

Darwin Initiative for the Survival of Species

Final Report

1. Darwin Project Information

Project Reference No.	162/10/030
Project title	Developing local capacity for biodiversity surveys in Papua New Guinea
Country	Papua New Guinea
UK Contractor	University of Sussex
Partner Organisation (s)	New Guinea Binatang Research Center (formerly Parataxonomist Training Center)
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Project website	www.entu.cas.cz/png/
Author(s), date	Dr A.J.A. Stewart, Dr V. Novotny; 28 November, 2004

2. Project Background/Rationale

The primary aim of the project was to train a team of 'parataxonomists' (biodiversity technicians) based at the New Guinea Binatang* Research Centre (BRC) (formerly the Parataxonomist Training Center) in Madang, Papua New Guinea (PNG), so that they would become a source of expertise for carrying out local biodiversity surveys, producing data for various types of 'client', including national and international nature conservation organisations, international researchers in tropical forest ecology and insect taxonomy and sustainable-forest-use projects, and at the same time providing material for national taxonomic collections. The project was led by Dr Alan Stewart (University of Sussex (UoS), UK) in collaboration with Dr Mike Wilson (National Museum of Wales, Cardiff, UK) and Dr Vojtech Novotny (BRC). The project aimed to enhance the sophisticated indigenous knowledge of the natural world by Papua New Guineas by introducing them to formal biological training, with the aim of strengthening the capacity for biodiversity surveys in PNG, which was previously seriously inadequate. The importance of this approach becomes obvious when considering the importance of PNG as one of the last three "wilderness areas" remaining in the tropics, the limited local capacity for biodiversity surveys and the limited extent and efficiency of overseas-driven surveys to date, illustrated by our poor knowledge of PNG biota.

* 'Binatang' means 'insect' in the most widely used language in PNG, Tok Pisin.

3. Project Summary

The project aimed to transform biodiversity surveying in PNG from an overseas-driven to a local activity, relying on local experts with access to national biological collections who can establish rapport with both local grassroots landowners and international research communities. The project succeeded in achieving this aim, since it created, equipped and trained a fully localised team of 12 biodiversity technicians ('parataxonomists') who demonstrated their independent ability to conduct surveys of insect and plant biodiversity in remote areas of PNG and provide high quality research data and material. This team is now providing paid assistance to local landowners, environmental and government organisations and local and overseas research teams. The parataxonomists also proved to be excellent educators of grassroots villagers, who own 97% of rainforests in PNG, on environmental issues by delivering lectures, organising workshops and creating and distributing educational materials for villagers and schools. Furthermore, the project also obtained a large number of specimens and biodiversity data on the Lepidoptera, improved the National Insect Collection and established the parataxonomist team at BRC as the leader in entomological research in PNG. Finally, the project trained one local MSc student.

The project goal as set out in the logical framework (Appendix V) was achieved, because the project did result in the intensification of insect biodiversity surveys, the build-up of insect specimens and increased involvement of local landowners in these surveys. In particular, we completed six surveys that produced 29,000 mounted insect specimens, mostly deposited locally in PNG at BRC and the National Insect Collection in Port Moresby.

The purpose of the project as specified in the logical framework was to transform biodiversity surveying from an overseas-driven activity to one based on local teams of parataxonomists who can establish a rapport both with local grassroots landowners and with international researchers. This approach has been especially successful, since the team of parataxonomists that was established during the project continues to operate in PNG. Its success is documented by meeting the target for the project outputs (specified below) in terms both of biodiversity surveys and educational activities.

The project outputs and activities as specified in the logical framework centre around the establishment, development, training and equipping of the parataxonomist team, the development and enhancement of biological collections and the construction of relevant databases. These outputs were all achieved. We also made a substantial contribution to equipping the parataxonomist team at BRC with laboratory and field equipment (microscope and light source, digital camera, laptop computer, solar panel and generator for working in remote locations) and a 4-wheel drive vehicle for access to remote sites.

Our key assumption in the logical framework has been proved valid, namely that "parataxonomists are better biodiversity surveyors than university graduates who tend to pursue administrative careers in towns and are thus unavailable for fieldwork and also become too removed from concerns of village landowners". The project succeeded largely because we managed to complete or exceed the activities planned, particularly those relevant to training parataxonomists. This was achieved by intensive training in PNG, as well as through extensive overseas training of six senior parataxonomists. We also demonstrated the validity of the assumption in the logical framework that "there is a pool of highly dedicated and capable school leavers in PNG villages with extensive traditional knowledge of the natural world who can be trained [to become] fully qualified biodiversity surveyors (parataxonomists)". BRC has never had difficulty in recruiting new trainee parataxonomists of high calibre and potential; generally, these recruits remain employed by BRC for extended periods because they regard their work as being interesting, valuable and providing good career prospects.

Modifications: The objectives and predicted outputs were not significantly modified during the project's lifetime. However, we can point to three significant *additional* accomplishments:

- training one MSc student from the University of Technology, Lae, Papua New Guinea
- extending the overseas training experienced by six parataxonomists to include visits to academic institutions in USA, Czech Republic and Panama, in addition to those in UK
- establishing a new local NGO, the Simbu Bioresearch Group, in Mu Village (Simbu Province, PNG) lead by the parataxonomists trained during the project and active in biodiversity surveys and environmental education. The viability of this project is demonstrated by a National Geographic Society (USA) project recently awarded to this group.

Relevance to the CBD: The project is relevant to Articles 7, 8, 10, 12, 13, 14, and 17 under the Convention on Biological Diversity, particularly to Research and Training (Article 12); see Appendix I.

4. Scientific, Training, and Technical Assessment

(i) Training of parataxonomists in PNG

We trained a team of 12 parataxonomists at BRC throughout the three years of the project. The training was led by Dr Vojtech Novotny who resided at the BRC for six months in each of the three years and was supported by a total of five visits from Dr Alan Stewart and Dr Michael Wilson. The parataxonomists also benefited from long-term stays at BRC by PNG M.Sc. students (Darren Bito and Rapo Pokon) and overseas PhD students (Gregory Setliff, Milan Janda, Jiri Hulcr - entomology, Antonin Krasa - herpetology, and Daniel Stancik - botany). Shorter visits were made by other researcher collaborators (Dr George Weiblen, Dr Jan Leps - botany) who assisted in training and helped to create an intellectually stimulating environment at BRC.

The parataxonomists were trained to: (1) design and implement biodiversity surveys, (2) process and evaluate plant and insect samples, (3) sort insect and plant species, (4) produce high quality biological specimens, (5) document the specimens by digital photography, (5) organise the logistics and supervise village assistants during fieldwork in remote field conditions, (6) summarise the information in electronic databases, field guides, technical reports and education leaflets for grassroots landowners, (7) understand basic biological concepts, and (8) use computers.

We evaluated progress by the parataxonomists mid-project by setting them a full-day comprehensive test designed to assess their theoretical and practical skills, including understanding of basic biological concepts, practical identifications of insects and plants, practical computer tasks, and questions relevant to biological survey logistics and data analysis. This test was carried out in December 2003 (i.e. 28 months into the project), and identified the remaining gaps in training which were then rectified during the last year of the project. The results indicate that a core group of 8 parataxonomists by that stage had already acquired the crucial skills needed for their work, since they scored over 75% of the maximum number of marks, while the remaining 4 parataxonomists needed to improve particularly their computer skills. The test and a summary of the results are presented in Appendix VI. The training continues after the completion of the Darwin project. For instance, two senior parataxonomists have successfully completed a one-month field ecological course organised primarily for the final year undergraduate students at University of PNG.

