

## DARWIN INITIATIVE FOR THE SURVIVAL OF SPECIES : APPLICATION FOR GRANT FOR ROUND 9 COMPETITION

Please read the accompanying Guidance Note before completing this form. Give a full answer to each section; applications will be considered on the basis of information submitted on this form. Applicants are asked not to use the form supplied to cross refer to information in separate documents except where this is invited on the form. The space provided indicates the level of detail required but you may provide additional information on a separate sheet if necessary. Copies of this form are available on disk or by e-mail on request. You are asked also to complete the summary sheet attached at the end of this form. Although you may reproduce this sheet in a reasonable font, you should not expand it beyond an A4 sheet (leaving the allocated space for DETR comments to be made) as additional information will not be taken into account.

### 1. Name and address of organisation

DEPARTMENT OF BIOLOGICAL SCIENCES, UNIVERSITY OF DURHAM, SOUTH ROAD, DURHAM DH1 3LE

### 2. Principals in project

Details	Project leader	Main project partners or co-ordinators in host country	
Surname	Dr Hamer	Professor Mohamed	Dr Chey
Forename(s)	Keith	Maryati	vun Khen
Post held	Senior Lecturer	Director	Head of Environmental Sciences
Institution (if different to the above)	As above	Universiti Malaysia Sabah	Forest Research Centre
Department	As above	Institute of Tropical Biology & Conservation	Entomology
Telephone			
Fax			
Email			

Please provide a one page CV for each of these named individuals.

### 3. Project title (not exceeding 10 words)

MOLECULAR TOOLS FOR PROMOTING BIODIVERSITY IN RAINFOREST FRAGMENTS OF BORNEO

### 4. Abstract of study (in no more than 750 characters)

IN SABAH (BORNEO) AS ELSEWHERE, DEVELOPMENT OF AGRICULTURE MUST BE BALANCED AGAINST LOSS AND FRAGMENTATION OF NATURAL FOREST. WITH LIMITED RESOURCES, CONSERVATION NEEDS TO BE TARGETED EFFECTIVELY, YET FOREST MANAGERS LACK THE MEANS OF ESTABLISHING PRIORITIES FOR FOREST PATCHES BASED ON KEY CRITERIA (SPECIES DIVERSITY, REPRESENTATION OF SPECIES OF HIGH CONSERVATION VALUE, IMPORTANCE WITHIN NETWORKS OF LOCAL POPULATIONS). BUTTERFLIES ARE HIGHLY DIVERSE IN SABAH, WITH MANY ENDEMIC SPECIES, AND THIS PROJECT WILL DEVELOP AND USE MOLECULAR GENETIC TOOLS TO PROVIDE CLEAR PRACTICAL GUIDELINES FOR THE CONSERVATION OF BUTTERFLY BIODIVERSITY IN FOREST PATCHES. IT WILL ALSO LEAVE A LASTING LEGACY OF TWO FULLY TRAINED SABAHAN CONSERVATION BIOLOGISTS USING MOLECULAR GENETIC TECHNIQUES TO MEASURE AND PROMOTE BIODIVERSITY ACROSS A WIDE RANGE OF TAXA IN SABAH AND THROUGHOUT SE ASIA

### 5. Timing. Give the proposed starting date and duration of the project.

1<sup>st</sup> April 2001; three years.

### 6. Describe briefly the aims, activities and achievements of your organisation. (Please note that this should describe your unit,

institute or department within a university.)

**Aims**

To promote excellence in teaching and research in ecology and environmental sciences

**Activities**

The Ecology Research Unit within the Department of Biological Sciences at Durham currently contains 14 academic staff and three research technicians. Our research covers fieldwork sites from Arctic tundra to tropical rainforests, and we have strong collaborative links with many UK and international institutions. We have particular research strengths in molecular and conservation biology and seven of our staff are members of the University of Durham Centre for Tropical Ecology, including the Director of the Centre, Dr K.C. Hamer. We offer Bachelor of Science Degrees in Ecology and Environmental Sciences in addition to contributing to six other degrees in Biological and Natural Sciences

**Achievements**

During the past three years, members of the Ecology Research Unit have attracted funding worth over £5,000,000 for projects addressing fundamental and applied questions in Ecology and Conservation Biology, from a variety of sources including research councils, central government agencies, industry and the EU. We currently have nine postdoctoral research staff and 52 postgraduate students, with a further 12 having successfully completed their studies since 1997. We have published over 200 research papers in major scientific journals since 1997 and members of the Unit sit on a number of international research and policy committees (WHO, EU, etc). In January 2000 we obtained a maximum score of 24/24 in the UK Government Teaching Quality Assessment.

