Darwin Initiative for the Survival of Species

Annual Report

http://www.darwin.gov.uk

Project Reference Number : 162/12/026

Towards sustainable management of alien invasive weeds in southern China

Project Leader and Author: Dr. Carol A. Ellison, 19th May 2006

Darwin Initiative for the Survival of Species

Annual Report

1. Darwin Project Information

Project Ref. Number	162/12/026
Project Title	Towards sustainable management of alien invasive weeds in southern China
Country(ies)	UK, China
UK Contractor	CABI (formerly CABI Bioscience, an institute of CAB International), Silwood Park, Ascot, Berks. SL5 7TA
Partner Organisation(s)	Institute of Biological Control (IBC), Chinese Academy of Agricultural Sciences (CAAS), Beijing, China. (IBC is now part of the Institute of Environment and Sustainable Development in Agriculture, but will still be referred to as IBC in this Annual Report) Guangdong Entomological Institute (GEI), Guangzhou, China
Darwin Grant Value	£177,508
Start/End dates	October 2003 / September 2006
Reporting period and report number	1st April 2005 –31st March 2006 (April 2006 inc.) Report 3.
Project website (updated 2005)	http://www.cabi.org/projectdetail.asp?Heading=Projects&projid=63 '*Mikania micrantha* in Southern China. Towards sustainable management of invasive alien weeds'
Author(s), date	Dr. Carol A. Ellison, 19th May 2006

2. Project Background

- Invasive alien species (IAS) represent the greatest threat to the preservation of global biodiversity after habitat destruction. In the fight to safeguard the world's biodiversity against IAS, it is essential not only to assess their impact, but also to develop and employ control strategies that are not damaging to the environment. The use of co-evolved natural enemies, a strategy referred to as classical biological control (CBC), has proven to be an efficacious, cost-effective, sustainable and safe option for the management of alien weeds. The aim of this method of natural weed suppression is to select agents (arthropod and pathogen) from the centre of origin of the target weed, and after intensive assessment and screening for specificity, release them in the invasive range.

  As a leading international organisation in the field of biological control, CABI has received a number of independent requests from local scientists in China, concerning

the sustainable control of invasive alien weeds (IAW). CABI has a history of collaborative development projects with China, and has an office in Beijing. Although China has expertise in the biological control field, CBC of IAW has yet to be fully exploited, and the use of pathogens is a totally new technology to China.

Amongst those weed species that have been identified as having the highest environmental impact in China, is the pernicious, neotropical, composite *Mikania micrantha* (mile-a-minute weed or Mikania). This vine is a serious problem in Guangdong Province, particularly within the highly biodiverse National Conservation Areas. This project aims to implement a pilot project for the CBC of Mikania, by exploiting a similar programme that has been undertaken in India.

3. Project Purpose and Outputs

- The purpose of this project is to develop the capability of exploiting pathogens for the sustainable management of IAW in China. The project will specifically develop and apply the research already undertaken under a Department for International Development (DFID)-funded Natural Resources International-administered project for the classical biological control of Mikania in India, using the highly host specific, neotopical rust fungus *Puccinia spegazzinii*. Training activities and hands-on experience received during the project will empower Chinese scientists with the skills necessary to develop new collaborative proposals. The objective is to develop these proposals during the course of the programme, with support from CABI personnel, targeting other invasive weeds that are seriously affecting the biodiversity in natural environments in China.

  Annex 1 is a report of the progress and achievements against the Logical Framework for Financial Year 2005/2006, the project logical framework (updated in October 2005), follows this as Annex 2.

- It has proved necessary to interrupt the progress of the fieldwork in China, while permission to use the selected rust isolate, from Argentina, is finally secured from the Argentine authorities. At this stage it is felt that a no-cost extension is the most appropriate way to address this delays in the progress of the project. Thus, no changes have currently been made to the design of the project.