The net result of the training is that a team of 12 parataxonomists now exists that has become highly skilled in all practical stages of biodiversity assessment. This is particularly remarkable in view of their lack of education beyond secondary school level.

Our Darwin training programmes in PNG have generated substantial interest in the biological community both locally and internationally. In particular, Takeuchi & Golman (2001, *Sida* 19: 445-468) cited our programme as an example to be followed by other plant surveys in PNG. They

commented that BRC "demonstrated [that the] success of such [an] organization in entomology by itself shows that the protocols can work for botany." Furthermore, Pfeiffer & Uriil (2003, *Telopea* 10: 61-72) commented that our project "has demonstrated the viability of employing indigenous parataxonomists in large-scale, long-term, biodiversity inventories" when discussing plant surveys for the international Flora Malesiana project. Finally, our project became one of the focal points of the authoritative review of the parataxonomist approach which we co-authored (Basset et al. 2004, *Journal of Applied Ecology* 41: 163-174). It received positive evaluation also by Janzen (2004, *Journal of Applied Ecology* 41: 181-187). Only rarely do training programmes receive such extensive attention in peer-reviewed biological journals.

(ii) Overseas training of parataxonomists

Three pairs of parataxonomists successfully completed training visits to the UK (one pair in each of the three years; John Auga, William Boen, Richard Kutil, Markus Manumbor, Kenneth Molem and Martin Mogia). Each pair visited and received training at three academic institutions in the UK:

- (a) University of Sussex, hosted by Dr Alan Stewart. The parataxonomists were introduced to a variety of field ecological techniques and UK habitats, including temperate deciduous forest as a comparison to tropical forest. Day visits were made to the Natural History Museum in London, where they were able to see and discuss the work done by insect taxonomists specialising in Lepidoptera, Hymenoptera, Hemiptera and Coleoptera. Visits to other institutions varied between years, but included the Royal Horticultural Society at Wisley where they were shown the work of the entomology section, the Royal Entomological Society and the Zoological Society of London. At Sussex University, they were given training in various laboratory techniques including insect mounting techniques and examination of specimens using a Scanning Electron Microscope.
- (b) National Museums & Galleries of Wales, Cardiff, hosted by Dr Mike Wilson. The parataxonomists were given introductions to the museum's insect collections and taxonomic facilities (including photomicroscopy, morphometric analysis and freeze drying). They were also given training in taxonomic and curatorial techniques and were able to see how a major national museum operates. They visited a number of local habitat types, including montane environments, and were able to see a variety of temperate agricultural systems.
- (c) Royal Botanic Garden and Herbarium, Kew, hosted by Drs Tim Utteridge, Simon Owens, Rogier de Kok and William Baker. The parataxonomists were given an introduction to the systematics and phylogeny of key plant groups and were trained in botanical curation techniques. They were shown the experimental work done by Kew and given the opportunity to discuss issues associated with particular plant taxa found in PNG.

We were particularly fortunate in being able to use the opportunity of the parataxonomists visiting the UK to extend their itinerary to include visits to other overseas institutions with which the BRC has collaborated. This gave them the opportunity to see how their own work (e.g. in the form of specimen collections) was being used by overseas scientists with whom they had been collaborating for several years. These extra visits represented significant added value to the Darwin-sponsored training in the UK because they were made possible by the Darwin programme but were funded from other sources. Their programmes included visits to:

- (a) Smithsonian Tropical Research Institute, Panama, hosted by Dr Yves Basset. The parataxonomists visited the canopy crane facility at Port Sherman and were taught insect collecting methods using the crane. This visit was especially valuable as it was their first experience of a tropical environment outside New Guinea and it provided an opportunity to visit a Neotropical forest.
- (b) Department of Plant Biology and the Bell Museum of Natural History at the University of Minnesota, St. Paul, USA, hosted by Dr. George Weiblen. The parataxonomists visited plant

collections and molecular biology laboratories, where they sequenced plant material previously collected in PNG by them and were taught the general rationale of phylogenetic studies using molecular data. They also visited the Bell Museum exhibit on PNG plants.

- (c) Department of Systematic Biology, National Museum of Natural History, Smithsonian Institution, Washington DC, USA, hosted by Dr Scott Miller and Karie Darrow. The parataxonomists inspected the insect collections, including material they had collected during the Darwin light trapping programme and received training in insect dissections and digital photography using the advanced facilities available at the museum.
- (d) Institute of Entomology of the Czech Academy of Sciences and the University of South Bohemia, Ceske Budejovice, Czech Republic, hosted by Dr. Vojtech Novotny, Prof. Jan Leps and postgraduate students Lukas Cizek, Milan Janda and Jiri Hulcr with whom they had worked in PNG in the past. The parataxonomists visited several nature reserves, completed botanical surveys of permanent plots, took part in an introductory biology field course organised by the University of South Bohemia for undergraduate biology students and visited several farms. All of these provided them with valuable contrasts to analogous ecological systems and sampling techniques used in PNG.

It would be difficult to overstate the achievement of this component of the project. None of the six parataxonomists had travelled outside New Guinea before embarking on their round-the-world itinerary. In all cases, they managed to complete the programme without adverse incident and gained considerably in 'worldliness' in the process. All three pairs of parataxonomists were very pleased with their visits and felt that they had significantly expanded their knowledge and experience. This was a significant factor in their subsequent promotions to team or survey leaders at BRC.

(iii) Student and research training

Mr. Rapo Pokon, a graduate student from the University of Technology (UniTech), Lae, PNG, completed his M.Sc. research, based at BRC as a Darwin-sponsored in-house student; Lawong Balun (UniTech, Lae) and Vojtech Novotny served as his co-supervisors, with John Mukiui (UniTech, Lae) as the principal supervisor. His research on diversity in root-feeding chrysomelid beetles (Thesis title: *Host specificity and species richness of beetle larvae (Coleoptera) feeding on the roots of trees in a lowland rainforest in Madang, Papua New Guinea*) progressed particularly well because he was able to obtain the first quantitative data on this topic from the tropics. In order to facilitate this work, we also organised his study stay at the Wildlife Conservation Society's centre in Goroka. He reported on his results at the 5th New Guinea Biological Conference (see below), submitted a paper to the *Journal of Tropical Ecology* and is currently about to submit his thesis for defence. He will graduate in March 2005. This M.Sc. training represents an additional accomplishment of the project which originally included only short-term "work experience" stays for university undergraduate students. This M.Sc. training was a direct response to the needs of the University of Technology, that lacks capacity for such training in entomology - Rapo Pokon is the only M.Sc. student presently trained in this field at this university.

Responding to a request by our local collaborator, the National Agriculture Research Institute (NARI) in Port Moresby (PNG), we provided one month of training at BRC for Mr. Mark Ero, who is the Chief Curator of the National Insect Collection. He is a recent M.Sc. graduate in entomology from the University of Papua New Guinea. During his one-month training at BRC, he received instruction in the curation of insect collections, field entomological research and sampling techniques, as well as data management and digital imaging. His training consolidated the collaboration with NARI that we developed during the course of the project.