7. Has your organisation received funding under the Initiative before? If so, please give details.

Biodiversity of butterflies in tropical rainforests of Sabah Borneo (sixth round)  
*Prosopis juliflora*: implications for the biodiversity of caatinga (fourth round)

8. Which overseas institutions, if any, will be involved in the project? Please explain the responsibilities of these institutions.

**Institute of Tropical Biology and Conservation, Universiti Malaysia Sabah**

As Director of the Institute of Tropical Biology and Conservation, Professor Maryati will be instrumental in recruiting personnel and co-ordinating the day to day running of the project in Sabah. She will also be responsible for obtaining permission to collect material for molecular genetic analysis. The Institute is the designated establishment for housing biological material in Borneo and will provide a permanent home for specimens after the project, within one of the primary insect collections in the Asean (Association of South East Asian Nations) region.

**Forest Research Centre, Sabah**

Most forested areas in Sabah are under the direct control of the Forestry Department, whose Conservation and Research Division is the Forest Research Centre. The selection of forest patches for study has been made in consultation with the Forest Research Centre and Dr Chey vun Khen (Head of Environmental Sciences) will provide practical support for the fieldwork including permission to carry out research and practical assistance in gaining access to more remote areas.

**Yayasan Sabah (Sabah Foundation)**

Dr Waidi Sinun (Senior Conservation Officer) and Mr Gregory Mosigill (Regional Forestry Manager) will provide logistic support and consultation on development of ecologically sustainable forest management strategies and guidelines. Ms Sylvia Yorath (Environmental Education Officer) will provide assistance with producing and disseminating educational packages.

**PROJECT DETAILS**

9. Define the purpose (main objective) of the project in line with the logical framework.

Data gathering and capacity building to assist conservationists, ecologists and forest managers in Sabah with promoting responsible economic growth that maximizes the development of agriculture and silviculture whilst minimizing the impacts of loss and fragmentation of rainforests on biodiversity. This will be achieved by providing clear practical advice on the size and placement of forest patches necessary to preserve species richness and genetic diversity. In addition, we shall assist conservationists in establishing priorities for the conservation of species, by using genetic techniques to identify butterfly species of high conservation value and determining their vulnerability to habitat fragmentation. The project will focus on butterflies, which are highly diverse in Sabah with many endemic species. However the principles elucidated by this project will be broadly applicable to a wide range of insects, and we shall leave a lasting legacy of two fully trained Sabahan conservation biologists using molecular genetic techniques to measure and promote biodiversity across a wide range of taxa in Sabah and throughout SE Asia.

10. Is this a new project or the continuation of an existing one?

New project

11. What is the evidence for a demand or need for the work? How is the project related to conservation priorities in the host country(ies)? How would the project assist the host country with its obligations under the Biodiversity Convention?

How was the work identified?

Tropical conservationists face three major challenges in identifying priorities for conservation in the face of limited funding resources and the continuing loss of biodiversity: (1) tropical communities contain many cryptic species that are highly distinct genetically yet cannot be distinguished using traditional morphological methods. This is especially true of invertebrates, which constitute over 90% of biodiversity. Thus in many cases, even in well-studied taxa such as butterflies, inventories of invertebrate biodiversity are based on 'morphospecies', which have no taxonomic validity and thus are very poor estimators of biodiversity; (2) limited resources need to be targeted towards those species with the highest conservation value, but most tropical countries lack the molecular genetic skills required to identify those species which have the greatest phylogenetic uniqueness and so contribute most to biodiversity; (3) isolation of populations within forest fragments can limit the dispersal of individuals, so reducing genetic diversity within populations and increasing the likelihood of local extinctions. Effective conservation in fragmented landscapes requires estimates of gene flow patterns within and among habitat fragments, in order to minimize the isolation of populations and consequent loss of biodiversity. Yet the molecular genetic tools for estimating gene flow patterns are almost completely lacking in tropical countries. This is a matter of urgent concern because in the near future, most remaining tropical forest will occur as fragments scattered among agriculture and urban development. Conservationists in temperate regions are well aware of the importance of size and isolation of habitat fragments for species survival, but this has rarely been considered in tropical communities. This is unfortunate given that a high proportion of tropical species are dependent on forest.

How is the project related to conservation priorities in the host country?

