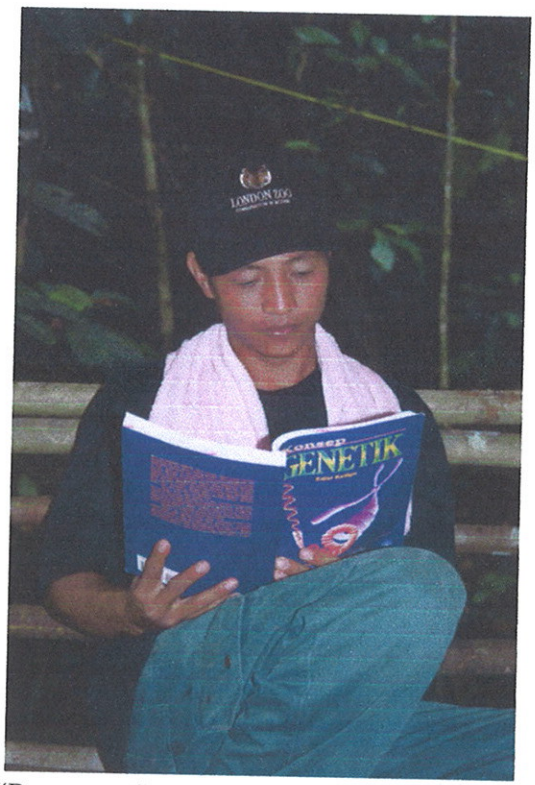
DARWIN INITIATIVE for the SURVIVAL of SPECIES
ROUND 9 – FINAL REPORT

CONSERVATION OF THE ORANG-UTAN IN KINABATANGAN WILDLIFE SANCTUARY, SABAH, MALAYSIA



"Ben… apa dia autosome terangkan sekali lagi?"
"Ben… what's an autosome again?"
Jamil Sinyor, KOCP research assistant, learning about genetics in the forest of the Lower Kinabatangan Wildlife Sanctuary, during the 2001 orang-utan sampling expeditions with Zulkiflie Abdullah, Mohd. Fairus Jalil and Benoît Goossens

Mr Laurentius Ambu
Deputy Director
Sabah Wildlife Department

Prof Datin Dr Maryati Mohamed
Director
ITBC, Universiti Malaysia Sabah

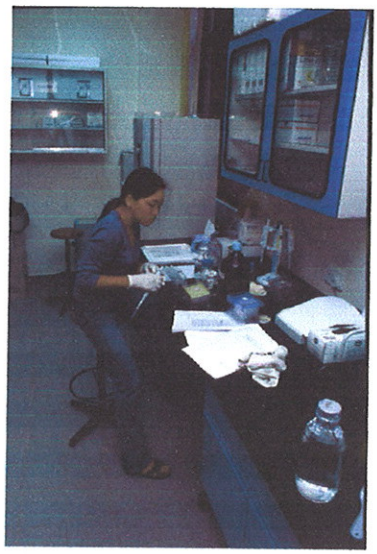
Dr Isabelle Lackman-Ancrenaz
Co-Director
HUTAN, KOCP

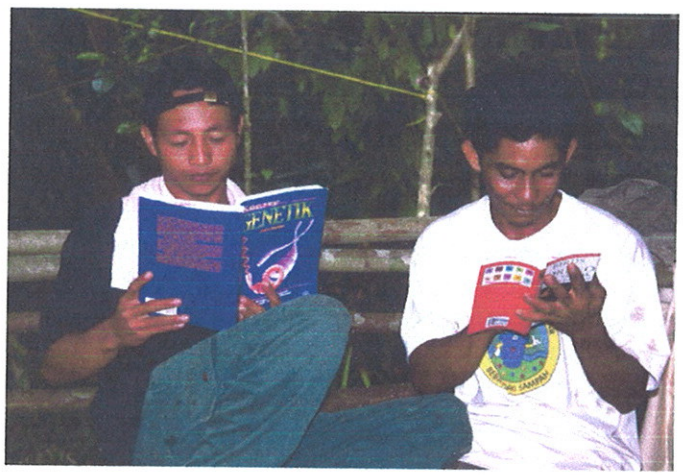
Dr Marc Ancrenaz
Co-Director
HUTAN, KOCP

Prof Michael W. Bruford
Head, Project leader
BEPG, Cardiff University

Dr Benoît Goossens
PDRA
BEPG, Cardiff University

TO FAIRUS, SHEENA, JAMIL and ZUL,
and all KOCP FIELD ASSISTANTS





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No. Tel. : 088-252887
No. Telefaks : 088-219805

PEJABAT PEMBANTU MENTERI
(ASSISTANT MINISTER)
KEMENTERIAN PELANCONGAN, KEBUDAYAAN DAN ALAM SEKITAR,
(MINISTRY OF TOURISM, CULTURE AND ENVIRONMENT)
Tingkat 5, Menara Alliance Bank,
Wisma Tun Fuad Stephens, Karamunsing,
88300 Kota Kinabalu.

26th September 2003

Professor Michael W. Bruford,
Cardiff School of Biosciences,
Cardiff University,
Main Building,
Park Place,
P.O.Box 9155,
Cardiff CF10 3TL,
Wales.

Dear Professor,

Thank you for your letter. My apology for being unable to reply much earlier. Malaysia celebrates "Merdeka" for a month. The National Closing Celebration was held in Kota Kinabalu on the evening of 16th September 2003. Now everybody is back on the feet and rushing to finish off their 2003 target. It is true when people say "time flies"; we are on the last quarter of the year. I remember mentioning to you about nature tourism in Sabah and how orangutan becomes the flagship wildlife. When we established the Sepilok Orangutans Rehabilitation Center in 1964, no one at that time would have thought that it would become one of the most preferred place of interest in Sabah.

The orangutan conservation workshop which was actively and keenly participated was a great success. The state government has taken the resolution from your workshop very seriously. While we discussed about the orangutan issues and its contributions towards tourism in Sabah, we are now being informed that the Bornean elephant, the newest unique subspecies of animal endimic to Sabah need an urgent study on its characteristics distribution and conservation needs.

In view of this, I would like to seek your good office and kind assistance in sourcing special grant from the Darwin Initiative U.K to enable us to carry out the study of the Bornean elephant. The results of your current orangutan project are potentially important, they have been publicised widely and are being considered positively at the government level and we would appreciate if you could kindly continue with this tedious and enormous task and we would certainly wish the same be extended to the Borneo's unique elephant in a very near future.

Many thanks for your assistance and contribution to this worthy course and hope you will continue to support us. Best wishes and looking forward of meeting you in Kota Kinabalu, Sabah soon.

Yours sincerely,

[DATUK HJ. KARIM HJ. BUJANG]

VISIT
SABAH
Malaysian Borneo
The New Millennium Nature Adventure Destination

DADAH MEMBAWA KESENGSARAAN
PELIHARALAH KEHARMONIAN KELUARGA ANDA

Workshop on Orang-utans adopts resolution containing six recommendations

KOTA KINABALU: A resolution containing six recommendations encompassing forest management, agricultural practice, the tourism industry, ex-situ conservation, research and public awareness was adopted at the final session of a three-day International Workshop on Orang-utans in Sabah, held at the Shangri-La's Tanjung Aru Resort.

State Tourism, Culture and Environment Minister Datuk Chong Kah Kiat, who officiated the closing of the workshop, assured reporters later that the document will eventually be studied by the State Cabinet for appropriate action.

"Once I receive the formal presentation, then I'll of course, through my Ministry, table it to the Cabinet for consideration...that's important," he said.

The workshop resolved that because the orang-utan is facing a high risk of extinction in the future, a number of urgent and strategic actions need to be taken to ensure its conservation in the State.

The key elements of the resolution revolve around the latest population studies carried out by the Sabah Wildlife Department, aided by Danish International Development Agency (DANIDA), which found that Sabah has 13,000 orang-utans, about half of them in the Sabah Foundation concession areas.

Based on this information, a key recommendation drafted in concensus by all the participants in the workshop called for "natural forest management" to be implemented in areas of Sabah which have a lot of Orang-utans, where very limited development of industrial tree plantations or other mono-cultures should occur.

"There are still plenty of forest areas in Sabah where biodiversity is not so rich, where one can develop mono-cultures and fast growing tree plantations," noted Soren Mark Jensen, DANIDA Chief Technical Advisor with the Sabah Wildlife Department.

The workshop resolved that:

- Sabah's forest should be managed for orang-utan conservation by reviewing the current and future State forest management plans in light of a State Wildlife Strategy formulated by the Sabah Wildlife Department, by enhancing collaboration among relevant management authorities and through the issuance of practical guidelines to foresters, especially in Forest Management Units (FMUs) which harbour over 60 per cent of Sabah's orang-utans.
- Agricultural practice must incorporate the needs of orang-utans into sensitive protection measures for small scale agriculture, and with the strict control of land development for oil palm plantations in orang-utan habitat regions, including enforcement of Section 38 of the Wildlife Conservation Enactment which legally requires developers to give 30 days' notice to the Wildlife Department of any plan to develop sensitive areas.
- Policy should be adopted for the enhancement and development of sustainable and responsible orang-utan tourism in Sabah, both to minimise its impact on environment and to enhance the conservation of the orang-utan population itself.
- The already world-recognised ex-situ conservation activities for orang-utan conservation in Sabah should be improved, especially through the development of initiatives at the new Sabah Zoological Park and Gardens.
- Current vital research on Sabah's orang-utans should continue to be promoted and enhanced, especially through activities at local universities, institutions and departments.
- Awareness of orang-utan's needs and the legal framework for their protection must be heightened, especially among policy makers and both forestry and plantation managers and workers.

"I think it is a very successful workshop but, of course, workshop is one thing, action is another. But sometimes, a workshop can facilitate action if they can collect good data and give clear input," Jensen said.

"I think we have succeeded in that, indicating now clearly where we have got the orang-utans in Sabah and we now know in which forests they are and which forest areas should be given the priority," he said.