Mr. Chris Dal, an undergraduate student in biology at the University of PNG, received 10 weeks training, during which time he also took part in the field and laboratory entomological research

activities at BRC. Finally, Mr. Lawong Balun, a lecturer at the University of Technology, also took part in the Darwin-sponsored fieldwork.

(iv) Biological surveys

Our research programme of six light-trap surveys of Lepidoptera biodiversity has been successfully completed. However, its original focus on general surveys covering major geographical areas of PNG was redirected into two distinct projects: (i) the comparison of beta diversity within lowlands and along an altitudinal gradient in the Madang area (3 surveys), and (ii) the comparison of natural communities with those on restored vegetation created on artificially revegetated areas after gold mining on Misima Island (Milne Bay Province, PNG; 3 surveys). We decided on this modification of the programme because the Misima surveys presented a unique opportunity to compare moth communities in three contrasting habitats within a confined area: primary forest, secondary regrowth after traditional slash-and-burn agriculture and artificially revegetated areas after gold mining.

The study in Madang Province included surveys in the Madang lowland forest (at one site that was 200 m above sea level) and an altitudinal gradient from 200 to 1,600 m above sea level, including 4 sites, in the nearby Finisterre Mts. The results include data on 15,000 individuals from 1,300 species of Lepidoptera and demonstrate low beta diversity between 2 sites 100 km apart within the same lowland forest type, but substantial species turnover along the altitudinal gradient.

The Misima surveys produced 14,000 individuals from 916 species of Lepidoptera. It demonstrated rapid recolonization of revegetated areas, at least within 0.5-1 km distance from the neighbouring natural forests. We were able to suggest a number of indicator species that are particularly associated with either primary forest or revegetated areas, whose presence can be used in future to monitor progress of the community towards pristine forest. These results were presented at the International Congress of Entomology in Brisbane this year by the Project Leader (Stewart, Novotny & Miller, 2004) and they will be submitted as two papers to peer reviewed journals in 2005.

The resulting 29,000 moth specimens will mostly be deposited at the National Insect Collection in PNG, at BRC and the Smithsonian Institute in Washington USA that coordinates the taxonomic analysis of the material. The 1,400 species of Lepidoptera were documented by digital images. The resulting database was provided to the Department of Environment and Conservation in PNG and will be further used for research and education.

The parataxonomists also assisted, and are acknowledged by, several other research projects, particularly on insect ecology (University of Minnesota, Smithsonian Institution) and biodiversity surveys (WWF, Indo-Pacific Conservation Alliance).

(v) Scientific and conservation conferences

Our Darwin project made it possible for BRC parataxonomists and students to attend several local and international conferences where they also presented their results. This increased the presentation skills of the trainees, built their confidence, raised the profile of the entire BRC team and helped to establish useful contacts and collaboration. The parataxonomists, students and researchers presented the following talks and posters:

Science and Technology in Developing Countries: Emerging Trends in the New Millennium Conference, University of Goroka, Goroka, Sept 12-14, 2001. Six parataxonomists participated: William Boen, Kenneth Molem, Martin Mogia, Richard Kutil, John Auga, Elvis Tamtai and Markus Manumbor, two of which gave oral presentations:

Molem, K., Mogia, M., Kutil, R. & Auga, J. (2001) Scientific and traditional taxonomies of rainforest plants.

Tamtiai, E., Manumbor, M., Boen, W. & Isua, B. (2001) Parataxonomists: A new approach to training for science.

4th New Guinea Biological Conference, Cenderwasih University, Jayapura, Indonesia, August 2002: Four parataxonomists participated: Joseph Kua, Borenke Kaupa, Richard Kutil and Brus Isua. In addition to the opportunity to learn about the activities of their counterparts on the Indonesian side of the island, this was also the first overseas visit for all of them. They also presented their own research in the form of two oral presentations and one poster:

Isua, B & Auga, J. (2002) Host specificity and species richness of long horn beetles (Cerambycidae) reared from rainforest trees in Papua New Guinea. Poster.

Kua, J., Kaupa, B., Eresula, L. & Sinebare, D. (2002) Caterpillars feeding on *Ficus* trees in Chimbu mountains (Papua New Guinea). Oral presentation.

Kutil, R, Hiuk, S., & Damag, M. (2002) Host specificity and species richness of fruit flies feeding on fruits in a Papua New Guinean rainforest. Oral presentation.

3rd International Canopy Conference, Cairns, Australia, June 2002: Two parataxonomists (William Boen and Kenneth Molem) and one researcher (Vojtech Novotny) participated, presenting:

Boen, W. & Molem, K. (2002) Parataxonomists: a new approach to ecological research. Poster.

Novotny, V. (2002) Simple and predictable: communities of caterpillars in Papua New Guinea. Oral presentation.

Association for Tropical Biology, 2002 Annual Meeting, Panama City, Panama, July 29-Aug 2: Two parataxonomists (William Boen and Kenneth Molem) visited the Smithsonian Tropical Research Institute in Panama and contributed a poster to be displayed at the Association of Tropical Biology meeting organised shortly after their departure:

Molem K., Boen, W., Auga, J., Damag, M., Hiuk, S., Isua, B., Kutil, R., Manaono, M., Manumbor, M., Mogia, M., Tamtiai, E., Hulcr, J., Janda, M., Novotny, V., Cizek, L., & Basset, Y. (2002) Parataxonomists: a new approach to ecological research.

5th New Guinea Biological Conference, "Conservation through Education and Research", Goroka University, Goroka, Papua New Guinea, 23-25 August 2003: Three parataxonomists (Joseph Kua, Borenke Kaupa, and Martin Mogia) as well as M.Sc. student Rapo Pokon participated. They presented their own research in the form of three oral presentations and one poster:

Kua, J., Kaupa, B., Nimai, K., Eresula, L., Auga, J., Boen, W., Isua, B., Kutil, R., Manaono, M., Manumbor, M., Molem, K., Mogia, M. & Tamtiai, E. (2003) Caterpillars feeding on *Piper aduncum* (Piperaceae), an alien tree in Papua New Guinea, at high and low elevations. Oral presentation.

Mogia, M., Andreas, M., Hulcr, J. & Setliff, G. P. (2003) Host specificity of bark beetles (Curculionidae: Scolytinae and Platypodinae) in lowland rainforests of Papua New Guinea. Oral presentation and poster.

Pokon, R. & Setliff, G. (2003) Host specificity of leaf beetle larvae (Chrysomelidae) feeding on the roots of trees in the lowland rainforest in Madang, Papua New Guinea. Oral presentation.

6th New Guinea Biological Conference, University of Manokwari, Manowari, Indonesia, October 2004: This conference took place shortly after the completion of the Darwin project but the two parataxonomists (William Boen and Martin Mogia) who attended presented their Darwin results in the form of two oral presentations:

Boen, W. (2004) Beta diversity of Lepidoptera in lowland rainforests of Northern New Guinea. Oral presentation.