4. Progress

- *Previous achievements: October 2003-March 2005*
  The project was initiated in October 2003. The Inception Workshop was held in November in China, and the prospective rust release site Neilingding Island, Guangdong Province, off the coast of Southern China, had been established by GEI. At the workshop, the project work plan was discussed, the methodology for the assessment of the weed within the permanent sample plots agreed, and the release site for the rust visited by all collaborators. Two Chinese scientists (Han Shichou and Fu Weidong) came to CABI for training in February 2004 and the isolate of the rust to be imported into China was selected. An Import Licence was obtained by IBC, from the China Import and Export Inspection Bureaux (IEIB) and the rust shipped to China in July 2004. Additional host specificity testing was completed by February 2005 in quarantine, and the results submitted to the IEIB. Due to the chlorosis observed on sunflower in response to inoculation with the rust, IEIB requested that a selection of sunflower varieties also need to be tested before they would consider issuing a rust release permit. The issue of the infection of the only native *Mikania* species in Asia, *M. cordata,* by the rust was not raised (see annual report 04/05 for detail). The rust release site had been selected on Neilingding Island, off the coast of Guangdong, and permanent sample plots established and the *Mikania micrantha* density recorded.

- *Progress during current reporting period*
  The sunflower varieties were challenged with the rust and none became infected. A licence was agreed by the IEIB for an experimental release for the rust to be undertaken on Neilingding Island, this was undertaken in September 2005, but for political reasons (discussed below and in the Darwin six-month report, October 2005) the site had to be

destroyed. A new 'trial' rust release site was established on Jui-zhou Island, about 20 km from the original release site on Neilingding Island. The rust was released at three permanent sample sites in October 2005, but the rust failed to establish, due to the late season environmental conditions being non-conducive for infection. Continued efforts have been made to gain permission to use the rust from the correct authorities in Argentina (from where the rust was collected), but this has not yet been secured, because of the absence of an appropriate policy framework in the country. A number of publications and proposals for funding, after the end of the project, have been completed this project year.

Slippage: The project progressed well during the first six months of this reporting period, but due to the lack of permission to use the rust (from Argentina), this part of the project is effectively on hold. A request has been made to the Darwin Initiative Secretariat for a no-cost extension to the project, to enable the original outputs or the project to be addressed, once permission has been obtained from Argentina.

The achievements of the project this year can be considered under the following categories:

Planning

The progress of the project and problems encountered were deliberated between all project personnel during the biological control workshop at GEI (see Training, below) and subsequent meeting at CAAS in Beijing. Proposals to apply for funding for continuation of the work after the end of the Darwin project were discussed in detail. Because of the delay in obtaining permission from Argentina to use the rust in China, it was decided that the project leader would request a no cost extension to the project to enable all the original outputs to be addressed.

Research

Interaction Between *Puccinia spegazzinii* & *Helianthus annuus* (sunflower)

Following the request from the IEIB, over 10 different varieties of sunflower were collected from two provinces (Neimeng and Xinjing), including eight edible and two oil-use varieties (Table 1). The sunflower seed was planted into individual pots, and maintained at approximately 25^{o}C in the quarantine greenhouse. In May 2005, once the plants had reached the 3-4 leaf-pair stage, the rust was inoculated on to 3 replicate plants, per variety, by suspending mature rust infected leaves of *Mikania* over the test plants (May 2005). During the 24-48 hour inoculation (dew) period, the humidity was maintained around 100% and the temperature at 20-25 ^{o}C.

Table1. Varieties of hybrid sunflower used in the testing of *Puccinia spegazzinii*

Sunflower Variety	Use of seed	Source
RH 3708	edible	America
Heidapian Huakui 2	edible	Inner Mongolia
Heixinghuo	edible	Inner Mongolia
707C	edible	America
Xinkui hybrid 4	edible	Xinjing
Xinkui hybrid 8	edible	Xinjing
Sandaomei	edible	Xinjing
Heimaya	edible	Xinjing
G101	Oil	America
KWS	Oil	Germany

Over a period of one week following inoculation, three sample pieces of leaf were collected from each variety, each day, for microscopic analysis of the plant-pathogen interaction.

Tissue-cleaning: The leaf samples were cut into 2-5mm pieces, and placed in the fixing solution (acetic acid : 95% alcohol [3:1]) for 24hr, and then transferred into saturated chloral hydrate until all the chlorophyll had been bleached from the tissue. After this, the samples were placed it in staining reagent (0.1% Fuchsin acid) for one day and then dipped it into colour division solution until the colour was very distinct (saturate chloral hydrate). The samples were mounted in 50% glycerol and observed microscopically for evidence of leaf penetration and haustorium formation by the rust. The results are shown in Table 2, and provide conclusive evidence that sunflower is not a host of *P. spegazzinii.*

Table 2. Host specificity screening of the rust *Puccinia spegazzinii* against sunflower varieties