The conclusion among most experts was the Sabah Foundation, which has about 6,000 individuals inside their concessions, especially in FMU 20, 21 and 22, holds the trump card to the fate of orang-utans in Sabah, given that the largest concentration of wild orang-utans are living in these commercial lowland natural forests.

However, it is learnt that Malua Forest Reserve, where not only 1,100 orang-utans but also a rich herd of tembadau are found, may have been earmarked by the Foundation for oil palms.

Although the general forest areas are more important for orang-utan conservation, there is a growing interest to reconnect the different fragmented compartments within the wildlife sanctuary in the Lower Kinabatangan, which has about one-thirteenth of Sabah's total orang-utan population.

Jensen said because the Lower Kinabatangan has seen a lot of research carried out by both French primatologists Dr Marc Ancrenaz and wife Dr Isabelle Lackman Ancrenaz and University of Cardiff geneticists, Benoit Goossens and Michael Bruford, it is a "very valuable" site specific area.

"I hope it will materialise one day that we get this fragmented sanctuary a little bit more connected again," said Jensen.

"There are a lot of management issues where individual sub-populations in each lot are not big enough for orang-utans to survive in the long term, which means we have to move orang-utans from one area to another but it is much easier if nature makes it that they can walk through the corridor forests," he said.

He added: "To keep the animals sustainable in the long run, we simply have to reconnect the forests." —KAN YAW CHONG

Take care of the last 13,000: Chong

By KAN YAW CHONG

KOTA KINABALU: Malaysians in Sabah must take care of the last 13,000 of their "closest relatives in the forests" by developing sustainable forestry to ensure their survival as 70 percent of the Orang-utans live in commercial secondary forests which are outside protected areas, said Tourism, Culture and Environment Minister Datuk Chong Kah Kiat, Wednesday.

"The question of monkey or gold does not arise," he said.

"It is not about one or the other because monkeys are our golden assets and we will continue to have both as long as we have our monkeys," he quipped at the closing ceremony of the three-day International Workshop on Orang-utans in Sabah, held at the STAR.

Chong said although Sepilok Orang-utan Rehabilitation Centre near Sandakan represents a shining rehabilitation success story which has attracted world attention, it is not an answer to their ultra long term survival in the wild.

"At present our forestry management ... inadequate for the long-term conservation of our Orang-utans in the wild specifically and biodiversity in general," he noted.

Citing reasons, Chong pointed out the fact that "most" of Sabah's conservation areas in commercial forests are located in the higher altitudes and are protected as water resources.

"The forest diversity values of these areas are generally not as extensive as those found in the lowland forests, which are known to be extremely rich in biodiversity," he said.

As such, Chong assured workshop participants and the media: Where necessary and possible we will consider extending the protective area network system in some form to significant tracts of lowland and other types of forests to protect unique and outstanding examples of fauna and flora biodiversity or ecological habitats."

Chong also said Orang-utans and forestry "should not" be conceived as antagonistic entities.

"Man and Orang-utans need the forests for a variety of objectives. We can certainly live side by side with these animals which, apart from their iconic tourism and conservation values, serve as seed dispersers in regenerating our forests," he added.

He noted Sabah already has a model in Deramakot Forest Reserve where sustainable management of forestry practices provides a "very good example" of how good forest economy and the conservation of species, can be churned out ...

Given the threat of extinction within the next 20 years, Sabah needs to step up efforts to conserve and protect its wild populations of Orang-utans found in other parts of Sabah outside Sepilok, Chong said.

"I am told that the Orang-utan has 96.4 per cent of the human DNA. Perhaps this is the reason the animal is so charismatic and has so much universal appeal," Chong noted.

He said the State Government realises that "effective" conservation and management of this "principal icon" of tourism is a "prerequisite" to the growth of Sabah's tourism industry.

Citing Rwanda's case, a Mountain Gorilla project there started by bringing in 500 tourists who spent about US$2,000 but 10 years later, an average of 5,000 tourists came and spent US$1 million in direct park fees and another US$3 million in other parts of Rwanda.

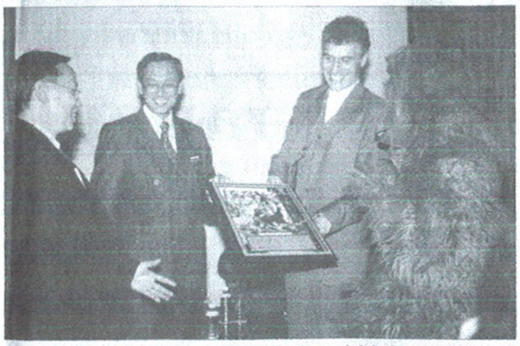
The workshop was jointly organised by the Sabah Wildlife Department and its partners — Danida, French NGO HUTAN and Cardiff University.

The strong scientific basis on which the workshop outputs were generated prompted most observers to believe Sabah now has an extremely sound overall strategy for Orang-utan conservation in Sabah.

"These are good tangible outputs, which we must follow through and put them into practice," Chong said.

He said the Lower Kinabatangan ... example on how to deal with challenges concerning ... conservation.

Chong paid glowing tributes to the dedication of French research couple, Dr. Marc Ancrenaz and wife Dr. Isabelle Lackman Ancrenaz who have "devoted" five years of research on the Orang-utans there and provided related training to the local people of Lower Kinabatangan.



Datuk Chong presents memento to French primatologist Dr. Marc Ancrenaz, looked on by a 'wild man of the forest' and Laurentius Ambu – the Deputy Director of Wildlife Department.

Chong: Act most repugnant

SPEAKING out for the first time after the killing of three Orang-utans at Rasa Ria Resort more than a week ago, Chong described the act as "most repugnant."

"You will agree with me that (such) actions have struck at our human sensitivities which are not merely about the protection of these animals but about their wanton destruction," he said.

Chong said the reward of RM60,000 posted to find the perpetrators and bring them to justice show public concern and how much the Orang-utan means not only to the people in Sabah but also for the rest of the world.

"In this respect, I am grateful to the management of Shangri-la Rasa Ria Resort and the Royal London Circus for posting the reward amount," he said.

He appealed to the public who have ... this incident and other criminal activities to come forward to report to the authorities.

Citing the "totally protected species" status of the Orang-utan, it is a "very, very serious offence to hunt, let alone kill them," Chong told them.—KYC

People say thanks you to Dr M for leadership

PUTRAJAYA: Malaysians, represented by various organisations, Wednesday expressed their appreciation to Datuk Seri Dr Mahathir Mohamad for his role in developing the country of more than 20 million and making it peaceful.

The appreciation came in the form of bouquets of flowers, greeting cards, portraits and other souvenirs which were presented to the Prime Minister and his wife, Datin Seri Dr Siti Hasmah Mohd Ali, at a ceremony at the Prime Minister's Department here.

The ceremony, attended by 3,500 people, was held in conjunction with the country's 46th National Day on Aug 31.

In his brief speech, Dr Mahathir said he was proud to have the opportunity to observe the historic day at the federal administrative centre here for the first time.

"I am fortunate to be able to see Putrajaya developing well and could celebrate National Day here. For me, I am thankful for being able to celebrate National Day here while I am still the Prime Minister," said Dr Mahathir, who has been leading the country since 1981.

The National Day celebrations will be held for the first time at the federal administrative capital.

Dr Mahathir also advised the people to drive carefully, especially during the National Day celebrations, to prevent accidents.—Bernama

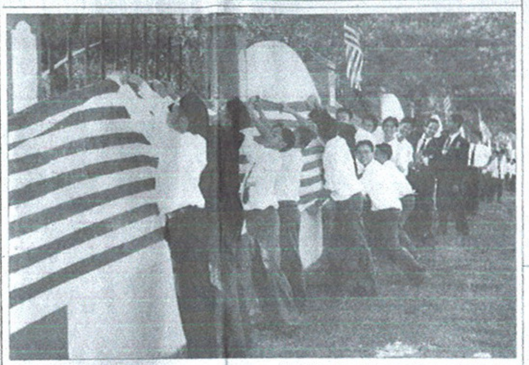
Dept's views sought

From Page One

In the wake of the killing, Masa has sought the views of the Sabah Wildlife Department and resort operators on whether it is proper to allow private-owned areas for conservation of animals, particularly orang-utans.

"I want their opinions on whether, besides the Wildlife Department, it is proper for other parties such as resorts or recreation centres to keep or conserve orang-utans.

"To me, it is based on their recommendations...if it is alright then we will allow," he said.—Bernama



***FLAG-DRAPED SCHOOL*...students and teachers of SM Sains in Labuan working hand-in-hand to drape the fencing of their school with a 250-meter long *Jalur Gemilang*.**

Though not a record-breaking feat, the school's way of promoting the national flag not only steals the show but also sets a fine example for all, including the students.

It took four days of hard work by some 500 teachers and students to prepare and put up the RM1,000 flag of painted cloth.

Added to the flag, which carries the signatures of all who contributed to the effort, is a 10-meter banner with the theme and logo *Keranamu Malaysia*. — SOHAN DAS

29,000 pieces of VCDs seized, says Customs

KOTA KINABALU: Customs and Excise Department Director Haji Hassan Arshad said the department seized about 29,000 pieces of illegal or pornographic video compact discs (VCDs) as of July this year.

Speaking during a press conference here Wednesday, Hassan said in Sandakan alone, about 26,000 VCDs were seized during a raid on July 25.

He said a 29-year-old man was arrested for questioning.—NASHIR MANSOR

M'sia to lobby for World Youth Forum

KUALA LUMPUR: Malaysia will lobby Asean countries at the 4th Asean Ministerial Meeting on Youth (AMMY) in Manila next month for its bid to host the United Nations World Youth Forum in 2005.

Youth and Sports Minister Datuk Hishammuddin Tun Hussein, who will be attending the two-day meeting from Sept 3, said Malaysia had a good chance of hosting the international forum.