The State of Sabah (Borneo) is the poorest financially in Malaysia and the vast majority of its income is generated through conversion of rainforest into oil palm plantation and other forms of silviculture. This increasingly leaves patches of rainforest interspersed among oil palm and other plantations. These rainforest patches may contribute significantly to the conservation of rainforest biodiversity and some have been gazetted as Virgin Jungle Reserves to protect them from further disturbance. However resources for protection are highly limited and the choice of patches to preserve is largely arbitrary, because forest managers lack the means of establishing priorities for patches based on key criteria (species diversity, representation of species of high conservation value and importance within a network of local populations). This lack of vital information also excludes forest managers from making informed recommendations as to the size and placement of forest patches to be preserved in future agricultural developments. This critical need for molecular genetic information and infrastructure within Sabah has been recognized in the recent investment in molecular genetics facilities at Universiti Malaysia Sabah. This has given UMS the equipment they need to carry out molecular genetic analysis, but they lack suitably trained staff or the means to train them.

How will the project assist the host country to meet its obligations under the Biodiversity Convention?

This project will, in consultation with Sabahan forestry researchers and managers, allow the development of strategies that balance conservation of rainforest biodiversity with agricultural development to meet local community requirements.

12. In what ways can this project be considered a Darwin project? How does the project relate to the Darwin principles? How would the project be advertised as a Darwin project and in what ways would the Darwin name and logo be used?

The project will work in close association with the *SE Asian Rainforest Research Programme* (SEARRP), which is a major

collaboration between UK institutions and SE Asian governments. The project will provide essential and urgently required information on the impacts of forest fragmentation on genetic diversity of species and hence their long-term viability. Such data are currently unavailable but are essential to allow forestry researchers and conservation biologists to have an informed input to the development of ecologically sustainable forest management strategies. This critical link between field research and the development of appropriate management tools makes this an appropriate and important Darwin Initiative project.

The project relates closely to the principles of the Darwin Initiative: it is focused on an area of acknowledged high biodiversity rain forest with outstanding butterfly diversity including many endemic species; it utilizes collaboration between local and UK institutions in the monitoring and conservation of biodiversity in a biologically rich country with little existing local expertise or financial resources for conservation (Sabah is one of the poorest states within Malaysia); through its training and capacity building, its novel and integrated approach and its outputs, the project is likely to be a significant catalyst for further funding via the SEARRP.

Butterflies are charismatic flagship species of high public concern. The Department of Biological Sciences in Durham and collaborating institutions would advertise the project as a Darwin project through use and display of the Darwin name and logo on all information and educational material, publications, descriptive literature and equipment, at conferences and other meetings and in press releases and magazine articles.

13. Set out the proposed timetable for the work, including the programme's measurable outputs using the attached list of output measures.

#### Summary Timetable

1<sup>st</sup> April 2001 - 30<sup>th</sup> September 2001. Two Sabahan graduate biologists (Darwin Research Fellows - DRF I & II) receive training in Sabah in ecological techniques, establish fieldwork sites and commence collection of data and biological material for molecular genetic analysis.

1<sup>st</sup> October 2001 - 30<sup>th</sup> September 2002. DRF I receives training in molecular genetics techniques at Durham and uses these techniques to identify and describe cryptic butterfly species and to attach conservation values to species on the basis of phylogenetic (evolutionary) distinctiveness. DRF II collects data and biological material in Sabah, including material to be analysed by DRF I, which will be taken to Durham in March 2002 by Project Director and Field Research Team Leader.

1<sup>st</sup> October 2002 - 30<sup>th</sup> September 2003. DRF I collects data and biological material in Sabah, including material to be analysed by DRF II, which will be taken to Durham in March 2003 by Project Director and Field Research Team Leader. DRF II receives training in molecular genetics techniques at Durham and uses these techniques to determine gene flow patterns of selected butterfly species within and among forest fragments.

1<sup>st</sup> October 2003 - 31<sup>st</sup> March 2004. DRF I & II complete molecular genetic analyses at Durham and assist in writing of reports and scientific papers.