Variety	Macroscopic symptom	Microscopic analysis of leaf
Mikania micrantha	+chlorotic spots	√
RH3708	-	×
Heidapian, Huakui hybrid 2	-	×
Heixinghuo	-	×
707C	-	×
Xinkui hybrid 4	-	×
Xinkui hybrid 8	-	×
Sandaomei	-	×
Heimaya	-	×
G101	-	×
KWS	-	×

\+ symptoms observed

\- no symptom

√ haustorium evident

× no haustoria observed

Trial Release of *Puccinia spegazzinii* on Neilingding Island, Shenzhen, China

A trial release of the rust was undertaken in mid-September 2005 on Neilingding Island. Permission had been granted by the IEIB to undertake this release in the contained area of an island, in order check the results of the host specificity testing undertaken in quarantine, under natural field conditions. As discussed in the Half Year Report (October 2005), this was not considered by China to be the formal release that would require permission from Argentina. In addition, at the time, all evidence from CABI's contacts in Argentina had inferred that permission was imminent anyway.

Rust infected aerial parts of *Mikania* were placed in a in a cool box, maintained at 4^{o}C, and transported by air from Beijing quarantine to Shenzhen, and then by boat to Neilingding Island (Table 3). The low temperature within the cool box prevented the release of the infective basidiospores from the teliospores embedded in the plant tissue.

Table 3. Rust inoculum used in field trial

Item	Number
Leaf	65 leaves
Sori on leaf (pustules, cushion of teliospores)	966 sori in total
Average diameter of leaf sorus	3.3 mm
Sori on petiole or stem (elongated)	51 sori
Average length of petiole/stem sorus	5.0 mm

Three sites within the permanent sample plots, previously selected and evaluated for the level of *Mikania* infestation, were selected for the release of the rust. The rust inoculum was put in the field as given in Table 4. Approximately the same concentration of inoculum was used at each site. Weather condition during the inoculation were: temperature 30^{o}C and humidity >70%.

Table 4. Method of treatment

Plot Number	Number of Sites Inoculated	Method of Inoculation
1	10	Rust infected plant part was suspended over field plants using a clip. The ambient humidity was raised, by spraying the inoculation site with water.
2	20	As 1, but the ambient humidity was not increased.
3	25	As 1, but the ambient humidity was not increased.

A few weeks after this trial release of the rust, the plots had to be destroyed. This was due to political issues concerning the military status of the island and releasing a non-native organism in a nature reserve (see Half Year Report, October 2005). However, the quick response of Han Shichou to secure another Island trial release site for the rust, after discussions with Zhuhai Bureau of Forestry, was reported: Jiuzhou Island.

Report on Juizhou Island

Zhuhai is located at the south of Guangdong Province, and is adjacent to South China Sea. There are 146 islands within the jurisdiction of this city, scattered in the vast expanse of the ocean, hence her nickname “the City of a Hundred Islands”. Zhuhai is 140 Km away from Guangzhou, and borders Hong Kong and Shenzhen to east, Macao to the south and Zhongshan to the north by land. There is a southern, subtropical oceanic climate in Zhuhai, with an average air temperature of 22.1ºC: 14.5ºC in January and 27ºC in July. Annual rainfall is 1964 mm, the main rainy season is May - September, with torrential rain and sometimes typhoons occur.

Jiuzhou is a small island, around 1 km^2, and is about 3 km off the coast of Zhuhai to the south. Neilingding Island is approximately 20 km to east of Juizhou Island. It has a slightly drier climate than the mainland in Zhuhai, because it is affected by sea breezes. It would be suitable to test the rust from May to October.

A survey of the island in October 2005, found a 110 m^2 infestation of *M. micrantha* in the centre of the island, and some other smaller patches distributed on other part of the

Island. Three sites were established, for the release of the rust. Within these experimental plots, the following plants were recorded in addition to *M. micrantha*:

Asteraceae:	*Bidens pilosa, Wedelia trilobata*
Rubiaceae:	*Paederia scandens, Ixora chinensis*
Tiliacea:	*Microcos panniculata*
Lauraceae:	*Litsea glutinosa*
Mimosaceae:	*Acacia confusa*
Oleaceae:	*Ligustrum sinense*
Euphorbiaceae:	*Bridelia tomentosa*
Casuarinaceae:	*Casuarina equisetifolia*
Moraceae:	*Ficus pumila*
Rutaceae:	*Murraya exotica*
Acanthacea:	*Dicliptera chinensis*

Map of Juizhou Island

Trial Release of *Puccinia spegazzinii* on Juizhou Island, Zhuhai China

A similar release of the rust, to that given previously for Neilingding Island, was undertaken on Juizhou Island on 22nd October 2005. The main difference was that a plastic inoculation tent was constructed at Site 3, in order to increase the humidity and hence encourage the establishment of the rust. Shortly after the release, the onset of the dry season resulted in plant die-back and the rust was unlikely to have got the opportunity to establish.