"It is time for Malaysia to be given the opportunity and honour to host the forum, which has never been held in Asia. Malaysia's permanent representative in New York has expressed Malaysia's interest to the U.N.," he told a news conference after a post cabinet meeting at the ministry here Wednesday.

Hishammuddin

Hishammuddin said the official bid would be done through a resolution at the 58th session of U.N. Third Committee Meeting in the middle of next month.

He said Malaysia's success in the bid to host the forum would further strengthen the country's youth development programme.

On the AMMY, he said Malaysia would propose at the meeting several changes to the programmes implemented by AMMY.

This included the need to set up a Youth Programme Fund to provide financing to projects implemented through annual contributions of member countries so as to reduce dependency on Asean+3 dialogue partners, namely China, Korea and Japan.

Hishammuddin said Malaysia would also propose that the younger generation be included in the meeting and given the rights to express their views.

"This is important in efforts to further develop their capabilities to a higher level," he said.

The first AMMY was held in Jakarta, Indonesia in 1992, followed by Kuala Lumpur in 1997 and Yangon, Myanmar in 2000.—Bernama

Abbreviations

AREAS	The Asian Rhino and Elephant Action Strategy
BBEC	Bornean Biodiversity & Ecosystem Conservation
BG	Benoît Goossens
CAP	Capacity Building Project
CU	Cardiff University
DANIDA	Danish International Development Agency
FMU	Forest Management Unit
ICCB	International Course on Conservation Biology
ITBC	Institute for Tropical Biology and Conservation
JICA	Japan International Cooperation Agency
KOCP	Kinabatangan Orang-utan Conservation Project
KSE 2002	Kinabatangan Scientific Expedition 2002
LKWS	Lower Kinabatangan Wildlife Sanctuary
MFJ	Mohd. Fairus Jalil
MHL	Maklarin H. Lakin
MWB	Michael W. Bruford
PCR	Polymerase Chain Reaction
PDRA	Post Doctoral Research Associate
PHVA	Population Habitat Viability Analysis
SFD	Sabah Forestry Department
SJ	Sheena James
SOS Rhino	Save Our Sumatran Rhino
SWD	Sabah Wildlife Department
UMS	University Malaysia Sabah
WWF-Malaysia	World Wide Fund-Malaysia

Contents

1. Project Information

Project title	*Conservation of the orang-utan in Kinabatangan Wildlife Sanctuary, Sabah, Malaysia*
Country(ies)	*Sabah (Malaysia)*
Contractor	*Cardiff University*
Project Reference No.	*09/016*
Grant Value	*£147,264*
Start/Finishing dates	*01/12/2000-30/11/2003*

2. Project Background and Rationale

The recent technical developments in genetics and the use of non-invasive methods give conservation professionals powerful tools for the long-term management of wildlife populations. The orang-utan is a flagship species for wildlife conservation in Malaysia and one of the main populations is found in the forests of the Lower Kinabatangan region, Sabah (Appendix 13). These forests are in the process of being gazetted as a Wildlife Sanctuary (Lower Kinabatangan Wildlife Sanctuary, LKWS) under the Wildlife Conservation Enactment 1997 because of their unique wildlife diversity and abundance. However, although the aim of the Sanctuary is to create a corridor for wildlife along the Kinabatangan floodplain, these forests are currently seriously fragmented. It is not known whether the impact of habitat fragmentation on isolated orang-utan sub-populations could jeopardise their long-term survival. The current ecological and behavioural observations and the surveys undertaken by the Kinabatangan Orang-utan Conservation Project (KOCP) through different areas in the Lower Kinabatangan have shown an unusually high density of orang-utans in small fragmented areas. The high density is possibly due to recent habitat loss and consecutive concentration in the remaining forests. In these degraded forests, the distribution of orang-utan food sources in space and in time differs ~~of orang-utan food source~~s greatly from that found in primary forests. These factors are likely to affect orang-utan seasonal movements, territory ranges and therefore will impact the social and structure organisations.

The present project aimed at providing a range of essential information on the genetic structure of the Kinabatangan orang-utan population (e.g. genetic variability, gene flow between sub-populations, effective population size, and patterns of dispersal) to create a conservation strategy, involving the use of non-invasive genetic methods.

It was identified by the Sabah Wildlife Department (SWD), the KOCP and the Institute for Tropical Biology and Conservation (ITBC), University Malaysia Sabah (UMS) as providing crucial information and training opportunities to allow the long-term conservation of the orang-utan population and the ecosystem and tools for the development of practical management measures to ensure the maintenance of genetic diversity within this population over a long period of time.

3. Project Summary

At the time of the submission of our proposal for Round 9, a Logical Framework was not requested by Darwin Initiative.

The four main objectives of the project were the following:

1. to establish a high quality long-term research programme at the University of Malaysia Sabah in tropical biology and biodiversity conservation using non-invasive population genetic techniques;
2. to establish a university teaching programme in conservation science through which candidates for further training could be identified, and through which increased national awareness of conservation issues could be raised;
3. to establish population genetic methodology that could be applicable to endangered rainforest species in Sabah;
4. to investigate the genetic consequences of recent demographic changes brought about by human pressure, habitat disturbance, population fragmentation and high density of orang-utans.

These objectives were successfully achieved and we did not significantly modify our operational plan during the project.

The following Articles under the Convention on Biological Diversity best describe this project:

Article 6 (10%). General Measures for Conservation and Sustainable Use. At the end of the project, we co-organised an international workshop on orang-utan conservation in Sabah during which several recommendations for forest management, agricultural practice, tourism, *ex situ* conservation, research and public awareness for orang-utan conservation and two resolutions (one for orang-utan conservation in Sabah and one for orang-utan conservation in the LKWS) were formulated and presented to the Sabah Minister of Tourism, Culture and Environment Datuk Chong Kah Kiat during the closing ceremony.

Article 7 (5%). Identification and Monitoring. We identified the most vulnerable sub-populations of orang-utan isolated in fragments in the LKWS.

Article 8 (15%). *In-situ* Conservation. Production of a draft management plan for the orang-utan population in the LKWS and a draft State action plan for the orang-utan populations in Sabah.

Article 12 (30%). Research and Training. These were the main components of our project. We conducted research on the population genetics of the LKWS orang-utan population and trained two Malaysian scientists in molecular genetic methods at Cardiff University and UMS.

Article 13 (5%). Public Education and Awareness. Through an international course in conservation biology at UMS, we trained a variety of attendees, including NGO and GO staff, students and tourist guides in conservation biology and the importance of conserving biodiversity. Promulgation of measures to conserve orang-utans through the media in Sabah (several newspaper articles were published throughout the project – see attached copies) and the importance of genetic diversity in general to conservation issues.

Article 15 (15%). Access to Genetic Resources. At the end of the project a proposal for genetic management of large vertebrate populations in Sabah was submitted to the SWD. Computer-based database on genetic information of orang-utan population in the LKWS handed over to host country, and GIS map of orang-utans genetically identified in the LKWS. Establishment of a collection of non-invasive genetic samples from Asian elephant, Sumatran rhinoceros, banteng, Bornean orangutan, Proboscis monkey, long-tailed macaque, pig-tailed macaques, maroon langur, Hose's langur, silvered langur, Bornean gibbon at ITBC, UMS.

Article 16 (15%). Access to and Transfer of Technology. Set up of a non-invasive genetic laboratory and training of the member of staff in charge of that laboratory (Mohd. Fairus Jalil).

Article 17 (5%). Exchange of information. Course on conservation biology. International Workshop on Orang-utan Conservation in Sabah. Medias.

We have successfully met and achieved all our objectives and considerable additional accomplishments are also described in the report. Thanks to a fruitful collaboration with SWD, KOCP, DANIDA and UMS, the International Workshop on Orang-utan

Conservation in Sabah was the best achievement we could expect and the results surpassed our expectations.

4. Scientific, Training, and Technical Assessment

Research

Research staff and their respective roles in this project are as follows: Professor Michael W. Bruford (MWB) (Cardiff University, Project Leader), Dr Benoît Goossens (BG) (Cardiff University, Research Associate), Mr Mohd. Fairus Jalil (MFJ) (University Malaysia Sabah, Tutor and Darwin trainee), Ms Sheena James (SJ) (University Malaysia Sabah, Master student and Darwin trainee), Dr Marc Ancrenaz (KOCP, Director), Dr Isabelle Lackman-Ancrenaz (KOCP, Director), Professor Datin Dr Maryati Mohamed (UMS, ITBC Director). Two additional research collaborators also played an important role in the research component (but also in the teaching and training components) of this project: Dr Lounès Chikhi (currently a CNRS Researcher at Toulouse University, in France) and Dr Joanna Mary Setchell (currently a Research Fellow at Cambridge University).

During the six first months of the project (December 2000-May 2001) Benoît Goossens and two KOCP research assistants (Mr Jamil Sinyor and Mr Zulkiflie Abdullah) carried out a large-scale non-invasive sampling of the whole Kinabatangan orang-utan population. Overall about 350 samples (shed hairs found in orang-utan nests and faeces) were collected in the 10 Lots (or population fragments) of the Proposed LKWS (Appendix 13). Eighteen (Z Abdullah, J Sinyor, M Suali, B Elahan, H Elahan, AH Marhaban, R Saharon, Azli Etin, DMA Abulani, A Sawang, M Pilit, AR Pilit, H Suali, R Rukimin, Asni Etin, Azmi Etin, R Sakong and H Braim) local research assistants from KOCP were trained in the collection of non-invasive samples during field expeditions, together with one staff member (MFJ) from ITBC, UMS.

Shed hair and faeces were collected from wild orang-utans alongside the Kinabatangan river using boats. Orang-utans construct a new nest every night. Thus we were sure that the same animal provides each hair sample collected per nest. When orang-utans were encountered, faecal samples were also collected. GPS coordinates were taken for each sample. Faecal samples were stored in 50 mL Falcon tubes with ethanol, while hairs were stored in plastic bags. In total, we collected shed hair from 176 different nests, and faecal samples from 71 different orang-utans in the 10 lots of the LKWS. Faecal samples were also sometimes collected below fresh nests (32 samples). We also made transects in each lot, totalling 74 kms and counted nests observed to estimate the orang-utan population

density in the LKWS (see results in Table 1, paper submitted to Animal Conservation, Ancrenaz *et al.*, Appendix 2).

