

Darwin Fellowship - Final Report

(Please check guidance for submission deadlines, max 6 pages.)

Darwin Project Ref No.	EIDPS12
Darwin Project Title	Developing ecological tools for predicting impacts of forest disturbance across taxa
Name of Darwin Fellow	Noel Tawatao
UK Organisation	University of York
Your Organisation	Institute of Tropical Biology and Conservation Universiti Malaysia Sabah
Your role in your Organisation	Research student/tutor
Start/end date of Fellowship	October 2006 - September 2007
Location	Department of Biology, University of York
Darwin Fellowship funding (£)	£
Type of work (e.g. research, training, other, please specify)	Research and Training
Main contact in UK Organisation	Dr. Jane Hill
Author(s), date	Noel Tawatao

1. Background

- Briefly describe your involvement in the Darwin project before the start of your fellowship.

Prior to the start of the fellowship programme, I investigated responses of ants and termites to tropical forest disturbance, and related changes in diversity to changes in abiotic factors. My fieldwork was carried out in Sabah (Malaysian Borneo) where previous and existing Darwin projects are being implemented. This work was carried out for my Masters degree. During my research and field studies at Danum Valley it became clear to me from talking to other researchers that there was little consideration of whether or not ants responded to habitat disturbance in a similar way to other invertebrates. This fellowship arose directly from these discussions.

During the field work for my Master's research project, I particularly discussed my ideas with researchers involved with previous Darwin Initiative projects 9/10025 & 6/7040. These previous projects examined the degree to which species richness and genetic diversity of butterflies were affected by habitat disturbance (selective logging) and forest fragmentation. Findings revealed significant impacts of commercial selective logging and forest fragmentation on butterfly diversity but that these impacts were relatively minor compared with the consequences of clear-felling and conversion of forest to agriculture. The findings also suggested that small forest remnants make an important contribution to regional diversity. In this fellowship, I have investigated whether or not similar patterns are evident across taxa with different ecological traits and life-histories, and I have focussed specifically on ants.

- Describe aim and objectives of the Fellowship, and programme of work.

The fellowship investigated whether responses of different species and taxa to land-use changes co-vary, and if responses are predictable from species' ecological traits and taxonomy. In order to tackle these questions, I have taken two approaches. First, I have collated and analysed existing published data across a wide range of taxonomic groups

(animals and plants) to compare responses of species to moderate (e.g. commercial selective logging) versus severe (e.g. agriculture, clear felling) forest disturbance. My findings show that moderate disturbance has negligible impacts on most species, but that severe disturbance results in the decline of many species. I have also collected new field data for ants to examine impacts of commercial selective logging, and habitat fragmentation. I have analysed these data in relation to species diversity, as well as in relation to species' functional traits. These data show that selective logging had little impact on species diversity, but that groups such as soil nesters and predators were adversely affected by logging. This implies that habitat disturbance may affect ecosystem functioning even when impacts on diversity are minor.

- Briefly describe the roles of the UK and Fellow's institutions.

The Department of Biology at York University have provided all the training and expertise necessary for my development as a research scientist, and for the successful completion of my project. For example, there is expertise at York in the research areas of global environmental change, biodiversity, statistical techniques and insect ecology, and I have benefited from working alongside these research groups and discussing my findings with them. The University of Leeds provided further expertise in tropical insect diversity and provided me with specific training in the use of stable isotopes. I have also benefited from existing links through a current Darwin Initiative project at the University of York with the Natural History Museum, London. This has helped me with ant taxonomy and identification. The Biology Department at York is also collaborating on projects with the NERC Molecular Genetics Facility at the University of Sheffield, and this collaboration allowed me to attend a course and provided me with training in the molecular genetic techniques necessary for examining impacts of habitat disturbance on ant genetic diversity,.

The Institute of Tropical Biology and Conservation is a research institute within the Universiti Malaysia Sabah. Research at the Institute currently focuses on understanding the impacts of forest loss and disturbance on species diversity. Thus the findings of my research are of great importance to other researchers at UMS, and complement on-going research projects. I am currently employed as a tutor at the Institute, and so my findings will be passed on to other local researchers and students as part of my teaching.

- If you have undertaken a formal course of training, please provide a brief explanation of the course and a link to the course website if available.

I have attended masters-level courses within the Department of Biology at York. These are courses provided to students attending the MRes course in 'Ecology & Environmental Management'. I attended modules in 'Conservation Genetics', 'Molecular Techniques in Ecology', and 'Statistics for Ecologists' (<http://www.york.ac.uk/depts/biol/gsp/masters/mastersnow.htm>).