Above left shows the taking of the rust inoculum to Jiuzhou Island, contained in the cool box. Above right is the inoculation chamber constructed at Site 3; below is an internal view of the chamber. Mikania is the dominant plant. Attached to the top of the plants can be seen pieces of inoculum, identifiable by their cut ends being wrapped in wet tissue (to prevent immediate wilting).

Obtaining Permission from Argentina to use its Biodiversity to Protect Biodiversity

The on-going political process to get permission from Argentina, to use the *Mikania* rust in China, was discussed in full in the October 2005, Half Year Report. This is centred on the lack of a policy framework in Argentina, to enable the documentation for permission to be issued. Nevertheless, this delay remains unexpected and all the more all more difficult to understand given that Argentina and China are:

1) signatories to the CBD for which Article 8H commits signatories to controlling invasive aliens species that threaten biodiversity,

2) members of FAO who, under the International Plant Protection Convention have developed the Code of Conduct for the Import and Export of Classical Biological Control Agents. The spirit of this convention is the free exchange of agents for non-commercial exploitation,

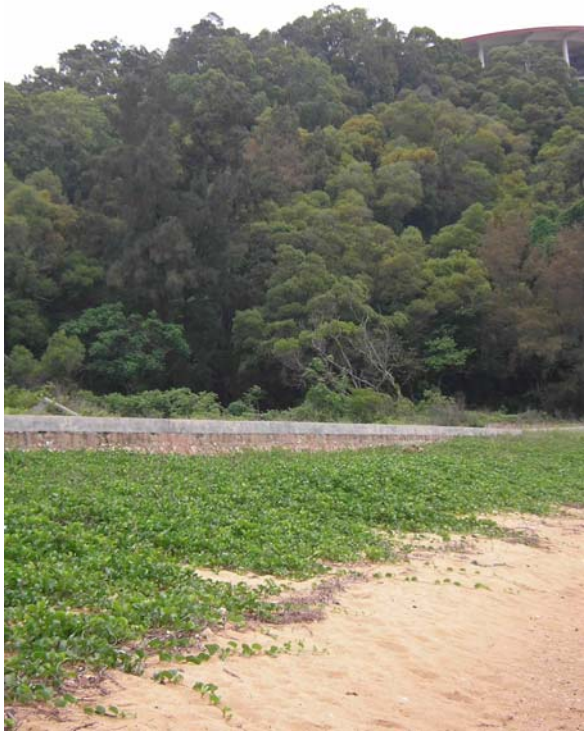
3) receivers of biological control agents themselves for the control of invasive alien species.

In the last 6 months, the Darwin Initiative Secretariat, has been involved in the process in Argentina, at the advice of the British Embassy, Buenos Aires. Despite considerable inputs from the Embassy, CABI and DEFRA the situation is frustratingly yet to be resolved. On the advice of the Secretariat, it has been recommended that there be no further releases of the rust, until Argentina provide the necessary documentation.

Training

A Darwin Initiative workshop on weed biological control was held at Guangdong Entomological Institute Guangzhou, China; 25th - 28th, April 2006. The workshop participant's photo is shown below. The programme is provided in Annex 4. CABI has copies of most of the PowerPoint presentations that were given at the workshop.

The third day of the Workshop a field trip was made to Juizhou Island (left). The permanent sample plots were observed and Mikania rust release strategies and monitoring methods were discussed.



Above, on the landing Jetty, are the team that visited Jiuzhou Island. To the left, is a view of Mikania permanent release Site 1 (at the base of the native forested hill, in semi shade).

Development of proposals

During this reporting period a number of proposals for follow-on funding for sustainable management of invasive alien weeds in Asia, have been developed and submitted. The table below provides details of each proposal.