Mogia, M. & Hulcr, J. (2004) Host specialization of bark beetles (Curculionidae: Scolytinae and Platypodinae) in lowland rainforests of Papua New Guinea. Oral presentation. The presentation by M. Mogia received the "Best Presentation of the Conference Award" by the organizing committee. This award, won in competition with university researchers from several PNG and Indonesian universities who attended the conference, clearly demonstrates the standards of our Darwin parataxonomist training.

"Biotic Interactions in the Tropics", Conference organised by the Association for Tropical Biology and Conservation and the British Ecological Society, Aberdeen, UK, 7-11 July 2003: One parataxonomist (John Auga) and two Project Leaders (Alan Stewart and Vojtech Novotny) participated (Richard Kutil was unable to attend due to illness). John Auga presented a poster:

Auga, J., Kutil, R. & Isua, B. (2003) Host specificity of cerambycid beetles (Cerambycidae) and fruit flies (Tephritidae) in a lowland rainforest in Papua New Guinea.

Royal Entomological Society Symposium on "Insect Evolutionary Ecology" and National Meeting, Reading, UK, 27-31 July 2003: Two parataxonomists (John Auga and Richard Kutil) and the Project Leader (Alan Stewart) participated. The poster by Auga et al. (see above) was presented.

International Congress of Entomology, Brisbane, Australia, 15-22 August 2004: The Project Leader (Alan Stewart) presented a summary of the Darwin survey work in Misima:

Stewart, A.J.A., Novotny, V. & Miller, S. (2004) Moth beta diversity patterns in Papua New Guinean rainforest.

(vi) Village ecotourism project

We assisted with the development of the Jeolmanu Waterfall eco-tourism project in Ohu Village (Madang Province, approximately 15 km from BRC) during the Darwin project. This included advice on the construction of the tourist track through the rainforest to local waterfalls, as well as designing and publishing information materials. The project was launched officially as one of the Madang tourist attractions in 2003. The launch ceremony was attended by many visitors from neighbouring villages, local and overseas tourists and the national press. It was accompanied by traditional dancing and was deemed to have been a success. The BRC is now assisting the community with further fundraising through the Travellers' Conservation Foundation (USA) scheme.

(vii) Village-based field stations

As part of the parataxonomist training, we have further developed our new concept of village 'bush laboratories'. The bush (or village) laboratory is a traditional village house converted into a simple laboratory that is lead by a local villager, who has been trained at BRC as a parataxonomist. The laboratory, equipped with solar power, a laptop computer, a microscope, a digital camera and basic insect and plant storage capacity serves as a local centre for ecological research and environmental education.

We have further developed an existing bush laboratory in Ohu Village, lead by senior BRC parataxonomist Brus Isua. A new research project on insect host specificity was initiated there that includes training of two lab assistants by B. Isua. Furthermore, a public display for environmental leaflets was built next to the laboratory building that serves to inform both local villagers and tourists on the laboratory's activities.

In view of the good results from Ohu village, a new bush laboratory was built in Mu Village in the Highlands (Simbu Province). It is a new traditional-style house that includes a laboratory, a room for community meetings and accommodation quarters for six persons. The laboratory was built as a community effort by the villagers who established a new NGO (Simbu Bioresearch Group) lead by BRC-trained parataxonomists Borenke Kaupa and Joseph Kua, who also supervise the laboratory. It

was equipped with solar power, a laptop computer, digital camera and portable printer. The viability of this concept has been demonstrated by a research project on insect biodiversity awarded jointly to BRC and Simbu Bioresearch by the National Geographic Society in 2004 (██████).

(viii) Butterfly farming course

Butterfly farming is being successfully promoted as a sustainable use of biodiversity in PNG. The reared insects are purchased centrally by the Insect Trading Agency and then marketed to collectors. Many villagers are interested in this activity but lack the necessary expertise. William Boen, the BRC parataxonomist who specialises on butterfly farming, organised two courses for prospective butterfly farmers during the Darwin project, one in Madang and one in Simbu, attended by a total of 25 participants. He has also written the Butterfly Farming Manual, an instruction brochure targeting such grassroots audiences.

(ix) Environmental education

The BRC programme of developing educational leaflets has been almost entirely led by the parataxonomists. They produced 73 leaflets in Tok Pisin or English during the project (see Appendix III). These leaflets were distributed in villages in Madang and Simbu that have had long-term collaboration with BRC (Ohu, Baitabag, Mis and Mu Villages) as well as in four remote village communities (Wannang, Niksek, Yapsiei and Utai Villages) in the Sepik area. The four remote villages were located within large tracts of intact rainforests, owned by the villagers, and lacked any road connection with the rest of the country. Each of these villages was visited by BRC parataxonomists and the leaflets were provided to the villagers and village school, together with verbal explanations by the parataxonomists. Furthermore, the parataxonomists regularly organised presentations for village schools in the Madang area. BRC also organized a small exhibition at the Goroka Cultural Show, one of the most important national festivals, in 2004. It was seen by several hundred visitors.

BRC also created a CD that includes pdf files of all research papers, educational leaflets, conference presentations and media reports that had been produced by the BRC and associated researchers over the last 10 years (195 items in total). It was distributed free of charge to all environmentally oriented NGOs, universities, teachers' colleges, research institutes and other relevant organisations in PNG (50 addresses in total). A copy of this CD accompanies this report (Appendix XI). Furthermore, the full list of the 73 leaflets in pdf format can be downloaded for free from the BRC website (www.entu.cas.cz/png).

Parataxonomists traveling overseas also educated school children about PNG and their biodiversity work by giving presentations at primary and secondary schools in Panama (Panama City), USA (Minnesota), UK (Brighton and Cardiff) and the Czech Republic (Ceske Budejovice and Brno).

5. Project Impacts

Evidence of achievement of project purpose: The parataxonomist team at BRC has established itself as the leader in insect biodiversity surveys in PNG. This is illustrated by interest from commercial, governmental, academic and non-governmental organizations in its services. In particular, BRC has completed a £10K project to survey insect biodiversity in areas revegetated after mining for Misima Mine Ltd., as a part of the environmental assessment required by PNG law. Also, BRC has provided assistance to World Wildlife Fund, Wildlife Conservation Society and Indo-Pacific Conservation Alliance. It is working with the University of PNG in Port Moresby and the University of Technology in Lae, as well as with overseas research teams from the Smithsonian Institution, University of Minnesota, Czech Academy of Sciences and Griffith University (Brisbane). It has been approached for assistance by New Zealand TV for help in filming an insect natural

history documentary. Also, BRC has been awarded a £12K project by the National Geographic Society USA. These activities demonstrate the success and viability of the parataxonomist team established during the Darwin project.

Following the expansion and development of its parataxonomist team, the partner organization (originally called The Parataxonomist Training Center) decided to change its name to New Guinea Binatang Research Center and to reformulate the organization's mission to reflect its broader range of activities and expertise that now include not only training, but also biodiversity surveys and educational activities. Together with parataxonomists trained in Costa Rica, BRC is now considered one of the two leading parataxonomist teams in tropical research and conservation (cf. Basset *et al.* 2004 and Janzen 2004 cited above).