#### Measurable Outputs

1. Training of two Sabahan graduate biologists (Darwin Research Fellows) at Durham University in (i) molecular techniques for identifying species and quantifying genetic diversity and (ii) ecological techniques for sampling and monitoring biodiversity in forest patches. This will include training in butterfly taxonomy and identification, cladistics and phylogenetic analysis, laboratory techniques for molecular genetic analysis, censusing techniques, database management and writing of reports and scientific publications (Code 4B and 5; March 2004).
2. Production of a comprehensive quantitative inventory of butterfly species in different sized forest fragments (Output Code 10) and a manual of genetic techniques (Output Code 10). Production of a fully labelled and annotated collection of specimens (Code 13B) and a computer-based database (Code 12A) to be housed at Universiti Malaysia Sabah and a field guide (Code 10) to assist with species identification, classification and recording (Output 10) (March 2004).
3. Production of two educational packages (pamphlets, 35mm slides, posters and leaflets), with narration in English and Malaysian, one to assist in teaching of molecular taxonomic techniques to local scientists, the other to assist in interpreting the consequences of forest fragmentation to local communities (Code 7; October 2000).
4. UK staff to spend a combined total of 28 weeks per person in Sabah assisting with data collection, training the Darwin personnel in the field and liaising with staff at collaborating institutions (Code 8; April 2001 - March 2004).
5. Establishment of 400 study plots in 20 forest fragments for long-term monitoring of butterfly biodiversity (Code 22; October

2001).

6. Evaluation of the relationship between forest fragmentation (size and isolation) and the diversity and conservation value of forest-dwelling butterfly species. Additionally, to estimate gene flow and genetic diversity within and among populations of selected butterfly species (10 papers to be submitted to peer-reviewed journals by March 2004; Code 11B).
7. Presentation of results of the project at meetings of the British Ecological Society, the Royal Entomological Society, UK and the Sabah Society, and organisation of research seminars and workshops at Universiti Malaysia Sabah to disseminate results and stimulate the development of new projects using molecular genetics techniques by the local scientific community (Code 14B; 10 presentations and two workshops by March 2004).
8. Presentation of results using the Sabahan and British local and national media where appropriate, also dissemination via local student networks and international networks including the World Wide Web (Code 15; at least 1 press and radio release in host country and overseas by March 2004 and Code 17; Web Page established by December 2001). Production of management recommendations in consultation with the Sabah Departments of Forestry and Wildlife and the Forest Research Centre Sabah (Code 9; March 2004). Enabling of two collaborators from Sabah (Dr Maryati Mohamed and Dr Chey vun Khen) to visit Durham for two weeks each, to gather information on teaching and use of molecular genetic techniques (Code 6; March 2003 and March 2004).

14. Do you know of any other individual/organisation carrying out similar work? Give the details of the work, explaining the similarities and differences.

Staff from a number of US universities and conservation agencies have worked for over 20 years on the impacts of forest fragmentation on species diversity in the neotropics (principally Amazonian Brazil and Panama) but in keeping with common practice, they have excluded from their work those groups of species that cannot be separated using traditional morphology. To our knowledge, impacts of habitat fragmentation and isolation on species biodiversity have not previously been studied anywhere in the palaeotropics (SE Asia or Africa). A number of researchers, including the Field Research Team Leader, have studied genetic diversity in populations of temperate butterflies, and have established protocols and tools for studying molecular genetics of butterflies, but these tools have yet to be applied to tropical species.

15. Will the project include training and development? Please indicate how many trainees will be involved, from which countries and what will be the criteria for selection. How will you measure the effectiveness of the training and will those trained then be able to train others? Where appropriate give the length of any training course.

Two Sabahan graduate students (Darwin Research Fellows) will be trained at Durham in a wide range of molecular genetic and ecological techniques. The effectiveness of this training will be measured through written, oral and practical examinations and by close monitoring of the quality of work produced throughout the project. Both Fellows will be appointed on the basis of qualifications (MSc in Ecology or Conservation), interest and aptitude. We have already identified 2 suitable candidates who have close ties with UMS and FRC. If appointed to this project, both are likely to be employed by their respective host institutions at the end of the grant, guaranteeing continued use of skills learnt during the project, and that they will be ideally placed to train others.

16. How will trainee outcomes/destinations be monitored after the end of the training?

Written, oral and practical examinations at Durham, coupled with field visits by the Project Director and the Fieldwork Research Team Leader to assess competence in the field. Continued supervision and monitoring throughout the duration of the project will ensure that both Fellows are able to work independently on novel molecular genetics projects by the end of their Fellowships.

17. How is the work of the project expected to continue after the end of grant period? A clear exit strategy must be included.