Project development activities for follow-on funding April 2005 – March 06

Project Details	Donor	Current stage of development
Sustainable management strategy and control technology for the invasive alien weed, *Ageratina adenophora* (*Eupatorium adenophorum*) in China. (Led by Fang Hao-Wan, CAAS, China, with CABI inputs)	Ministry of Science and Technology (MoST) China	Approved Start TBD
CABI staff time support for the MoST project above	Partnership Facility CABI, UK (donor provision for internal use)	Approved Start May 2006
Evaluation and Promotion of Invasive Alien Weed Sustainable Management in the south China Region (submitted January 2006)	Post Project Funding, Darwin Initiative, DEFRA	Not funded
Managing Wetlands for Sustainable Livelihoods at Koshi Tappu, Nepal. (Lead by Seb Buckton, Wildfowl & Wetlands Trust, with CABI inputs concerning invasive species management; Mikania is the top invasive species present)	Darwin Initiative, DEFRA	Approved Start April 2006
IBC collaborators are developing proposals for funding to continue work initiated under this	Chinese government and MoST	Under development

Project Details	Donor	Current stage of development
Darwin Initiative funding (discussed after 2006 GEI Workshop).		
GEI collaborators are preparing application for funding to continue work initiated under this Darwin Initiative funding (discussed at 2006 GEI Workshop).	Guangdong Regional Government	Under development

Assessment and Monitoring

Data on the infestation and impact of Mikania on Neilingding Island has been published in Chinese, with an English abstract (see Annex 3). CABI has offered the services of personnel at our China office in Beijing, to translate the paper into English. Since the issue concerning the unfortunate need to destroy the rust release sites on Neilingding Island, the obtaining of this data in English (as part of Output 2) is less critical. However, it still considered be useful data for a general assessment of the ecological impact of the weed in China.

Timetable for reporting period April 2006 to September 2006

Time period	Output (output addressed in Logical Framework)	Activities	Personnel Responsible
April 2006 (Activity continued from previous year)	Permanent sample plots established & weed impact assessed in China (2)	English translation of Chinese published paper of original release site (Nelingding Island) being undertaken by CABI personnel (see Appendix II). Data on weed infestation of permanent sample plots within new release site (Jiuzhou Island) continue to be gathered and analysed.	CABI-China Office GEI Han Shichou/ Li Liying
June 2006-August 2006 (activity continued from previous year)	Biocontrol agent imported and released in china (3)	Rust released on Jiuzhou Island, Guangdong Province: Potted, living rust infected plants transported to Island, and placed in field	GEI Han Shichou/ Li Liying IBC Fu Weidong/ Zhang Guoliang
August 2006	Biocontrol agent imported and released in china (3)	Full release permit obtained by IEIB Full release permit issued by Shenzen Authorities & Guangdong Bureau of Forestry Rust released at selected sites on mainland China.	IBC Fu Weidong/ Zhang Guoliang GEI Han Shichou/ Li Liying
August 2006 (requested to be delayed)	Public awareness campaign implemented (5)	China, Guangdong: Targeted information produced (leaflets, posters, and videos); media contacted (local and national T.V. and newspapers); popular articles produced	GEI

Time period	Output (output addressed in Logical Framework)	Activities	Personnel Responsible
		China, Beijing: Policy makers awareness campaign UK: Press release made	IBC CABI
Sep 2006 (requested to be delayed)	Results publicised and new project proposals developed (6)	End of Project Workshop held in Beijing New project proposals finalised	IBC Fu Weidong/ Zhang Guoliang

5. Actions taken in response to previous reviews (if applicable)

- The 04/05 Annual Report Reviewer raised the issue of not being able to achieve the goals of the project if permission had not been obtained from Argentina in the next six months. Unfortunately, we are now in this position, and we have indeed re-evaluated our strategy for the final months of the project. Following discussions at the biological control workshop, in April 2006, it was concluded that an application would be made to Darwin Initiative Secretariat for a no-cost extension to the project. In effect, the project would be, as far as possible put on hold until the Argentinean issue had been resolved.

  In addition to this, there has been an increase in project development activities and preparation of publications. This Darwin Initiative Project is considered to be of high importance within the invasive alien species control fraternity of China, and there is a serious commitment to complete the project. Indeed, funding for a similar project on another important weed destroying biodiversity in China (*Ageratina adonophora*) has already been secured by CAAS.

6. Partnerships

- *Within Darwin Project:* As in previous years there has been good communication over the year between China and CABI. Personnel from CABI's Beijing Office have had increased involvement with project activities and communication, which has significantly helped the smooth running of the project.