Training and capacity building: The main focus of the entire project was capacity building and training. The training concentrated on parataxonomists and involved 18 persons in total, 12 at any one stage of the project. The trainees included 8 new recruits with no previous experience or position in any organisation, as well as 9 staff parataxonomists at BRC and one field assistant with another project (TKC, Tree Kangaroo Conservation). Most of the trainees continue working at BRC or its partner organisations, particularly Simbu Bioresearch Group. Only one senior parataxonomist, Samuel Hiuk, left BRC, and he was able to find a new job in the area of expertise that he was trained for. He was offered a position as research officer at the PNG Cocoa and Coconut Research Institute, but finally accepted a position in a local NGO, Madang Research Institute, working in grassroots education and biodiversity surveys.

Paraxonomist personnel trained during the Darwin project:

Name	Pre-Darwin position	Current position
Mark Andreas	None	BRC parataxonomist
John Auga	BRC parataxonomist	BRC parataxonomist, survey leader
William Boen	BRC parataxonomist	BRC parataxonomist, team leader
George Damag	None	BRC parataxonomist
Micah Damag	BRC parataxonomist	none
Samuel Hiuk	BRC parataxonomist	Madang Research Inst. educational officer
Brus Isua	BRC parataxonomist	BRC, Ohu village laboratory leader
Borenke Kaupa	None	Simbu Bioresearch team leader
Joseph Kua	None	Simbu Bioresearch parataxonomist
Richard Kutil	BRC parataxonomist	BRC parataxonomist
Roll Lilip	None	BRC parataxonomist
Max Manaono	TKC field assistant	BRC parataxonomist
Markus Manumbor	BRC parataxonomist	BRC parataxonomist
Martin Mogia	None	BRC parataxonomist, survey leader
Kenneth Molem	BRC parataxonomist	BRC survey leader
Kua Nimai	None	Simbu Bioresearch parataxonomist
Steven Sau	None	BRC parataxonomist
Elvis Tamtai	BRC parataxonomist	BRC parataxonomist

Development of collaboration between UK and local partner: The project has helped to cement collaborative links between the UK Project Leader and the PNG local partner (BRC), as witnessed by subsequent joint applications for further funding from the Darwin Initiative and from NERC. Preparatory discussions for these applications have drawn in potential partners from a range of additional UK institutions including the Natural History Museum, Leeds University and RBG Kew.

Development of local collaboration within PNG: The project helped not only to train and equip the parataxonomist team, but was also crucial in its networking with other research and

environmental organizations in PNG and overseas. The many attendances and presentations by parataxonomists at conferences as well as their overseas training contributed to the recognition of their activities in the academic community, while their grassroots educational activities helped in networking with local NGOs and schools.

These contacts include long-term collaboration with the National Agriculture Research Institute (NARI) in Port Moresby, hosting also the National Insect Collection. We have trained the collection's chief curator Mark Ero and contributed specimens and identifications to the collection. This collaboration is now continuing beyond the Darwin project as NARI invited BRC as a partner for their Global Biodiversity Fund project that provides training and working experience for BRC parataxonomists.

BRC is collaborating also with the Project Leaders of both past and new Darwin projects in PNG. John Dransfield and his team at RBG Kew trained BRC parataxonomists during their visits to the UK. BRC is also working closely with WWF South Pacific who received Darwin project funding in 2004. Among others, their staff participated in our Darwin seminar where we shared our experiences from the project.

BRC maintains active collaboration also with the two principal universities (University of PNG and University of Technology), and the National Museum, the Department of Environment and Conservation of the PNG Government. BRC also works with international and local NGOs: WWF, Wildlife Conservation Society, Partners with Melanesians, Indo-Pacific Conservation Alliance, Bismarck Ramu Group, Research Conservation Foundation, PNG Tree Kangaroo Conservation Project, Simbu Bioresearch Group and Ohu Butterfly Farm & Conservation Area. BRC have also established contacts with provincial governments in the Madang, Simbu, East Sepik and Sandaun Provinces, obtaining permits for research and submitting reports on research and education activities to them. The Darwin seminar which we organised to review and discuss the project's achievements provided an excellent opportunity to strengthen this collaborative network (see Appendix VII).

Social impact: Overall, 80% of the total budget was spent directly on Papua New Guinea. This substantial investment brought radical changes in career prospects for the 18 parataxonomists, particularly the 8 new recruits for whom this was a unique opportunity to launch their professional careers. Similar, although smaller, benefits were brought to the participants in the butterfly training courses. There were also benefits for entire village communities: the establishment of the Simbu Bioresearch Group energised the whole village community and brought new expertise, activities and income to the village; the assistance with the ecotourism project in Ohu village and the continued support of the Ohu village laboratory benefited the village community socially as well as financially. The Ohu community also refocused their attention towards the forest conservation area that they maintain on their land because this was at last bringing tangible monetary benefits via ecotourism and research. Given the egalitarian village society in Papua New Guinea, there were inevitably some tensions and conflicts arising in the villages because the benefits accruing from the project could not be spread absolutely equally. However, the best indicator of an overall positive social impact is the continuity of the ecotourism and village laboratory projects beyond the Darwin funding and the keenness of the village communities to engage in similar collaborations with BRC in future.

An important focus of our project was on education. The fact that we were able to demonstrate that young people from village communities had been recruited as parataxonomist trainees, and had progressed to full-time (and well-paid) employment, demonstrated the importance of education to the village communities. This impact is difficult to quantify, but was obvious when the Ohu community discussed the possible closure of their village school for financial reasons; this was successfully opposed by the local staff of the Ohu village laboratory.

The extensive overseas travels by the six parataxonomists also had a profound impact in their home villages as they were often the first and only members of the community travelling overseas. Their increased understanding of the world beyond national PNG borders will help to inform important

decisions by the villagers, particularly regarding the use of traditionally owned lands and forest resources.

6. Project Outputs

The outputs are summarized in Appendix II. All research papers, educational materials, conference presentations and educational leaflets are available free of charge as pdf files from the BRC webpage: www.entu.cas.cz/png/ (96 documents in total). Free use of educational leaflets and other materials downloaded from the site is encouraged.

Dissemination of outputs: We had multiple target audiences for different outputs of the project: (i) grassroots villagers and forest landowners, (ii) school children, particularly from remote village schools in forested areas, (iii) students and research and conservation professionals in academic, governmental and NGO sectors in PNG, and (iv) the international research community. The education materials were distributed to villages and schools during personal visits and educational presentations organised by parataxonomists. The research and conservation organizations can use our www site to obtain pdf files of all our educational products. Also, we have published the results in international journals and presented them at local and international conferences. We also used local and national radio stations as efficient means of information dissemination in PNG. We also presented our results at the final Darwin seminar (see Appendix VII). Finally, all BRC results from the past 10 years, including all Darwin products, were compiled on a CD that was distributed free of charge to approximately 40 addresses in PNG, including key public and university libraries, governmental agencies, university biology departments, and NGOs.

Post-project continuation of activities: BRC is continuing in the above activities, but the extent of its activities is ultimately dependent upon funding. However, BRC is actively fund raising to meet the costs of the production and dissemination of educational materials.