I also attended a molecular genetics course on Amplified Fragment Length Polymorphism at Sheffield University (NERC Molecular Genetics Facility) on 19-23 February 2007. This complemented the courses I attended in York, and gave me specific training in using AFLPs for detecting changes in ant genetic diversity.

I also attended a course at South Western Research Station, Tuscon, Arizona. This course was organised by the California Academy of Sciences together with Harvard University. The course was held 2-14th August 2007 and covered all aspects of ant biology, including taxonomy, behaviour and ecology, and included ant identification. I was awarded a scholarship to cover the costs of my attending the course. The course organisers are very keen to include my Bornean ant material on the 'antweb' web site (www.antweb.org) as soon as possible. This will help other researchers to identify their material. The material I have collected is probably the most comprehensive ant collection from Borneo to date.

2. Achievements

- Summarise the work undertaken during your Fellowship. What were the main activities undertaken. Highlight any work undertaken but not originally planned and explain why this happened. Highlight any problems encountered and how they were overcome.

My fellowship had three main activities, which were all concerned with examining the general patterns of species' responses to forest disturbance. I think that an understanding of these patterns is very important for making reliable predictions of the distribution of biodiversity in the future.

- a) **Meta-analysis of existing published data.** I have searched on-line databases (e.g. Web of Knowledge) and found more than 60 studies reporting impacts of commercial selective logging and clear cutting on tropical taxa. In Sabah (Malaysian Borneo) where I am based, there is currently much discussion about the long-term future of production forest. Most areas of production forest have now been logged at least once, but are failing to regenerate and thus are of little current commercial value. Such areas are now under threat from conversion to oil palm plantations as a way of maintaining the State's economic returns from these areas. The aim of my study was to examine the role of production forest for biodiversity, and to compare changes in biodiversity following moderate and severe habitat changes. I examined changes in species richness as well as changes in species with different ecological traits (e.g. geographic range size, dispersal ability and habitat specialisation). My findings indicate little effect of moderate disturbance on any species (including many animal and plant taxa), suggesting that even quite degraded forest is important for conserving biodiversity. However, severe habitat disturbance following clear felling and conversion to agriculture resulted in major losses of biodiversity, showing that conversion of forest to oil palm will have significant impact on local biodiversity. I am currently preparing this work for publication.
- b) **Analysis of new field data for ants.** I have collected new field data for ants. I have developed a new sampling strategy which involves me taking a total of 25 samples of leaf litter (1m² quadrat) from a 2-km transect. I use a stratified sampling approach and sample 5 quadrats from each of 5 sites, each site separated by a distance of 500m. Invertebrates (including ants) are extracted from leaf litter using Winkler techniques. This new technique allows me to include a range of different levels of habitat heterogeneity within my sample along the 2km transect, but also allows me to obtain reliable data from a particular site (5 replicates per site). During this Fellowship, I have sampled a site in undisturbed forest, as well as a site selectively logged in 1988. I have also sampled six forest remnants, and will sample a further 5 sites when I return to Sabah next month (November 2007). This sampling of fragments has been slightly delayed by me breaking my leg in April 2007, which meant I could only do lab work for the next 2 months. I had been planning to briefly return to Sabah to complete this sampling of remnants sites, but as a consequence of breaking my leg I have had to delay this sampling until the end of the Fellowship. My analysis of effects of selective logging on ants shows that ant abundance was reduced by approximately one half following logging. However, there was little impact of logging on species diversity, although some functional groups (predators, soil nesters) were adversely affected. This suggests that logging may affect ecosystem functioning, and I will examine this further in the future research projects. The analysis of these field data on logging were based on me identifying ants to morphospecies, but I now wish to identify this material to species-level. In order to do this, I have already visited the Natural History Museum, London and I will visit the California Academy of Sciences (San Francisco; host of www.antweb.org) to complete this identification in January - March 2008. The novel part of my research to date has been to categorise ants into different feeding guilds and functional groups based on their ecological and morphological traits. This work will be extended with my analysis of forest fragmentation effects. The data I collect for this will form my PhD thesis for which I am registered at the Universiti Malaysia Sabah (currently about to embark on my final year of study). I am currently preparing a publication from the analyses of impacts of commercial selective logging on ants.

c) **Laboratory analysis of changes in genetic diversity of ant population following forest fragmentation.** I have attended courses at the Universities of York and Sheffield in the use of molecular genetics to examine changes in genetic diversity following habitat disturbance. These courses have included practical training, as well as study of the underlying theory and principles. This analysis of impacts of habitat fragmentation on genetic diversity will be finished once I complete my field sampling (end of Dec 2007), and sorting and identification of insect material. The field work was delayed because I broke my leg and I was unable to do any fieldwork for 2 months. However I was able to use this time to extend the scope of my meta-analysis (see above) and to extract additional data from published studies to examine impacts on species abundance. I have secured further funding to visit the Museum of Comparative Zoology in Harvard, as well as the California Academy of Sciences, San Francisco to identify new field material from forest fragments (Jan-March 2008). Once this material is identified to species-level, I will be able to select a few focal species for further study of genetic diversity. I will then return to the UK to complete this analysis in York (April - May 2008).