  Good relations between the China IEIB and IBC have continued to prove fundamental to the progress of this project.

- *Outside Darwin Project*: *Mikania* is an Asia-wide invasive weed problem, and CABI is established as the leader in the CBC of this weed. Consequently, though the Darwin Initiative and the sister project in India (funded by DfID) there has been much interest in taking this technology to other affected countries. Below is an update of the Asia-wide initiatives:

  Nepal: The Darwin Initiative has funded the project: Managing Wetlands for Sustainable Livelihoods at Koshi Tappu, Nepal. This project is lead by Seb Buckton, Wildfowl & Wetlands Trust, Slimbridge, UK, with CABI inputs concerning invasive species management in the reserve (Mikania is the top invasive species present).

  Taiwan: Taiwan National University has secured internal funding to introduce the Mikania rust pathogen into Taiwan. It has not been possible as yet to find the necessary funding to involve CABI in the project, to cover rust selection, shipment, training and shipping costs. The Seventh International Workshop on Biological Control and Management of *Chromolaena odorata* and *Mikania micrantha* (sponsored by International Organisation for Biological Control, and Forestry Bureau, Council of Agriculture, Taiwan) is to be held in Pingtung, Taiwan in September 2006. It is likely to be attended by some of the Darwin project collaborators from the UK and China. Issues

concerning collaboration between China and Taiwan to import the rust will be discussed. (Please note that politically this is not as straightforward as it may appear, the rust importation may still have to go through CABI. Also the isolate used in Guangdong may not necessarily be the one recommended for Taiwan).

South Pacific Islands: A programme has been funded by the Australian Centre for International Agricultural Research (ACIAR) for the classical biological control of Mikania in Fiji and Papua New Guinea (though the Secretariat of the Pacific Community). CABI has been asked to be a partner institute, and is supplying the best rust isolate(s) for the Mikania genotypes present in the two countries. This project will use the same training schedule developed for the Chinese collaborators for training Fijian project personnel. Lessons learned and techniques developed during the release programme in China will also be used.

7. Impact and Sustainability

- The biocontrol workshop held at Guangdong Entomological Institute was well attended and provided an excellent venue to promote the Darwin Initiative project, not only within senior personnel, but also to postgraduate students. Participants were also present from other institutes working in invasive species management in Southern China, who now, hopefully, have a better understanding of this sustainable approach to weed management.
- There is evidence for an increasing interest and capacity for biodiversity and its protection, because of the in-country work carried-out by the Chinese collaborators trained in the UK and their staff. It is only due to the dedication of the project personnel that such good progress has been made.
- The newly funded project in the field of invasive species management using pathogens, by the Chinese MoST, is testament to this increased interest.
- An application was for made for Darwin Initiative Post Project funding, with contribution from all current and new potential collaborators. Unfortunately, this was not successful. However, applications are being made by the Chinese Collaborators for Chinese funding to continue the work started under the Darwin Initiative.

8. Outputs, Outcomes and Dissemination

- The rust has been successfully shipped to China, established in quarantine and additional host specificity tested completed. A release permit was obtained for a trial release of the rust in a contained environment on an island, however, the rust did not establish due to the time of release (at the cusp of the rainy/dry seasons). It has been recommended that the trial release programme should not continue (due to the risk of the rust reaching the mainland) until permission from Argentina had been secured. Consequently, the rust release part of the project and the publicity campaign are effectively on hold. Hence, a no cost project extension has been requested to the Darwin Initiative Secretariat.
- Dissemination activities have been progressing well. The principles behind biological control, and the results of the Mikania project were disseminated through the Biological Control Workshop held at Guangdong Entomological Institute. The host specificity screening has been published in a peer reviewed Chinese Journal, and a book Chapter on the policy frameworks for the implementation of a classical biological control strategy in China is in press (the latter funded by DFID). The book, that this paper forms part of, will be provided to the relevant Chinese government policy makers.