7. Project Expenditure

	Original Budget	Actual Expenditure	>10% variation in expenditure (see notes below)
Alan Stewart, salary overheads			
Mike Wilson, salary overheads			
PTC Staff Salaries			
Travel & Subsistence			
Capital Items			
Vehicle Running Costs			
Other Equipment			
Office Costs			
Printing			
Conferences			
TOTAL			

Notes:

1. Dr Wilson made one out of the three visits to PNG that we had budgeted for, due to initial problems in obtaining a visa and other work commitments which emerged during the lifetime of the project. The salary overheads and travel costs thus saved were used to cover the significantly increased cost of international travel for the remaining visits. The remaining budget (approximately [REDACTED]) was vired to other budget categories and was partially used (as suggested by the Darwin Secretariat and in response to the review of our second annual report) to fund the Darwin seminar at BRC in August 2004. This adjustment was explained in a letter to Ms Carrie Haloun dated 15th July 2004 and was agreed in an email from Ms Haloun dated 19th July 2004.
2. In agreement with the Darwin Secretariat (Mrs Sylvia Smith, by email on 28 August 2002), the [REDACTED] savings made in the cost of the 4-wheel-drive vehicle were transferred into a new budget category "vehicle running costs" to ensure the maintenance of the vehicle during the lifetime of the project (to cover the costs of servicing, licence, routine repairs etc).
3. Printing costs for producing educational leaflets etc were less than expected, so the funds saved were transferred into office costs.

8. Project Operation and Partnerships

Principal partners of the project: These included:

- New Guinea Binatang Research Center, Madang: The principal partner, that coordinated the involvement of other partners, had a significant impact on shaping the Darwin proposal as well as its implementation. 19 staff members were involved during the project.
- National Agriculture Research Institute, Port Moresby: Recipient of insect specimens and biodiversity data; the Chief Curator of the National Insect Collection, Mark Ero, was trained at BRC.

- University of Technology, Lae: Collaboration with lecturers Lawong Balun (participation in fieldwork) and John Mukiu (co-supervisor of the Darwin student Rapo Pokon). Rapo Pokon trained for his MSc as a resident Darwin student at BRC for 2 years.

Collaboration with similar projects in the host country: BRC has also collaborated with several projects and organizations focused on biodiversity surveys. In particular, Darwin parataxonomists participated in the surveys organised by the Tree Kangaroo Conservation Project and WWF, while the Wildlife Conservation Society provided some training for Darwin parataxonomists and students. The Darwin parataxonomists also assisted with the National Science Foundation (USA) sponsored project on the species diversity and host specificity of insects, based at BRC. BRC also collaborated with the staff of the Forestry Research Institute (Kipiro Damas, Roy Banka, Robert Kiapranis) on plant identifications. This collaboration, together with overseas training of parataxonomists at Kew Gardens, represents a direct link with the only other concurrent Darwin project in New Guinea (Project Leader: John Dransfield). BRC coordinates its activities with the Department of Environment and Conservation, which is the relevant partner in PNG for biodiversity strategy.

International partners: BRC has the following main international partners:

- Smithsonian Tropical Research Institute, Panama (Y. Basset): parataxonomist training overseas
- University of Minnesota, Twin Cities (G. Weiblen, G. Setliff) parataxonomist training overseas and in PNG
- National Museum of Natural History, Smithsonian Institution, Washington (S. Miller, K. Darrow): parataxonomist training overseas, insect identification
- Institute of Entomology, Czech Academy of Sciences (V. Novotny, L. Cizek): parataxonomist training overseas and in PNG
- University of South Bohemia, C. Budejovice, Czech Republic (J. Leps, M. Janda, J. Hulcr): parataxonomist training overseas and in PNG
- Bishop Museum, Honolulu (A. Samuelson): insect identification

Post-project activity by local partnerships: The biodiversity survey and education activities by BRC continue. Community involvement is significant - communities are targeted by the education programmes and are also involved in all biodiversity surveys on their lands. The private sector is one of the potential customers for biodiversity surveys. In particular, environmental assessments are required by PNG law; mining companies, for example, are therefore under statutory obligation to commission such surveys, as illustrated by the project completed by BRC for the Misima Mines Ltd. during the Darwin project.

9. Monitoring and Evaluation, Lesson Learning

M&E results/evidence: The level of skills achieved by parataxonomists was assessed by the comprehensive test (Appendix VI) conducted in December 2003 (i.e. 28 months into the project). Particularly with respect to new parataxonomist recruits, the results can be attributed solely to Darwin training as these trainees came with no previous experience or knowledge of the subject of biodiversity surveys. Even more importantly, the parataxonomists were continually tested by practical tasks in the field. By the final year of the project, each team of four parataxonomists was independently able to carry out biodiversity surveys in remote areas of PNG that included the logistics of (i) assembling all equipment and food rations, (ii) transport by small Cessna aircraft and canoes, (iii) staying for three months in a forest village with no road connection, (iv) hiring 15 village assistants, (v) sampling 10,000 individuals of Lepidoptera following quantitative protocols, (vi) databasing and mounting the specimens, and (vii) transporting them back to the BRC laboratory.

Successfully accomplishing such surveys is a clear indication of successful training. The skills of parataxonomists in summarising and presenting data from the surveys is best demonstrated by their successful presentations at the national and international conferences. In particular, the award for the best presentation at the 6th New Guinea Biological Conference in Manokwari (Indonesia) given in 2004 to the parataxonomist Martin Mogia demonstrates the high standards of parataxonomist training, since his oral presentation was judged to be superior to those presented by professional researchers from several universities and research institutes based in New Guinea.

The research data collected are also considerable as they include 29,000 mounted and databased specimens of Lepidoptera from 1,400 species, each of them documented by digital imagery. These data represent an important increase in the knowledge of New Guinea Lepidoptera. Furthermore, our studies provide information on the recolonization dynamics of disturbed lowland rainforest by Lepidoptera and identify useful indicator species for primary and secondary vegetation (Stewart *et al.*, 2004). These data on Lepidoptera biodiversity distribution and dynamics are also of conservation value. Finally, the Darwin MSc student Rapo Pokon obtained host plant data on 4,500 root feeding larvae of leaf-beetles (Chrysomelidae) from lowland rainforest. This represents the first data set on larval host plants obtained from tropical forests for this important group of herbivorous insects; the resulting paper is now in review.

Problems: The only serious problems encountered during the project were delays experienced at the start of the project, due to complex administrative procedures needed to obtain research visas and permits from Provincial Governments to do research in each PNG province. However, these problems were successfully resolved during the first year of the project.

Key lesson: The key lesson from our project is that parataxonomists can become highly efficient in biodiversity surveying and environmental education in tropical countries, but that this potential is only rarely used. We have summarised this lesson in our paper (Basset *et al.* 2004) as follows: "We argue that data collecting by parataxonomists (local assistants trained by professional biologists) represents one of the most efficient approaches to the study of tropical ecosystems available to date. Parataxonomists can provide high-quality biological specimens and ecological information; statistical power will be high due to large sample sizes of data; database growth will be rapid and results will be published in a timely manner; and there will be collateral education of local people in conservation biology by the parataxonomists themselves. We stress that training local parataxonomists to inventory and monitor biodiversity is a promising and efficient strategy that deserves more attention in conservation biology. In particular, it may be one of the most feasible approaches for the biological monitoring of small and cryptic organisms in species-rich environments, such as invertebrates in tropical rain forests. Augmenting the number of local parataxonomist groups in various tropical countries and networking these contingents to monitor functionally diverse taxa may provide an efficient biological monitoring system in tropical forests." Other researchers (Takeuchi & Golman 2001, Pfeiffer & Uriil 2003; Janzen 2004) commented in the same vein specifically on our project as well as on parataxonomists in general.