A total of 279 samples were collected in the whole Kinabatangan floodplain and 69 samples were collected in the KOCP study site in Lot 2 of the LKWS during the 6-month period that BG spent in Sabah during 2001.

BG, Jamil Sinyor, Zulkiflie Abdullah and Marc Ancrenaz (director of KOCP) published a paper in Folia Primatologica (2004, 75(1), in press) titled: "Which nest to choose: collecting shed hairs from wild orang-utans" (Appendix 1).

Between June 2001 and January 2002, the main objective was to obtain genetic information from the 247 non-invasive samples selected for analyses. The work was done by BG and the trainee from UMS, MFJ (see training section) in the laboratory of Michael W. Bruford (MWB) in the Biodiversity and Ecological Processes Group (BEPG) in Cardiff University (CU). DNA was extracted from shed hair using a buffer method adapted in our laboratory. Faecal extractions were carried out in a Class I microbiological safety hood, using the QIAamp® DNA Stool Mini Kit and following a specific protocol for orang-utans detailed in Goossens *et al.* 2000 and Utami *et al.* 2002.

Fourteen human-derived microsatellite loci were amplified: 2 dinucleotide loci and 12 tetranucleotide loci. A multiple-tube procedure was conducted for each faecal extract for which three amplifications were performed using the locus D5S1457 according to Goossens *et al.* 2000. After that, the most successful extract (3 positive PCRs) for each sample was amplified seven times for each locus to avoid typing errors. DNA was successfully amplified for all loci for 201 (78%) of the samples. This is an extremely high percentage for non-invasive genetic studies. Two samples had the same genotype at all 14 loci and were taken from two fresh nests *ca.* 100 m apart. They were thus considered to be from the same individual, leaving a total of 200 different individuals (Appendix 15; about 20% of the whole LKWS population estimated by census, see Ancrenaz *et al.* submitted, Appendix 2).

Genetic diversity was measured as the mean number of alleles per locus, observed and expected (under random mating) heterozygosities. Two software packages were used (Partition and Genetix) to analyse patterns of genetic differentiation between the two sides of the Kinabatangan river and between the fragmented lots of the LKWS. We observed: (1) a high genetic diversity in the whole population (6.6 alleles and 74% of heterozygosity in the LKWS, see Table 2); (2) a limited but highly significant level of

genetic differentiation between the samples (average Fst=0.04, P<0.001); (3) the Kinabatangan river represents a natural barrier to the movement of orang-utans.

The high genetic diversity in the LKWS orang-utan population may be due to the recent habitat loss and isolation of the different fragments (lots), the population concentration in the remaining forests along the river and the long generation time of the species. Even if the current diversity is high, the results also suggest that the orang-utan sub-populations in the LKWS are likely to continue to decrease even if forest fragmentation stops, simply because densities are higher than under "natural" conditions. Significant loss of genetic diversity is likely to take place in the very near future, due to genetic drift. Inbreeding may also take place. We conclude that gene flow should be maintained or re-established by allowing individuals to move from one fragment to another.

Our results led us to make several conservation recommendations, which need to be addressed urgently to alleviate or prevent deleterious genetic consequences in isolated fragments. There is a need to: (1) halt the decline of the habitat availability by stopping illegal logging and overexploitation; (2) increase the available habitat area; (3) increase the suitability of available habitat; (4) maintain the current migration rate, so as to avoid the diminution of the genetic diversity (with sufficient migration a fragmented metapopulation will behave like a single large population of the same total size); (5) create habitat corridors between the different lots of the LKWS (particularly between lot 6 and lot 3, lot 8 and lot 10); (6) create habitat corridors which link LKWS to other areas in Sabah (Kulamba and Deramakot).

Two further papers are currently in preparation, one for Science (Report) and one for Molecular Ecology.

Between September 2002 and March 2003, the main objective was to obtain genetic information from the 65 different samples (faeces) collected between April 2000 and August 2002 in the Lot 2 of the LKWS, in a 4-km^2 study site (Appendix 14) in which KOCP research assistants conduct behavioural observations on habituated orang-utans. This work was done by BG and his trainee from UMS, Ms Sheena James (SJ) (see training section) in CU, following the procedures described above. DNA was successfully amplified for 13 microsatellite loci for 44 (85%) samples. Genotyping identified 35 different individuals: 12 adult females, six flanged males (adult males possessing secondary sexual characteristics (SSCs) such as cheek flanges and throat sac which enables them to produce loud calls), five unflanged males (sexually mature males that have not develop SSCs), three adolescent males, two adolescent females, five offspring, and two unidentified individuals (Appendix 15).

Three software packages were used (POPASSIGN 4.1, CERVUS 2.0 and KINSHIP 1.2) to analyse parentage and patterns of relatedness. Parentage determination was carried out for 15 individuals, for which we were able to find the mother in the study site. For ten of these, the father was also identified in the study site. The results are shown in Appendix 24. Furthermore, we were also able to investigate patterns of dispersal using relatedness data between known adults. Theoretically, if females are more related to one another than males are, we can conclude that females are sedentary while males disperse. In our study, we showed that adult females were indeed more related to one another than were adult males. A paper detailing these findings is currently in preparation for the Proceedings of the Royal Society B.

During the faunal survey carried out by the SWD and KOCP in the whole state of Sabah, we planned to collect orang-utan samples (faeces and shed hairs) from the different areas surveyed. Unfortunately, this sampling was largely unsuccessful, due to the difficulty of finding fresh samples (in mainly primary forests). The success of the 2001 sampling in the Kinabatangan was mainly due to the fact that wild orang-utans and fresh nests were sighted from the river, and that staff (BG and two KOCP research assistants) carrying out the sampling were dedicated to sampling for six months. Sabah-wide sample acquisition is still ongoing and genetic analyses will be carried out in the non-invasive genetic laboratory set up by BG and MFJ at UMS during the Darwin Initiative project.

In addition to the above publications, a chapter on non-invasive genetic methods in primates is included in a book entitled: "Field and Laboratory Methods in Primatology" edited by JM Setchell and DJ Curtis and published by Cambridge University Press (Appendix 5) in September 2003. BG and MWB are first and last authors, respectively. Two additional papers have been submitted, one to the International Journal of Primatology in which Darwin Initiative is acknowledged (Appendix 3), and one to Science (Brevia) on the orang-utan population size in Sabah (Appendix 4).

Training

BG's Malaysian counterpart, Mohd. Fairus Jalil (MFJ) from ITBC, UMS, received six months of training in molecular ecology techniques in CU (June-November 2001). MFJ worked with BG in the laboratory, extracting DNA from faecal samples and from shed hair samples previously collected in the field; amplifying nuclear markers and genotyping orang-utan individuals. He also spent time in the library, increasing his knowledge of both population genetics and conservation biology. Back in Malaysia, MFJ is now in charge of the non-invasive genetic laboratory. His work and the experience he acquired in Cardiff have resulted in a successful application for a PhD scholarship from UMS. He

will study for his PhD (2003-2007), part time at CU and at UMS, under the supervision of BG and MWB. The project title is "Comparative phylogeography and genetic differentiation of three primate species found in LKWS, Sabah, Malaysia" (see pictures of MFJ in the field, collecting primate faeces). MFJ presented an oral communication at the XIXth International Primatological Society Conference, held in Beijing, 4-9 August, 2002 (Appendix 32).

BG's second Malaysian counterpart, Sheena James (SJ) from ITBC, UMS, received three months of training in molecular ecology techniques in CU (January-March 2003). SJ worked with BG in the laboratory, extracting DNA from faecal samples and from shed hair samples previously collected in the field; amplifying nuclear markers and genotyping orang-utan individuals. She also spent time studying the literature, increasing her knowledge of both population genetics and conservation biology. This work is part of her MSc thesis (Title: "Patterns of relatedness in a fragmented orang-utan population in the Lower Kinabatangan", see 1st year progress report and proposal - Appendix 29) which she will submit in October 2004. Back in Malaysia, SJ followed the 2nd International Course on Conservation Biology and successfully obtained her certificate. She is now back in the field to collect more behavioural data on the orang-utans in the KOCP study site for her MSc thesis.

During the Kinabatangan Scientific Expedition (KSE) 2002 (Appendix 22, see also below), 25 course participants were trained in wildlife census techniques, non-invasive genetic sampling, and data collection for invertebrate, amphibian, reptile, bird and small mammal biodiversity studies. Disciplines covered included:

- Invertebrate studies: inventories of insects and non-insects species, use of certain genera as bio-indicators of habitat disturbance;
- Vertebrate inventories: Amphibians, birds, fishes, small mammals;
- Vertebrate population censuses: crocodiles, primates, hornbills, rhinoceros;
- Human-wildlife interactions;
- Inventory of flowering plants, ferns, moss, fungi;
- Medicinal plants and traditional knowledge: interviews with local communities, collection of samples, etc;
- Hydrology and geology of the Kinabatangan floodplain;
- Socio-economic study: interviews about traditional ways of living of the local communities, role of eco-tourism.

The results of the KSE 2002 are published in a book by UMS in collaboration with CU, KOCP, SWD and Japan International Cooperation Agency (JICA) and co-edited by BG (Appendix 44).

KOCP research assistants received training from BG in non-invasive DNA sampling for endangered species such as Asian elephant, Sumatran rhinoceros, orang-utan, proboscis monkey, pig-tailed and long-tailed macaques. Eight KOCP research assistants followed the International Course on Conservation Biology and obtained their certificate of completion with honour.