Table 5. Project Outputs (According to Standard Output Measures)

Code No.	Description	Year 1 Total	Year 2 Total	Year 3 Total	Year 4 Total	TOTAL
4C	Postgraduate training in biological control at workshop in Guangdong			30		
4D	Training duration			0.4 2 days		
6A	Training of 2 Chinese scientists (Ms. Fu Weidong from IBC and Prof. Han Shichou from GEI) in handling rust at CABI, UK	2				
6B	Training period in UK, 4 weeks	4				
8	Inception Workshop Beijing, China, for 5 days, two UK staff attended. Workshop attended by 12 people.	2				
8	Unscheduled project meeting Beijing, China, 1 day, both UK project staff attended. Meeting attended by 8 people.		0.2 (1 day)			
8	Attending Workshop in Guangdong and meeting in Beijing			1		
11A	Peer reviewed papers			2		
13A	Facilities established for holding of fungal rust culture for reference		1			
14A	Inception Workshop Beijing.	1				
14A	Unscheduled project meeting Beijing		1			
14A	Biological control workshop Guangdong			1		
14B	Workshop in Nepal where findings from Darwin project were presented. Attended by both UK project staff		1			
14B	CAAS/CABI Invasive Alien Species Meeting, Beijing. Darwin project activities were presented. Attended by all key Darwin project staff (UK and China)		1			
14B	Roundtable for Nature Conservation in the Pacific and the Invasive Species Working Group (ISWG) meetings held in Alatau, PNG in July 2005. Darwin Project activities were presented. Attended by CABI Darwin project leader.			1		
22	Permanent sample plots established on Neilingding Island, Guangdong Province, Southern China.	10				
22	Permanent sample plots established on Jiuzhou Island, Zhuhai, Guangdong Province, Southern China.			3		
?	Establish web-page on Darwin project on CABI website		1			

Table 6. Publications

Type * (e.g. journals, manual, CDs)	Detail (title, author, year)	Publishers (name, city)	Available from (e.g. contact address, website)	Cost £
Journal (in Chinese, English abstracts only)	Biology and Host Specificity of *Puccinia spegazzinii*, a Potential Biocontrol Agent for *Mikania micrantha* Fu Wei-dong, Yang Ming-li, Ding Jian-quing 2006	Chinese Journal of Biological Control 22(1): 67-72 Beijing, China	Fu Wei-dong, Institute of Environment & Sustainable Development in Agriculture, CAAS, Beijing, 100081, China	unknown
Book (in Chinese, English abstract only)	Invasion Ecology and Management of Alien Weed *Mikania micrantha* H.B.K. Wang Bo-sun, Wang Yong-jun, Liao Wen-bo, Zan Qi-jie, Li Ming-guang, Peng Shao-lin, Han Shi-chou, Zhang Wei-yin, Chen Rui-ping. 2004	Science Press, China, 239pp	Han Shichou, Guangdong Entomological Institute, Guangzhou, China	unknown

9. Project Expenditure

Table 7. Project expenditure during the reporting period (Defra Financial Year 01 April to 31 March)

Item	Budget (see project schedule)	Expenditure	Balance

10. Monitoring, Evaluation and Lessons

- The monitoring and evaluation are built-in to the progression of the project. For each output to be achieved a previous stage has to be successfully completed:
  - The rust was imported in to China, after a permit was obtained by IBC;
  - A release permit was applied for after the screening had been completed;
  - Reports must be supplied by all collaborators on a six monthly basis, to allow the release of funds.
- In a country like China, where European languages (in this case specifically English) have only recently become a significant part of the school curriculum, fluent English is not yet widely spoken, even within the scientific community. It thus essential to involve good English speaking collaborators in the project. In this project progress has been greatly

enhance by employing a CABI China Office staff member to facilitate activities. This has helped greatly with understanding political and cultural issues.

- The problems that have been encountered, concerning use of biodiversity from one country by another, have been a key lesson learnt from this project. The issues were discussed in the October 2005 HYR. In summary, this project is trying to use framework within Argentina's biodiversity strategy, which is still being developed. Nevrtheless, Argentina has never given any reason to suppose that permission will not be given. However, it is still very frustrating for the project collaborators to not be able to continue with the implementation of this exciting and groundbreaking project.

The main outputs from this year (05/06) of the project, given in the table below.