10. Actions taken in response to annual report reviews

The annual reviews were discussed with BRC staff on a regular basis. In addition to minor issues raised on the detail of reporting, the reviewer of our second annual report recommended organising a seminar at the end of the project to discuss and share lessons arising from the project, both internally and with other organisations. This recommendation was accepted and the resulting seminar proved to be very successful and was well attended (Appendix VII). A concern was raised in the same report that BRC does not have a sufficient management structure in place. This concern has been acknowledged and addressed by hiring a full-time, locally-recruited accountant.

11. Darwin Identity

Publicising the Darwin identity: The Darwin project has been acknowledged in our papers and other outputs as well as on the BRC www site. The Darwin award received significant attention by the PNG media, which was greatly helped by the British High Commission in Port Moresby adopting an active media-engagement policy. Deputy High Commissioners Chris Thompson and Jonathan Drew visited BRC twice in the course of the project. Ours was the first Darwin project awarded to PNG, while there were at least four applications for the 2003 round of projects, some of them from BRC's partner institutions. We attribute this increase in interest in the Darwin programme at least in part to the awareness raised by BRC about the Darwin Initiative in PNG.

Our project received the following media coverage (items preceded by an asterisk are reproduced in Appendix X):

PNG newspapers and other printed media

Auga, J. (2002) PNG Entomologist i wok long Wes Papua sevei. *Wantok* 13 July 2002, p. 4

Hulcr, J. & Janda, M. (2002) Science enters the village. *Paradise Magazine* No. 153, 3-4. [Also on-line at Papua New Guinea Tourism and Business Directory
<http://www.pngbd.com/forum/showthread.php?s=&postid=18999#post18999>

Mack, A. (2002) Understanding tropical ecosystems: Study of PNG insects and plants improves knowledge of tropical biology across the world. *Post-Courier*, July 12-14, 2002, p. 29.

* UK grants K1.5m biodiversity aid. *Post-Courier*, 2 April 2001, p. 6

* Britain funds eco project. *Post-Courier*, 23 May 2001, p. 8

* Britain to fund biodiversity study. *Diwai* 2001(3), 2

* Madang pair off to UK. *Independent*, 12 July 2001

* Local scientists bound for UK. *Post-Courier*, 26 July 2001

* Tupela man Madang go stadi long UK. *Wantok*, 2 August 2001

Village in a first. *Post-Courier*, 14 August 2001, p. 5

* Britain to fund biodiversity study. *The National*, 21 May 2001

* Researchers return. By Lucy Kapi. *The National*, 19 September 2002, p. 7

PNG radio

Radio Madang, programme about the Parataxonomist Training Center, October 2002

93 Yumi -FM (nation-wide radio station), interview with parataxonomist Martin Mogia, October 2004

Nokondi FM, Goroka, (local radio station), interview with parataxonomist Martin Mogia, October 2004

Overseas

* Preserving the biodiversity of Papua New Guinea. *The University of Sussex Newsletter*, 25 May 2001

Moravia Cable TV, Czech Republic, interview with parataxonomists K. Molem and W. Boen, August 2002

Czech TV Chanel 1 - News, report on parataxonomist visit, August 2003

Understanding of the Darwin identity in the host country: The Darwin Initiative is well known among international and local environmental NGOs operating in PNG. The fact that BRC frequently receives requests from other PNG organizations for information on the Darwin Initiative is evidence of the high level of interest in the Darwin programme. Our project seminar that hosted 34 participants from 10 PNG organizations was a particularly efficient forum for providing information on the programme, particularly as the opening presentation by the Project Leader, Alan Stewart, provided a general overview of the programme.

12. Leverage

Additional funds secured: The BRC attracted funding for biodiversity surveys from Misima Mines Ltd. (██████ over 2 years) and a research grant on insect biodiversity from the National Geographic Society (██████ over 1 year). Furthermore, the WWF, Tree Kangaroo Conservation project and Indo-Pacific Conservation Alliance met the costs of fieldwork for five other biodiversity surveys. The Darwin-sponsored developments in the BRC infrastructure and staff resulted in a commitment by the Czech Academy of Science to meet some of the core operational costs of the organization (£18K annually), starting in 2005. This is a major success in securing long-term sustainability for the organisation.

Strengthening local capacity to secure further funds: A large part of our training effort has been directed towards building up the parataxonomist team to a standard where they can compete for local funding. This has involved training in not just field and laboratory techniques but also, at least for the more senior members of the team, training in tendering for contracts, project management, logistics (see Section 9 above), data analysis and report writing.

13. Sustainability and Legacy

Enduring achievements: The principal aim of the project was to build a parataxonomist team that could continue its activity beyond the lifetime of the Darwin project. We believe that the project succeeded in creating the necessary conditions to achieve this sustainability. All BRC parataxonomists trained by the Darwin project continue to be active and the fund raising accomplished so far (see above) indicates that its long-term financial sustainability is possible, although of course not guaranteed. The partners continue to work together after the project (cf. the grant application referred to above). The expertise obtained by Darwin parataxonomists and students is the result most likely to endure and to make a long-term contribution to local conservation activities and environmental education in PNG.

The parataxonomist approach to biodiversity surveys is gaining acceptance amongst tropical biologists, although slowly. The Darwin-trained parataxonomists as well as the projects' principal investigators continue to advocate and actively pursue this approach (cf. Basset et al. 2004) both locally and internationally.

Additional funds sought: Building on the experience from combined parataxonomist and student training, we are seeking funding from the Darwin Initiative to strengthen postgraduate student training in PNG. An application was made by the UK Project Leader, in collaboration with the Natural History Museum London and the National Museums & Galleries of Wales, to the UK Natural Environment Research Council in July 2004 for ████████ for a project entitled: *The effects of host plant distribution and feeding specificity on beta diversity of sap-sucking insects in a tropical rainforest*. This application was unsuccessful but demonstrates our continuing commitment to widening participation in the work to include other organisations with a biodiversity remit. BRC has raised funds for parataxonomist-assisted research from the National Geographic Society and for some of the operational costs from the Czech Academy of Sciences (see above), and is about to apply also for National Science Foundation (USA) and the Travellers' Conservation Foundation (USA). In summary, funds to build on the success of the Darwin project are being actively pursued on a number of fronts.

14. Post-Project Follow up Activities

Our Darwin project has opened an exciting opportunity to develop our educational and training activities in PNG in a new direction by combining research and training activities of parataxonomists and postgraduate students.

Only a very low proportion of the PNG population can study at university, particularly for postgraduate degrees. The constraints are financial, as well as the lack of research facilities and expertise; most university staff are heavily involved in teaching and have neither the time nor the resources to pursue an active research programme.