Jamil Sinyor, one of the KOCP research assistants, was trained by BG in writing scientific papers in English and he presented and as a result he presented an oral communication at the XIXth International Primatological Society Conference, held in Beijing, 4-9 August, 2002 (Appendix 33). Jamil also followed the first International Course on Conservation Biology and obtained his certificate of completion with honour. He is also currently involved in MFJ's PhD work and he is helping the latter in the collection of long-tailed macaques and proboscis monkeys faecal samples, as he gained his experience during the orang-utan project and the collection of orang-utan faecal samples.

During a one-day field training course on Manukan Island (Tunku Abdul Rahman Park) on 9 May 2003, 25 course participants were trained in coral reef and fish identification and conservation by Dr Annadel Cabanban from the Borneo Marine Institute, UMS.

Teaching

The first International Course on Conservation Biology (ICCB) was organised by BG with help of other members of the Darwin team at ITBC, UMS, between 15 April – 24 May 2002 (see Announcement leaflet – Appendix 17, List of participants and their affiliations – Appendix 18, Programme - Appendix 19). Subjects covered during the course included: What is conservation biology?; Systematics, taxonomy and phylogeny; Biogeography and island biogeography; The extinction crisis and threats to biological diversity; Behavioural ecology and conservation; Genetic diversity in populations; Non-invasive genetics and conservation; Population demography and viability, population and habitat viability analysis; Conservation management; Ecological research techniques in conservation; Human genetics and human colonisation; The concept of phylogeography; and Wildlife conservation in Sabah. The course was divided into three periods: three weeks at ITBC, two weeks of fieldwork in the Kinabatangan floodplain, and one week of report-writing and assessment at ITBC. The three first weeks were devoted to lectures, seminars, practicals, wildlife films, fieldwork (on Gaya Island) and discussion of scientific papers. During weeks 4 and 5, the participants took part in a comprehensive expedition to the Kinabatangan floodplain co-organised by UMS, CU, KOCP, SWD and JICA. Week 6 was spent at ITBC for course assessment. Assessment was based on three equal contributions: 1/3 for the preparation and submission of a report on the field

expedition, 1/3 for presenting a summary of a scientific paper to the other course participants, and 1/3 for participation in a workshop entitled "Application of genetics to the conservation of endangered species in Sabah". At the end of the course a certificate of completion was given to those participants who attended the course, the expedition and passed the assessment procedure (see Appendix 21 for representative certificate of completion). All participants who attended at least 70% of the lectures during the three first weeks received a certificate of attendance to that effect. Of 33 participants, 17 received a certificate of completion (Appendix 18). Most of these were staff from governmental and non-governmental agencies, showing their great motivation and the wish to increase their knowledge in conservation biology. Sixteen participants received a certificate of attendance (Appendix 18). The course was taught by researchers involved in the Darwin project (Dr Benoît Goossens, organiser, CU and UMS; Prof Michael W. Bruford, Project Leader, CU; Dr Marc Ancrenaz and Mr Sahdin Lias, KOCP); staff at the ITBC (Dr Menno Schilthuizen), guest lecturers (Dr Joanna M. Setchell, University of Surrey Roehampton; Dr Lounès Chikhi, University College London), and guests from Sabah agencies (Mr Mahedi Andau, Director SWD; Mr Augustine Tuuga, Senior Wildlife Officer, SWD; Mr Peter Malim, Senior Wildlife Officer, SWD; Mrs Anna Wong, Senior Officer, SWD; Mr Soren M. Jensen, Chief Technical Adviser, Danish Cooperation for Environment and Development, SWD; Ms Lee Shan Khee, WWF Malaysia).

The second ICCB was organised by BG with help from other members of the Darwin team at ITBC, UMS, between 21 April – 16 May 2003 (see Announcement leaflet – Appendix 17, List of participants and their affiliations – Appendix 18, Programme – Appendix 19). Subjects covered during the course were similar to the course in 2002. Two lectures were added: Eco-tourism and conservation; Marine ecology and conservation. The course was divided into two periods. The three first weeks were devoted to lectures, seminars, practical (PHVA), wildlife films, fieldwork (on Manukan Island) and workshops. One day (7 May 2003) was dedicated to student presentations on "Wildlife Conservation in Sabah" (see programme - Appendix 20). Week 4 was spent at ITBC for course assessment. Assessment was based on two equal contributions: a Powerpoint presentation by each student to the class on one selected Sabah animal or plant species (see programme – Appendix 20 and powerpoint presentations on CD2 - Appendix 48); participation in a workshop entitled "How to conserve wildlife biodiversity in protected areas in Sabah?". For the latter, five protected areas were selected and presented (powerpoint presentations) by 5 groups of 5 students: the Lower Kinabatangan Wildlife Sanctuary; Maliau Basin; Crocker Range National Park; Danum Valley; Tabin Wildlife Reserve (the presentations are also included on the CD2, Appendix 48). At the end of the course a certificate of completion was given to those

participants who attended the course and passed the assessment procedure (Appendix 21). All 25 participants received a certificate of completion (Appendix 18). Most of these were tourist guides (13) and staff from governmental and non-governmental agencies (10). The course was again taught by researchers involved in the Darwin project (Dr Benoît Goossens, organiser, CU and UMS; Prof Michael W. Bruford, Project Leader, CU; Drs Marc Ancrenaz and Isabelle Lackman-Ancrenaz, KOCP); staff at the ITBC (Dr Menno Schilthuizen), guest lecturers (Dr Joanna M. Setchell, University of Surrey Roehampton; Dr Lounès Chikhi, University of Toulouse; Dr Annadel Cabanban, Borneo Marine Institute). Seminars were presented by Dr Annadel Cabanban and Dr Menno Schilthuizen (UMS), Dr Edwin Bosi (SOS Rhino), Prof Michael W. Bruford (CU) and Mr Takahisa Kusano (JICA).

Capacity building

Two objectives of the project were the setting up of a non-invasive genetic laboratory at ITBC, UMS, and the establishment of a methodology for studying population genetics of endangered rainforest species in Sabah. Both these objectives were achieved successfully:

(1) the genetic laboratory is established and is currently used by MFJ and SJ (trained by BG during the Darwin project). An ABI 3100 sequencer has been installed in the laboratory during the summer 2002 and is used extensively by MFJ and SJ, and by other scientists. BG and MFJ have also set up a room dedicated to the extraction of non-invasive samples such as hair and faeces at ITBC.

(2) BG has established long-term genetics projects on the Sumatran rhinoceros (*Dicerorhinus sumatrensis*) (individual identification, sex-ratio and relatedness patterns in Sabah populations) in collaboration with SOS Rhino (Drs Nan Schaffer and Edwin Bosi), SWD, KOCP and UMS, and on the estuarine crocodile (*Crocodylus porosus*) population genetics in collaboration with SWD and UMS. Two Malaysian students, co-supervised by BG, started their MSc projects in October 2003: Ms Leni Tupang on the rhinoceros project (proposal, Appendix 26) and Ms Tara Singh on the estuarine crocodile project (proposal, Appendix 27).

(3) BG has submitted a proposal to SWD and UMS entitled: "Genetic management of large mammal populations in Sabah" to create a DNA bank of large mammals (but also for other tropical animal species) from Sabah (Appendix 28).

5. Project Impacts

One of the main project achievements which led to the accomplishment of the project purpose was that we provided enough essential information on the genetic structure of the Kinabatangan orang-utan population to be included in the management plan of the

species in the LKWS. The genetic results were also presented during the International Workshop on Orang-utan Conservation in Sabah (Announcement package with Letter of invitation, Programme, List of invitees and Booklet "Orang-utan in Sabah: Portrait and key Management Issues – Appendix 41). Furthermore, the importance of genetics has also been highlighted in the recommendations (research heading) adopted by the workshop participants: recommendation 3 "The **genetic** analysis of all major populations in Sabah, including those samples generated through the Sepilok rehabilitation centre" and recommendation 5 "Carry out research on the demographic, **genetic** and ecological consequences of the construction of forest corridors, managed translocations and other habitat factors affecting major population foci". It is also the second urgent recommendation of the resolution on the conservation of the orang-utan in the lower Kinabatangan floodplain: "Take such steps as are necessary to maintain a **genetically** viable population of orang-utans in the lower Kinabatangan floodplain".

The International Workshop on Orang-utan Conservation in Sabah will certainly help the host country (and especially the Sabah Wildlife Department and the Ministry of Tourism, Culture and Environment) to meet its obligations under the Biodiversity Convention. This Workshop was the first of this kind, in which all Sabah stakeholders met and discussed important issues on an endangered species, here the orang-utan. All partners (SWD-DANIDA, KOCP, CU and UMS) including Sabah Forestry Department, produced high-quality data (*i.e.* maps of orang-utan distributions in Sabah (Appendix 12), genetic data, how involve local human communities in ape conservation, a successful example of forest management in Deramakot Forest Reserve), which led to the formulation of recommendations and resolution on the conservation of orang-utan in the LKWS and in the State of Sabah (Appendix 11). These recommendations and the resolution will be tabled for consideration at the State Cabinet. Basically, SWD will be proposing to the State Government to conserve some of the Forest Management Units (FMUs) solely for natural forest management. These are FMUs belonging to the Sabah Foundation (FMUs 15, 16, 20, 21, 22, 23 and 26). Sabah Foundation FMUs harbour a high density of orang-utans and a significant total orang-utan population – 6,900 individuals (53% of all orang-utans in Sabah). Other FMUs harbour about 2,500 individuals (19%).
The surveys carried out by SWD and KOCP showed that 72% (9,400 individuals) of orang-utans are living in logged and exploited forests, with the majority found in FMUs 17, 19, 20, 21 and 22 (see Appendix 12). The orang-utan population in protected areas is estimated at only 28% of the total population in Sabah (estimated at 13,000 individuals), or an equivalent of 3,600 individuals (Ancrenaz *et al.* 2003 in workshop proceedings, Appendix 43 and paper submitted to Science, Appendix 4). Therefore, high priority should be given to maintaining the most important forests under natural forest management regimes and avoiding industrial tree plantations and all other forms of

presented their respective work in the NGOs and GOs they are employed by (Appendix 20). We also organised a day (during the 2002 course) during which several Sabah Wildlife Department officers presented talks about their activities for conserving biodiversity in Sabah. Four KOCP research assistants presented their work on orang-utan conservation to the course participants during a seminar session. During the KSE 2002, which was jointly organised by the Darwin Initiative project, national television followed participants during their work and conducted interviews with participants. This resulted in a three-part television program about the expedition broadcasted on Malaysian national television. The expedition was also covered by the national and regional press (see CD6, Appendix 52). Through this, we helped to increase knowledge of Sabah's biodiversity conservation within local NGOs, GOs, and the public.