- What have been the main achievements of your fellowship? Key documents should be annexed to this report.

1. The finding that commercial selective logging has little impact on diversity across a wide range of taxa. This provides further support that moderately-disturbed forest is important for biodiversity conservation. Such areas deserve more protection, especially because as their commercial value declines, these areas become increasingly threatened with conversion to other non-forest land-use types. 2. The preparation of two papers for publication. 3. The description of a new record of ant species (*Lordomyrma reticulata*) on Borneo. 4. Invitation to attend the 'antweb' ID course and to make my Bornean material available to other researchers on-line. 5. Presenting my research at conferences in the UK (British Ecological Society Tropical Ecology Group, Royal Entomological Society Post-Graduate Forum – winner of 'best poster' competition).

3. Outcomes, lessons and Impact

- Do you feel that the work undertaken during your Fellowship has improved skills that are relevant and important for your work in your organisation? How are you planning to apply those skills in future work?

The fellowship has greatly enhanced my taxonomic skills on ants and other soil invertebrates, both from a morphological and genetical perspective. Training in techniques on sampling design and application of statistical and diversity analysis to my data have provided me with important new knowledge on how to conduct research successfully. All these skills I have gained will now be shared with my colleagues at UMS, Sabah, through teaching and collaborative research.

- What arrangements have been made for your future involvement, what more could be done, what discussions have taken place with your original employer to ensure that your new skills are utilised?

I am currently registered as a PhD student at the Universiti Malaysia Sabah. I am also a tutor at UMS. The Institute of Tropical Biology at UMS has a strong focus on studying ants because it is recognised that they are so important in ecosystem functioning. Thus my new identification skills will be valuable to on-going and new research projects at the Institute. My employment as a tutor at UMS will allow me to pass on these skills. My study on the impacts of forest fragmentation on biodiversity is part of longer-term projects at York and Leeds, and I will continue to collaborate on these projects in the future. UMS is developing a project with York on the sustainable production of oil palm, and the role of forest remnants in promoting more sustainable production. My skills in field sampling, data analysis and ant identification will be an important part of this new project.

- Has the Fellowship helped to improve your capacity to solve practical problems related to the sustainable use and/or conservation of biodiversity in your country?

Many forested areas in Sabah are rapidly being converted from forest into oil palm plantation. Data are urgently needed to understand the consequences of this for biodiversity, and to provide information on how to minimise loss of biodiversity. Results from my research will emphasise and increase the awareness of conserving the remaining forest fragments. My research will also provide information to help Sabah's Forestry Department decide on where to allocate resources for maximising protection of remaining forested areas, and whether or not forest remnants are likely to be viable in the long-term.

- Have you had the opportunity to make contacts with other UK biodiversity institutions, intergovernmental organisations, NGOs or the private sector during your fellowship? Will these contacts be useful for your future work, and how are you planning to maintain them?

The fellowship has strengthened my collaboration with different organisation working on tropical invertebrates and ecology. I am currently collaborating with the University of Leeds on a project examining isotopic changes in ants as a result of habitat disturbance. Isotope signatures can be used to determine the trophic level at which the ants are feeding, and whether this is affected by habitat disturbance. I have formed collaborative links with the University of Cambridge and helped researchers identify ant material from tropical epiphytic ferns in Sabah. I have also formed new collaborative links with the Natural History Museum to help my taxonomic studies on the ants of Borneo. Outside the UK, I have also established links in the USA with the Museum of Comparative Zoology, Harvard University and the California Academy of Sciences. Images of my ant material will be uploaded onto 'antweb', which will facilitate research by other ant biologists from different parts of the world. I have also agreed that my samples will be incorporated into the 'Biodiversity Research Center' in Ontario, Canada and used for bar-coding and contributing to the 'Tree of Life' project.

- Any other issue emerging from your experience as Darwin Fellow that you would like to raise, or suggestions for improvements to the Darwin Initiative Fellowship scheme.

Overall I have found this experience very useful and helpful. The opportunity to work with researchers in the UK has been very exciting, and I have learnt important new research skills. These new skills have been successfully used in my current research for my PhD. I have enjoyed attending Darwin Initiative workshops, but would have liked better communication among Darwin Fellows to discuss our experiences in the UK. For example, an email listing, or a special session for Fellows to present their work at the London Darwin workshops.