BRC is ideally suited to assist local postgraduate students in their dissertation research. It provides one of the best laboratory facilities and information resources for ecological and entomological research in the country and, more importantly, research expertise and active research programmes which could be joined by students. The combination of Darwin-trained parataxonomists and students has proved to be particularly fruitful, as their respective skills are complementary: the parataxonomists have good practical field research skills while the students have a deeper theoretical understanding of research. Also, the local and overseas scientists associated with BRC provide an excellent research environment in which the students can acquire new research skills. BRC provides dormitory-style accommodation for parataxonomists, students and researchers alike, thus creating a supportive environment for research.

Biology departments at both major PNG universities (UniTech and UPNG) are enthusiastic about our involvement in postgraduate training; there is presently one student from each of these universities resident at BRC. We envisage BRC becoming a centre for training in ecology and entomology for local students, providing them with an opportunity to pursue postgraduate research. The optimum BRC capacity is approximately five resident students, which is already a sufficiently large group to allow interaction and encouragement among the students, as well as between students, parataxonomists and visiting UK researchers.

15. Value for money

The project spent 80% of its budget on Papua New Guineans, minimising overheads for UK institutions and other expenses that diminish the output:cost ratio. In addition, the salaries of all researchers (except for overheads) were completely covered by their own institutions. We were also able to cover the cost of fieldwork during the biodiversity surveys from other sources. In addition to the one month of training in UK for six parataxonomists that was originally planned, we managed to include an additional 1.5 months for each of them, visiting academic institutions in Panama, USA and the Czech Republic, at no additional cost to Darwin.

The overall focus of the project was on cost-efficient approaches to biodiversity surveys and its results should, if applied elsewhere, contribute to better value for money in mapping tropical biodiversity worldwide.

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 that integrate conservation and sustainable use.
7. Identification and Monitoring	20	Identify and monitor components of biological diversity, particularly those requiring urgent conservation; identify processes and activities that have adverse effects; maintain and organise relevant data.
8. In-situ Conservation	10	Establish systems of protected areas with guidelines for selection and management; regulate biological resources, promote protection of habitats; manage areas adjacent to protected areas; restore degraded ecosystems and recovery of threatened species; control risks associated with organisms modified by biotechnology; control spread of alien species; ensure compatibility between sustainable use of resources and their conservation; protect traditional lifestyles and knowledge on biological resources.
9. Ex-situ Conservation		Adopt ex-situ measures to conserve and research components of biological diversity, preferably in country of origin; facilitate recovery of threatened species; regulate and manage collection of biological resources.
10. Sustainable Use of Components of Biological Diversity	5	Integrate conservation and sustainable use in national decisions; protect sustainable customary uses; support local populations to implement remedial actions; encourage co-operation between governments and the private sector.
11. Incentive Measures		Establish economically and socially sound incentives to conserve and promote sustainable use of biological diversity.
12. Research and Training	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 Awareness	15	Promote understanding of the importance of measures to conserve biological diversity and propagate these measures through the media; cooperate with other states and organisations in developing awareness programmes.
14. Impact Assessment and Minimizing Adverse Impacts	5	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 access and joint development of technologies.
17. Exchange of Information	5	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		
1a	Number of people to submit PhD thesis	0
1b	Number of PhD qualifications obtained	0
2	Number of Masters qualifications obtained	1 (graduation in March 2005)
3	Number of other qualifications obtained	0
4a	Number of undergraduate students receiving training	1
4b	Number of training weeks provided to undergraduate students	10
4c	Number of postgraduate students receiving training (not 1-3 above)	0
4d	Number of training weeks for postgraduate students	0
5	Number of people receiving other forms of long-term (>1yr) training not leading to formal qualification(i.e not categories 1-4 above)	18 parataxonomists trained for 1-3 years, 36 person-years training in total
6a	Number of people receiving other forms of short-term education/training (i.e not categories 1-5 above)	25
6b	Number of training weeks not leading to formal qualification	50
7	Number of types of training materials produced for use by host country(s)	73 types of leaflets
Research Outputs		
8	Number of weeks spent by UK project staff on project work in host country(s)	8
9	Number of species/habitat management plans (or action plans) produced for Governments, public authorities or other implementing agencies in the host country (s)	0
10	Number of formal documents produced to assist work related to species identification, classification and recording.	0
11a	Number of papers published or accepted for publication in peer reviewed journals	7
11b	Number of papers published or accepted for publication elsewhere	0
12a	Number of computer-based databases established (containing species/generic information) and handed over to host country	4 MS Access databases with images and taxonomic information on insects

Code	Total to date (reduce box)	Detail (←expand box)
12b	Number of computer-based databases enhanced (containing species/genetic information) and handed over to host country	0
13a	Number of species reference collections established and handed over to host country(s)	1 (at New Guinea Binatang Research Center)
13b	Number of species reference collections enhanced and handed over to host country(s)	1 (the National Insect Collection at NARI)

Dissemination Outputs		
14a	Number of conferences/seminars/workshops organised to present/disseminate findings from Darwin project work	1 (August 2004)
14b	Number of conferences/seminars/ workshops attended at which findings from Darwin project work will be presented/ disseminated.	9 conferences
15a	Number of national press releases or publicity articles in host country(s)	12
15b	Number of local press releases or publicity articles in host country(s)	0
15c	Number of national press releases or publicity articles in UK	3
15d	Number of local press releases or publicity articles in UK	3
16a	Number of issues of newsletters produced in the host country(s)	0
16b	Estimated circulation of each newsletter in the host country(s)	0
16c	Estimated circulation of each newsletter in the UK	0
17a	Number of dissemination networks established	1 (network of village communities and schools regularly targeted by BRC)
17b	Number of dissemination networks enhanced or extended	0
18a	Number of national TV programmes/features in host country(s)	1
18b	Number of national TV programme/features in the UK	0
18c	Number of local TV programme/features in host country	0
18d	Number of local TV programme features in the UK	0
19a	Number of national radio interviews/features in host country(s)	1
19b	Number of national radio interviews/features in the UK	0

19c	Number of local radio interviews/features in host country (s)	2
19d	Number of local radio interviews/features in the UK	0
Physical Outputs		
20	Estimated value (£s) of physical assets handed over to host country(s)	████████ 4WD vehicle), ██████ (microscope, laptop, solar etc), not allowing for depreciation
21	Number of permanent educational/training/research facilities or organisation established	2 (the Parataxonomist Training Center significantly developed in the course of the project and re-launched as the New Guinea Binatang Research Center; the Simbu Bioresearch Group established)
22	Number of permanent field plots established	2 (each with a village laboratory established for its study)
23	Value of additional resources raised for project	████████████████████

Appendix IV: Darwin Contacts

Project Title	Developing local capacity for biodiversity surveys in Papua New Guinea
Ref. No.	162/10/030
UK Leader Details	
Name	Dr Alan J A Stewart
Role within Darwin Project	Project Leader
Address	
Phone	
Fax	
Email	
Other UK Contact (if relevant)	
Name	Dr Michael R Wilson
Role within Darwin Project	Collaborator
Address	
Phone	
Fax	
Email	
Partner 1	
Name	Dr V Novotny
Organisation	New Guinea Binatang Research Center (formerly Parataxonomist Training Center)
Role within Darwin Project	Partner organisation in host country
Address	
Fax	
Email	
Partner 2 (if relevant)	
Name	
Organisation	