The impact of the project in terms of collaboration between UK and local partners is discussed throughout this whole report (see also Project Operation and partnerships). All partners wish to pursue the collaboration. They submitted a new proposal to the Darwin Initiative (Round 12) in the hopes of improving the already successful capacity building and the research components, and increase the knowledge on Biodiversity Conservation, and of ultimately build upon the Darwin legacy by focusing on another endangered species, the Asian elephant and on west-east collaboration (multicentric collaboration between Asia and Africa)

In terms of social impact, the local community in Sukau (LKWS) has benefited (as a whole) from the project. But the Darwin Initiative project was a minor element compared to the involvement of one of the local partners, KOCP who are directly working with the local community in Sukau village, in the LKWS, and who provide employment, training and capacity building to more than 30 villagers. BG spent several months (particularly during the 6-month expeditions in 2001) with KOCP local research assistants. During the ICCB 2002 and 2003, eight KOCP assistants spent 4 weeks in Kota Kinabalu and received training in conservation biology. One of them, Jamil Sinyor, attended the XIXth International Primatological Society Conference in Beijing, China, in August 2002. He presented an oral communication on his work during the field sampling expeditions, in front of a large audience of renowned primatologists. MFJ, one of the two Malaysian trainees also attended the same conference and also gave a talk. He also made interesting and useful contacts related to his thesis work on proboscis monkey and long-tailed macaque genetics. This experience is something that the two trainees will never forget. The local community was also largely involved in the organisation of the KSE 2002, and took an active part in the two-day village participatory workshop on ethnobotany and ethnozoology organised in Sukau, 28-29 June 2003 (Appendix 23). Several representatives from three main villages in the LKWS (Abai, Sukau and Batu Putih) and

a dozen KOCP research assistants attended the International Workshop on Orang-utan Conservation in Sabah and took part in each of the six working groups, bringing several interesting inputs which were taken into consideration in the recommendations and the resolution.

Satisfactory exit strategies are in place:

1. **a draft management plan for the Kinabatangan orang-utan population which was presented during the Workshop in August 2003; a resolution on the orang-utan conservation in the LKWS which was drafted, presented and adopted by consensus during the Workshop; a list of recommendations and a resolution for the conservation of orang-utans in Sabah drafted, presented and adopted by consensus during the Workshop. The Recommendations and Resolution were presented to the Sabah Minister of Tourism, Culture and Environment, Datuk Chong Kah Kiat, at the close of the Workshop. During the post-Workshop press conference, the Minister stated that his Ministry would be tabling the Recommendations and Resolution at the State Cabinet for consideration.**
2. **a draft State action plan for the entire Sabah orang-utan population which is in preparation.**
3. **the conservation biology course will continue after the Darwin completion, the CDs of the course have been disseminated to ITBC staff for further use during their lectures. Contacts between BG, MWB (CU) and Mr Takahisa Kusano, Chief Technical Advisor for JICA have been established with the aim of setting up a collaborative teaching programme in conservation biology at ITBC in coming years.**
4. **the population genetic methodology for other endangered rainforest species is established, and new projects are under development (Asian elephant (new Darwin application Round 12), Sumatran rhinoceros (Leni Tupang, UMS MSc), Proboscis monkey and long-tailed macaques (Mohd. Fairus Jalil, UMS and CU PhD), estuarine crocodile (Tara Singh).**
5. **publications include one article published, five articles submitted in peer-reviewed journals, and four book chapters.**
6. **Mohd. Fairus Jalil, one of the two DI trainees, has started a PhD on the phylogeography of three primate species in the LKWS.**
7. **Jamil Sinyor, one of the two KOCP research assistants trained in the collection of non-invasive samples is involved in other similar projects. He is currently employed by MFJ as a research assistant and is in charge of the collection of faecal samples of proboscis monkeys and long-tailed macaques in the LKWS. He was also involved in the collection of non-invasive samples from large mammals**

(including Asian elephants, bantengs and orang-utans) during the faunal survey in Sabah in 2002 and 2003.

6. Project Outputs

All project outputs are quantified in the table in Appendix II using the coding and format of the Darwin Initiative Standard Output Measures. We also provide full details in Appendix III of all publications and material that can be publicly accessed.

All outputs in the agreed schedule were successfully achieved (see details in Appendix II). We also produced additional outputs. The training course in conservation biology was carried out in 2002 and 2003 (4). Two UMS staff members were trained in genetic techniques (6), one started a PhD in 2003 (MFJ, in collaboration with CU) and the other (SJ) will submit her MSc thesis in October 2004 (2). The PDRA spent 6 months per year during the three years of the project in the host country (8). One scientific article is published, five are anticipated (11A, 2-3 were scheduled), four book chapters were produced (11B), one edited book was produced (11B), a management plan for the orang-utan population in the LKWS was produced (9). We established a database for the orang-utan distribution (see attached map of identified orang-utans in the LKWS) and genetic information in the LKWS (including information on genetic relationships between individuals in the KOCP study site) (12A). We created a species reference collection of faeces for 11 endangered mammal species in Sabah which is maintained at ITBC, UMS (13A). We produced a 'booklet' (on CDs) in English and in Malay with all lectures, seminars, and workshops carried out during the two courses 2002 and 2003. Lecturers at ITBC (e.g. Dr Henry Bernard) already use this 'booklet'. We co-organised an international workshop on orang-utan conservation in Sabah (14B), plus two additional small workshops. UK scientists and partners intended several conferences (Adelaide (one oral presentation), Beijing (three oral presentations)) and presented several seminars (5) to disseminate the project results (14A&B). 20-25 newspaper articles were produced in the national and local press (Sabah Times, Daily Express, The Borneo Post, News Straits Times, STAR) during the project (15A&B) and the Darwin project was also publicised in local newsletters (ITBC Newsletter, WWF-Partners for Wetland in Sabah, Tembadau Newsletter of the SWD and BBEC Newsletter of JICA project) (15B). Three newspaper articles were produced in the UK and Darwin project was also publicised in the WWF-UK Primate-report (newsletter) (15C). The KSE 2002 and the International Workshop on Orang-utan Conservation were also publicised on national TV channels in Malaysia (RTM, TV3) (18A). Finally, a non-invasive genetic laboratory has been established and is now in operation at ITBC, UMS (21).

The information relating to project outputs and outcomes has been disseminated through workshops, seminars, newspaper articles, book and scientific papers (see Appendix II and III for full details):

September 24, 2001	Darwin Initiative Workshop in UMS, Kota Kinabalu, Sabah, Malaysia, presentation of a poster: "Non-invasive sampling of orang-utan hair and faeces in the LKWS, Sabah, Malaysia", Goossens B, Zulkiflie A, Jalil MF, Lackman-Ancrenaz I, Ancrenaz M, Mohamed M, Andau P, Bruford MW (Appendix 31)
May 4-June 2, 2002	Kinabatangan Scientific Expedition 2002, co-organised by CU (Darwin Initiative), KOCP, UMS, SWD and JICA was reported in the local press (Daily Express, The Borneo Post, Sabah Times). As a result of the KSE 2002, an edited volume will be produced by UMS, SWD, CU (Darwin Initiative), KOCP and JICA.
June 28-29, 2003	Workshop organised in Sukau (Kinabatangan) to disseminate the KSE 2002 results to the villagers of Sukau and to discuss and share traditional knowledge of ethnobotany and ethnozoology. About 70 villagers and eight scientists attended.
August 25-27, 2003	International Workshop on Orang-utan Conservation in Sabah was extensively covered by the media in the national (Peninsular Malaysia, Sarawak) and local (Sabah) press.

Dissemination of the results of this project will continue after project completion as the main partners are fully and permanently involved in the conservation of the orang-utan in Sabah. The management plan for the orang-utan in the LKWS will be implemented over the next few years and results will be extensively publicised in the international, national and local media. Furthermore, as the two UK scientists (MWB and BG) and the three main partners wish to submit a new proposal to Darwin Initiative (Round 12) on the conservation of forest elephants in both Malaysia and central Africa, we will be still involved in the dissemination of the outputs of the current project on orang-utans. The SWD and the KOCP, with the help of UMS will be responsible for further information dissemination. The UK scientists will be continuously informed of such dissemination.

7. Project Expenditure

PROJECT COST					
Total Darwin Grant: £147,264 Annual Darwin Grant: * 200/2001 £21,427, * 01/02 £48,174, * 02/03 £44,998, * 03/04 £32,665					
Expenditure details	**00/01**	**01/02**	**02/03**	**03/04**	**Total**
Postage, stationery					
Travel, subsistence					
Conferences, seminars					
Other : Field consumables Laboratory consumables					
Salaries					

Grant expenditure provided by the Research and Consultancy Division

Expenditure details	Budget	Actual expenditure
Postage, stationery		
Travel, subsistence		
Conferences, seminars		
Consumables		
Salaries		
Total		

As the field consumables budget was spent during the fieldwork season, which ran from the 1st December to the 31st of May, fieldwork expenditure in Malaysia is not included in the expenditure for the reporting period (although most of this expenditure occurred within the reporting period) because BG came back from the field only on the 28th of May 2001 and could not produce claims before that time. The amount spent on field consumable in Malaysia is £5,509, which was added to the next reporting period. We also requested changes in the last period of the contract to be able to organise two main events: the second International Course on Conservation Biology at UMS and the International Workshop on Orang-utan Conservation in Sabah. All changes to the original budget were agreed by the Darwin Initiative (by email).

