University	Durham University Library, South Road, Durham DH1 3LE	
MSc Thesis	Dawood, M. (2000). Ecology of <i>Ragadia makuta</i> (Lepidoptera: Satyrinae) in Tropical Rainforests of Sabah, Malaysia	Durham University	Durham University Library South Road, Durham DH1 3LE	
MSc Thesis	Benedick, S. (2001). Responses of Fruit-feeding Forest Butterflies to Selective Logging in Sabah, Borneo	Durham University	Durham University Library South Road, Durham DH1 3LE	
MSc Thesis	Mustaffa, N. (2001). Temporal Variation in Fruit-feeding Forest Butterfly Communities in Sabah, Borneo	Durham University	Durham University Library South Road, Durham DH1 3LE	

Appendix IV: Darwin Contacts

Project Title	Biodiversity of butterflies in tropical rainforests of Sabah, Borneo
Ref. No.	162/7/040
UK Leader Details	
Name	Dr Keith Hamer
Role within Darwin Project	Project Leader
Address	Dept Biological Sciences, University of Durham, South Road, Durham DH1 3LE
Phone	
Fax	
Email	
Other UK Contact (if relevant)	
Name	
Role within Darwin Project	
Address	
Phone	
Fax	
Email	
Partner 1	
Name	Dr Maryati Mohamed
Organisation	Universiti Malaysia Sabah
Role within Darwin Project	Logisitic support and liaison
Address	Institute for Tropical Biology and Conservation, PO Box 2073, 88999 Kota Kinabalu, Sabah Malaysia
Fax	
Email	
Partner 2	
Name	Dr Chey vun Khen
Organisation	Forest Research Centre Sabah
Role within Darwin Project	Logistic support and assistance with training
Address	PO Box 1407, 90715 Sandakan, Sabah Malaysia
Fax	
Email	