It is envisaged that the permanent study plots established by this project will continue to be used by the Forest Research Centre and Universiti Malaysia Sabah for long-term monitoring of changes in biodiversity of forest fragments well beyond the end of the grant period. Forest management strategies written in the final year of the grant will include recommendations for future monitoring and research. These will be written in consultation with the Regional Forestry Manager and Senior Conservation Officer of the Sabah Foundation, to help ensure that the recommendations are carried out. There is a high probability that both Fellows will continue to work at their host institutions (UMS and FRC) after the end of the project. Facilities for molecular genetic analysis are already in place at UMS, and internal funding for maintenance of facilities has been ensured, so that the availability of fully trained staff resulting from this project will ensure that molecular genetic work on biodiversity in Sabah continues beyond the lifetime of the project.

#### MONITORING AND EVALUATION

18. Describe how progress on the project would be monitored and evaluated in terms of achieving its aims and objectives, both during the lifetime of the project and at its conclusion. How would you ensure that it achieves value for money? What arrangements will be made for disseminating results? If applicable, how would you seek the views of clients/customers?

Both Darwin Research Fellows will produce written annual reports and field visits by the Project Director (KC Hamer) and Field Research Team Leader (JK Hill; four each in total) will monitor progress with fieldwork. Both the Sabahan Project Co-ordinator (M Maryati) and the Fieldwork Advisor (Chey VK) will assist the Fellows in developing and carrying out novel projects after the conclusion of the grant. The results of the project will be disseminated widely through the media in Sabah and via research papers, seminars, conferences, workshops and a website. The Sabahan project Co-ordinator has very close links with the media (TV, press and radio) in Sabah, which have already proved very effective in promoting awareness and disseminating results of previous collaborative projects.

19. 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
<p><b>Goal</b> To assist conservationists, ecologists and forest managers in Sabah with promoting responsible economic growth that balances maximizing agricultural development with minimizing the impacts of loss and fragmentation of rainforest on biodiversity</p>	<p>At end of project, guidelines on the most appropriate sizes and placements of forest fragments will be incorporated into economic planning, and molecular genetic techniques firmly established for measuring and promoting biodiversity</p>	<p>Reports and guidelines received and accepted by State Agencies. Trained Sabahan staff in post and using molecular genetic facilities at UMS to develop new projects.</p>	<p>N/A</p>
<p><b>Purpose</b> To provide clear practical advice on the sizes and placements of forest patches necessary to preserve species richness and genetic diversity. To leave a lasting legacy of trained Sabahan staff using molecular genetic techniques to measure and promote biodiversity within Sabah and throughout SE Asia.</p>	<p>Practical assistance given to forest managers and conservationists (March 2004). Molecular genetic tools used to resolve otherwise intractable taxonomic uncertainties and identify cryptic species (Sep 2002). Darwin Research Fellows able to use molecular genetic and ecological techniques to develop further projects (March 2004).</p>	<p>Management guidelines written to assist in maintenance and promotion of biodiversity in forest fragments. Biodiversity inventories and guides updated after resolution of taxonomic difficulties.</p>	<p>Forest managers and conservationists have a meaningful input into economic planning. This is guaranteed by the State legislature. Molecular genetics facilities are maintained at UMS beyond the life of the project. Internal funding has already been approved at UMS, subject to availability of suitably trained staff.</p>
<p><b>Outputs</b> Quantitative elucidation of how species diversity and genetic diversity within species relate to forest patch size and isolation. Training of two Sabahan Darwin Research Fellows in ecological and molecular techniques for measuring species richness and quantifying genetic diversity.</p>	<p>Research papers written up (March 2004). Successful completion of training courses by Darwin Research Fellows (September 2002 for DRF I, September 2003 for DFR II).</p>	<p>Research papers published in peer-reviewed scientific journals. Darwin Research Fellows attain appropriate standard in written, oral and practical examinations.</p>	<p>Darwin Research Fellows take up posts at UMS and FRC. This is almost certainly guaranteed by the recruitment process. Research leads to clear guidelines.</p>
<p><b>Activities</b> Collection and analysis of data on biodiversity in selected forest fragments. Attendance by Darwin Research Fellows of training course at Durham with additional training for both Fellows in Sabah.</p>	<p>Fieldwork sites established (Sep 2001), material collected (Apr 2001-Sep 2003), Darwin Research Fellows attend courses and receive in-house training at Durham (Oct 2001-Sep 2002 and Oct 2002-Sep 2003).</p>	<p>Map of study sites produced; collection of material established; Darwin Research Fellows appointed and arrive in Durham.</p>	<p>Successful recruitment of Darwin Research Fellows and establishment of study plots in forest fragments. Both of these are greatly facilitated by the close links that we have with our collaborating institutions in Sabah.</p>