8. Project Operation and Partnerships

Collaboration with the local partners:

Three local partners worked on project activities together in collaboration with BG: Sabah Wildlife Department (SWD), University Malaysia Sabah UMS) and Kinabatangan Orang-utan Conservation Project (KOCP). Their relationships during the project were extremely good and they will continue to be active after the end of the Darwin project.

1. **SWD** was very supportive and gave all the authorisations required to sample in the LKWS and in the Forest Reserves, as well as in the Sepilok Orang-utan Rehabilitation Centre. They also provided an export permit for the samples (shed hair and faeces). SWD is including the genetic results in the Kinabatangan orang-utan management plan. SWD also sent four participants (Mr Abdul Karim Hj. Dakog and Mr Sailun Hj. Aris, Senior Wildlife Officers, Mrs Anna Wong, Wildlife Officer, and Dr Nathan Sen, Director of the Sepilok Orang-utan Rehabilitation Centre) to the ICCB 2002 held at UMS.
2. **KOCP** provided BG with accommodation, transportation means and other practical support in the field, email and internet access, office at their research station during his stay in Sukau village, located on the Kinabatangan river. He worked with their local research assistants during the field expeditions in 2001. The KOCP research station was also used as a base camp for the Kinabatangan Scientific Expedition 2002. KOCP also provided several research assistants who took part in the expedition. Their experience in the field greatly facilitated the work of the scientists. KOCP also sent four participants (Mr Datu Mohd. Ahbam Abulani, Mr Jamil Sinyor, Mr Sahdin Lias, and Mr Azrie Sawang) to the ICCB 2002 and four participants (Mr Ramlan Sakong, Mr Rosdi Sakong, Mr Hadrin Lias, and Ms Hamisah Elahan) to the ICCB 2003 held at UMS. KOCP research assistants also carried on the orang-utan faecal sampling throughout the years in their study site for the mating strategies part of the project. Dr Isabelle Lackman-Ancrenaz (KOCP co-director) organised a one-day workshop entitled "Eco-tourism and conservation" during the ICCB 2003. Dr Marc Ancrenaz (KOCP co-director) was involved in teaching during ICCB 2002 and 2003.
3. **UMS** provided BG with an office at ITBC, email and internet access and all the facilities necessary to organise the ICCB 2002 and 2003. UMS also provided Michael W. Bruford with an office at ITBC during the courses 2002 and 2003. UMS sent 21 participants (students: 10, and staff: 11) to the ICCB 2002 and two participants (Mr Mohd. Fairus Jalil and Ms Sheena James) to the ICCB 2003.

The Kinabatangan Scientific Expedition 2002 was jointly organised by UMS, SWD, CU (Darwin Initiative), KOCP and JICA. This represented an effort of more than 650 men/day of field research.

Resources Development Adviser, Mr Roger Cox. The latter is in charge of finalising the LKWS orang-utan population management plan, which will incorporate inputs from the genetic study. Together with KOCP directors, we also collaborated to prepare the International Workshop on Orang-utan Conservation in Sabah, which was held in Kota Kinabalu, 25-27 August 2003.

6. **Japan Government (JICA) represented in Sabah**: JICA co-organised the KSE 2002 and the workshop on ethnobotany and ethnozoology held in Sukau in June 2003. Mr Takahisa Kusano, JICA Chief Technical Advisor gave a seminar on their Bornean Biodiversity & Ecosystem Conservation (BBEC) programme during ICCB 2003.

7. **WWF-Malaysia**: WWF sent three participants (Mr Engelbert Dausip, Mr William J. Dausip and Mr Jabanus Miun) to the ICCB 2003 at UMS.

8. **Tourism Industry (Private Sector)**: Borneo Tourism Institute, Wildlife Expeditions and SI Tours sent 6 (Ms Soon Kai Ning, Mr Wong Yin Ket, Mr Yee Yehsi, Mr Daniel Doughty, Mr Foo Meng Boon, and Mr Ag Zakariah Hj Ibrahim), 3 (Ms Dionysia Gustin, Ms Mariati Amit, and Mr Mohd. Basri Bahar) and 4 (Mr Lee Teck Seng, Mr Efigenio Typay Jr, Mr Gary Albert, and Mr Walter Stephen) participants, respectively, to the ICCB 2003. These 13 tourist guides were extremely motivated throughout the whole course and contacts have been established between BG and the Sabah Tourist Guide Association (STGA) to set up a yearly training course in the future.

9. **SOS Rhino**: BG has established a collaborative project with SOS Rhino, SWD and KOCP to work on the genetics of the highly endangered Sumatran rhinoceros population in Sabah. Leni Tupang (Field Coordinator of SOS Rhino) has been identified to do an MSc at UMS under co-supervision of Prof Datuk Dr Maryati Mohamed and BG.

10. **International**: we have also been able to establish links with Indonesian projects through the participation of three Indonesian students in the ICCB 2002 and 2003. Mr Agung Daudi Seventri is a research assistant working for an orang-utan conservation project based in Kalimantan, Ms Selly Sitha Sariningsih is a student working for the Sumatran Orang-utan Conservation Programme based in Sumatra, and Ms Hartati Saat is involved in orang-utan research in Kalimantan. Through the courses and the expedition, they were able to share knowledge with the research assistants of the KOCP on orang-utan and biodiversity conservation in their respective countries. Dr Suci Utami Atmoko, an Indonesian scientist, who had already established a collaboration with UK scientists, BG and MWB (see Goossens *et al.* 2000 and Utami *et al.* 2002), was invited to the International Workshop to present a paper on the current situation of orang-utan conservation in Kalimantan and Sumatra (Indonesia). She presented the latest population estimates in both regions (see abstract of her paper in workshop proceedings) with new census data for Sumatra (around 7,300 orang-utans) and Kalimantan (around 18,000 orang-utans, with 76% located in West and Central Kalimantan). Dr Joanna Setchell (University of Surrey Roehampton, UK) was extensively involved in the teaching of

conservation science and behavioural ecology during both courses 2002 and 2003 and co-led with BG the primate census during the KSE 2002 (see book chapters). She has also contributed into the analyses of the orang-utan relatedness results. Dr Lounès Chikhi (University of Toulouse, France) was also involved in the teaching of population genetics during both courses 2002 and 2003, and is also involved in the analyses of the Kinabatangan orang-utan population genetics results.

9. Monitoring and Evaluation, Lesson learning

Monitoring methods have varied according to the activity being carried out. Laboratory and field work have been monitored through regular (weekly) meetings to discuss progress while in Cardiff and weekly (and more often, except when in the field) email consultation while the PDRA and counterparts were in Malaysia. Progress in the laboratory has been little short of spectacular and the data are a major contribution to orang-utan conservation as a result.

Progress of the students in the course at UMS was continually assessed and end-point assessed through formal work, discussion, workshops and presentations. The course was a great success in both years (2002 and 2003) and the participation of tourist guides and non-governmental NGOs (like KOCP) particularly increased the motivation level of the students. Evaluation forms were given out to students at the end of both courses in 2002 and 2003, and the content and breadth of the course was modified accordingly. Perhaps a little disappointing was the response from UMS staff during the 1st year (2002). However this was rectified in 2003 by the attendance of two key-persons for the future of the knowledge transmission at ITBC (MFJ and SJ, the two Darwin trainees).

Overall, communication and monitoring was rigorous in this project and results have been beyond our most optimistic expectations.

We would like to emphasise the exemplary collaboration between DANIDA, SWD, KOCP, UMS and CU for the organisation of the International Workshop on Orang-utan Conservation in Sabah which led to a very successful exercise, which was extensively publicised through the media in the country.

Key-lessons:

1. To adapt our teaching to the audience and show flexibility throughout the international course on conservation biology. With effort, we were able to adapt our training to the students and this was highly appreciated.

2. Any population genetic study depends strongly on the samples available. The main objective of the project (Kinabatangan orang-utan population genetics) was successfully accomplished because the field parameters were extremely favourable and the staff

carrying out the sampling was well trained, competent and dedicated 100% to it. The lesson we can learn from this is that any sampling of wild animal populations should be undertaken separately from other activities and by dedicated and well-trained staff.

Practical lessons valuable for other projects:
Never underestimate the budget while writing the application! We also believe that budget flexibility is vital for such big projects. The flexibility of the Darwin in allowing us to move money between different budget categories greatly facilitated our work and it is something which should be emphasised.

10. Darwin Identity

The research findings of the Darwin project were (and are still) publicised widely.

Meetings attended included:

1. Participation and presentation of Darwin project at the European Federation of Primatology Meeting in London, UK (November 2000).
2. Participation and presentation of research findings at the XVIIIth Congress of the International Primatological Society in Adelaide, Australia (January 2001).
3. Participation and presentation of the project at the Darwin Initiative Workshop in University Malaysia Sabah, Kota Kinabalu, Sabah (September 2001).
4. Participation and presentation of research findings to the Sabah Assistant Minister of Tourism, Culture and Environment in Sukau (Kinabatangan), Sabah during the Kinabatangan Scientific Expedition 2002 (May 2002).
5. Participation and presentation of research findings at the XIXth Congress of the International Primatological Society in Beijing, China (August 2002) (Appendices 30, 31 and 32).
6. Participation and presentation of research findings at the Ethnobotany and Ethnozoology Workshop in Sukau (Kinabatangan), Sabah (June 2003).
7. Organisation, participation and presentation of research findings at the International Workshop on Orang-utan Conservation in Sabah in Kota Kinabalu, Sabah (August 2003) (Appendices 33-36).
8. Participation and presentation of research findings at the XVIth French primatological Society Congress in Brussels, Belgium (October 2003) (Appendix 38).
9. Various seminars (2) and talks (3) presented by Darwin staff (MWB and BG) in university departments and conservation organisations in Europe (Appendix 39) and in Malaysia.

Use of the 'Darwin Initiative' logo:

1. Boat for field expeditions and collection of orang-utan samples (see pictures on CD5, Appendix 51)
2. International Courses on Conservation Biology 2002 and 2003 (Appendices 17 to 21, CDs 1, 2 and 3 of courses 2002 and 2003, CD5 with pictures)
3. Kinabatangan Scientific Expedition 2002 (Appendix 22, CD4 (Appendix 50) with movie on expedition, CD5 (Appendix 51) with pictures)
4. Kinabatangan Scientific Expedition 2002 edited volume (Appendix 44)
5. International Workshop on Orang-utan Conservation in Sabah (banner, see picture; tee-shirt (Appendix 54), letter of invitation, list of invitees, proceedings, booklet on Orang-utan in Sabah: Portrait and Key Management Issues (Appendices 41-43))
6. Poster during Darwin Initiative Workshop held at UMS in September 2001 (Appendix 31)
7. Powerpoint presentations during International Primatological Society Conference in Beijing in August 2002 (Appendices 32-33) and during several seminars presented by UK scientists (BG and MWB)

Promotion of Darwin funding and project:

1. Publications in peer-review journals (Darwin Initiative for the Survival of Project Grant no 09/016 acknowledged)
2. Newspaper articles on the Kinabatangan Scientific Expedition 2002
3. Newspaper articles on the International Workshop on Orang-utan Conservation in Sabah, August 2003

The Darwin Initiative is extremely visible among the academic, governmental and NGO communities in Sabah. This is because of the high profile of our project in the media and also due to the previous Darwin projects held at UMS. Darwin identity is very strong and unambiguous in Sabah.

The Darwin project retained its own identity through the genetics work and PHVA of the LKWS population of orang-utans. It was however a key part of the Sabah-wide effort, as enhanced in the International Workshop in 2003 where the Project Leader (MWB) co-facilitated and where the DI project was present through additional presentations.

11. Leverage

During the lifetime of the project, additional funds were attracted and provided by KOCP and DANIDA for the International Workshop (final cost of workshop: about RM70,000

(£11,111): RM39,000 (£6,190) from DANIDA, RM25,000 (£3,968) from KOCP). Additional funds were provided by KOCP for field expeditions in 2001 (salaries for field assistants, a second boat and engine: RM60,000 or £9,523). Additional funds were also provided by UMS for ICCB 2002 and 2003 (RM20,000 or £3,175). Additional funds were also provided by UMS, KOCP, WWF-Malaysia and JICA for the Kinabatangan Scientific Expedition 2002 and for the production of the book (RM40,000 or £6,350).

Efforts were made by the PDRA to strengthen the capacity of the UMS partner (ITBC) to secure further funds for similar work in the host country. Together, BG and ITBC attracted RM50,000 (£7,940) from UMS (2002/2003) for a project entitled "Population genetic structure and conservation of endangered primate species in the Lower Kinabatangan Wildlife Sanctuary" (Appendix 25). Further funding should be secured to follow-up that project. MFJ was awarded the Skim Latihan Akademic Bumiputra scholarship by the Ministry of Education to do his PhD in CU. BG has also helped in the writing-up of a proposal on the genetics of the Sabah estuarine crocodile (Appendix 27), together with an MSc student from ITBC, UMS which has been submitted to the Wildlife Conservation Society (The Field Veterinarian Program Wildlife Health Fund). Funds were also attracted to finance biodiversity work on Sumatran rhinoceros (Appendix 26), and SOS Rhino provided US$4,000 (£2,400) for genetic work at ITBC, UMS.

12. Sustainability and Legacy

Project achievements most likely to endure:
The Kinabatangan orang-utan management plan is likely to be implemented in the near future, mainly by SWD and KOCP and other stakeholders. The workshop resolution, statement and proceedings will provide the framework for orang-utan conservation in Sabah for the next 10 years at least.
The conservation education programme will be integrated into the programme of at least one lecturer at ITBC, UMS, Dr Henry Bernard.

Future of project staff and resources:
BG and MWB will be largely involved in the follow-up of the project in Sabah and together with the same partners in Sabah and partners in Gabon and Republic of Congo they have submitted a new proposal to the DI Round 12 (see below).

MFJ started a PhD on the phylogeography and population genetic structure of three primate species in the LKWS. He has been registered at CU since January 2003. MFJ is

co-author on the orang-utan population genetic papers. He is also in charge of the new non-invasive genetic laboratory at ITBC.

SJ will submit her MSc in October 2004. She has already submitted a very promising first year report. SJ is co-author on the orang-utan relatedness paper (in preparation).

The new non-invasive genetic laboratory at ITBC, UMS is operational and is used by the two trainees, MFJ and SJ. New projects have been initiated on Asian elephant, Sumatran rhinoceros, estuarine crocodile, and several primate species.

Continued collaboration:
Benoît Goossens (PDRA) and Michael W. Bruford (Project Leader), together with Darwin Initiative partners (UMS, SWD, KOCP) and also with partners in Africa (CIRMF and WCS in Gabon; HELP Congo and University of Brazzaville in the Republic of Congo) will submit a new proposal to the Darwin Initiative Round 12 on the conservation of forest elephants in Borneo and central Africa. This would give us the unusual opportunity of continuing similar work in two regions in which CU has already led two DI (on lowland gorillas, Round 8 and the current project, Round 9) and to consolidate the collaborations established. The capacity building and technology transfer will be considerably increased and of long-term benefit not only to Gabon and Sabah but also to the central African region and the South-East Asian region, as CIRMF and ITBC are the only conservation genetics laboratories of this kind within the equatorial rainforest belt of the two regions. We believe in long-term collaborations and we wish to enable the host countries to play a major role in the conservation of their biodiversity. We also think that the value for money would be considerable during such an original, multicentred project involving three continents: Europe (UK), Asia (Sabah) and Africa (Gabon and Republic of Congo), and monitored by the PDRA who has collaborated for several years within all host countries and with all host institutions.

Application of the project's conclusions and outputs:
Application of research findings was completed during the project and one paper was published and five were submitted before the end of the project. The genetic results will be incorporated in the management plan of the orang-utan population of the LKWS. The International Workshop on Orang-utan Conservation in Sabah organised at the end of the project was essential to bring to the government and to the public the importance to protect one of the most important flagship species of the country.

Additional funds being sought to continue aspects of the project:

Funding has been sought by BG and MFJ and procured by UMS (RM50,000 = £8,000) to fund MFJ's fieldwork in the Kinabatangan and collect faecal samples from long-tailed macaques and proboscis monkeys. The Malaysian Ministry of Education also provided a 3-year scholarship to MFJ to do his PhD in Cardiff University, under MWB and BG supervision. Additional funding for that project will be sought from the Royal Society, UK.

UMS also provided extra-funding for SJ for her master, which will be submitted in October 2004.

Funding were also procured by SOS Rhino to cover laboratory experiments to work on the genetic individual identification of Sumatran rhinoceros in the Tabin Wildlife Reserve. This work, carried out by Ms Leni Tupang (MSc student at ITBC) is co-supervised by BG and Dr Menno Schilthuizen, at UMS.

Funding is also sought (from Wildlife Conservation Society, The Field Veterinarian Program Wildlife Health Fund) to fund a genetic and health project on estuarine crocodile in Ulu Segama River, Sabah. Ms Tara Sinkh (MSc student at ITBC) will carry out the work under BG and Dr Menno Schilthuizen co-supervision.

13. Post-Project Follow up Activities

Based on the outcomes of this Darwin project, and in particular the resolutions made during the very successful International Workshop on Orang-utan Conservation in Sabah, we consider that the following-up activities would substantially strengthen and consolidate the results of this Darwin project:

1/ Designation of a Sabah Wildlife Department staff member in charge of the orang-utan management plan.

2/ Attendance of the SWD orang-utan staff member and Dr Marc Ancrenaz (KOCP director) at the Orang-utan Population and Habitat Viability Analysis Meeting to be held in Jakarta, Indonesia, in January 2004.

3/ Organisation of several micro-workshops, bringing together the stakeholders involved in the development and implementation of the final Kinabatangan orang-utan management plan, including the oil palm industry (and other agriculture activities); tourism industry; Forestry Department; Land and Survey District Office; Local communities; with a final workshop for the finalization of the management plan.

4/ Production of a brochure in Malay to improve local and national public awareness of the need to protect orang-utans in the Lower Kinabatangan floodplain.

5/ Reduce the incidence of illegal killing of orang-utans by providing the Honorary Wildlife Wardens in Sukau, with a boat and engine, a 4x4 vehicle and additional equipment and manpower.
6/ Protect and restore the Kinabatangan floodplain's riparian forests which function as corridors linking larger blocks of important orang-utan habitat by acquiring private lands contiguous to the Sanctuary lots; extending the Sanctuary; recovering land from oil palm plantations; and improving restoration and replanting programmes.
7/ Investigate the potential of artificial "bridges" between Kinabatangan tributary banks to allow orang-utans to cross small rivers (maintaining gene flow between isolated lots).

The strong commitment and capacity by host country partners to play a major role in follow-up activities to this project is demonstrated by the results of the International Workshop, as well as by the strong wish of the government to protect their wildlife (see Letter from Assistant Minister Datuk Karim Bujang).

We believe that the following-up activities 1, 2, 3 and 4 are suitable for Darwin Post Project Funding while we would look for other funds for activities 5, 6 and 7 which are long-term activities, unless Darwin Initiative would agree to cover part of the costs of such activities.

14. Value for money

We were able to achieve all outputs (including additional outputs) with very little money. Therefore, the value for money was extremely high considering the achievements of the project: trainees, science and international workshop. The team was also able to find additional funding and collaborations to achieve its objectives.

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Authors: Prof Michael W. Bruford (Project Leader) and Dr Benoît Goossens (Research Associate)
Co-authors: Drs Isabelle Lackman-Ancrenaz and Marc Ancrenaz (KOCP directors), Prof Datin Dr Maryati Mohamed (ITBC director), Mr Patrick Andau (SWD director)

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