Project Outputs	**Method of Evaluation**	**Current Status**
Update of project website http://www.cabi.org/projectdetail.asp?Heading=Projects&projid=63	Web page accessible on-line.	Completed
Screening of sunflower varieties with rust	Report produced by IBC and submitted to IEIB	IEIB issued permit for trial release
Establishment of 3 permanent sample plots on Jiu-zhou Island for release of rust	Report produced containing the data from the evaluation of the permanent sample plots.	Report on weed status within permanent sample plots under production.
Trial releases undertaken of *Puccinia spegazzinii* on Neilingding and Jiu-zhou Islands, Guangdong, China		Rust was purposely destroyed on Neilingding Island, and did not establish on Jiu-hou Island. More releases pending permission from Argentina.
Workshop held at GEI: Principles and Practices of classical biological control of weeds with pathogens.	CABI has copies of the main PowerPoint presentations. For Workshop Timetable see Appendix III.	
Submission of Proposal to: 1) MoST by CAAS personnel (in collaboration with CABI) 2) Darwin Initiative for Post Project funding for this project 3) CABI Partnership Facility 4) Wetlands and Wildlife Trust to Darwin Initiative for Nepal. (in collaboration with CABI)	Preparation and submission of proposal	1), 3) and 4) funded 2) failed

11. OPTIONAL: Outstanding achievements of your project during the reporting period (300-400 words maximum)

None to date.

Annex 1 Report of progress and achievements against Logical Framework for Financial Year: 2005/2006

Project summary	Measurable Indicators	Progress and Achievements April 2005-Mar 2006	Actions required/planned for next period
Goal*:* To draw on expertise relevant to biodiversity from within the United Kingdom to work with local partners in countries rich in biodiversity but poor in resources to achieve • The conservation of biological diversity, • The sustainable use of its components, and • The fair and equitable sharing of the benefits arising out of the utilisation of genetic resources			
Purpose To develop the capability of exploiting pathogens for the sustainable management of invasive alien weeds in China	SHORT TERM: *Puccinia spegazzinii* (rust) established in the field in China LONG TERM: Mikania weed controlled & conservation areas protected. Conservation authorities adopt classical biological control using fungi as an alternative strategy for the management of alien invasive weeds.	SHORT TERM: Host specificity screening of the rust completed in Beijing and Supplementary Dossier containing the results submitted to Chinese quarantine authority as part of application for release permit. Screening of additional sunflower varieties completed and trial release permit issued. Trial release of rust undertaken.	Rust to be released and established in Guangdong Province, and spread monitored.
Outputs			
1. Chinese scientists & weed control practitioners trained in weed biocontrol with pathogens	1. Scientists visit UK & receive training; workshop held	Workshop for weed control practitioners, in biological control, held in April 2006 at Guangdong Entomological Institute.	
2. Permanent sample plots established & weed impact assessed in China	2. Plots established & methodology agreed with collaborators	Permanent sample plots have been set-up on Jiuzhou Island & are being monitored.	Continue monitoring of plots in preparation for release of rust.

Project summary	Measurable Indicators	Progress and Achievements April 2005-Mar 2006	Actions required/planned for next period
		Data on the ecological-economic loss caused by Mikania on Neilingding Island, has been published in Chinese with English abstract (see Appendix II).	Commission English translation of paper. To be completed by June 2006.
3. Biocontrol agent imported & released in China	3. Permit for import & release applied	Supplementary Dossier (including additional sunflower varieties) on host specificity testing completed and submitted to IEIB. Permission to undertake experimental release provided by IEIB and Guangdong Authorities.	Apply for permission for full release permit from IEIB and Guangdong Authorities. Obtain permission from Argentina to use rust isolate in China.
4. Rust impact studies initiated	4. Methodology agreed with collaborators	Support was provided by UK collaborators (by e-mail & during workshop visit) on the development of techniques for monitoring of the rust in the field, & the establishment of suitable impact methodology.	CABI to continue with providing support.
5. Public awareness campaign implemented	5. Targeted information produced (leaflets, posters, videos); media contacted		The public awareness campaign will be initiated once permission has been obtained for the full release of the rust on mainland China.
6. Results publicised & new project proposal developed	6. Articles/proposals developed	Project proposal to MoST-China successfully obtained by CAAS-CABI. UK staff time supported from the CABI Partnership Facility. Darwin Initiative Post Project Funding applied for (unsuccessful). Darwin Initiative project for Nepal (Lead by	Continue with the development of new project proposals. A national press release will be made in the UK once the rust has been released and has established on mainland China. Project person to attend Chromoleana / Mikania Workshop

Project summary	Measurable Indicators	Progress and Achievements April 2005-Mar 2006	Actions required/planned for next period
		Wildfowl & Wetlands Trust) successful. IBC collaborators developing proposals for Chinese government funding to continue work (discussed at BC workshop) GEI collaborators preparing application for Guangdong Regional Government funding to continue work (discussed at BC workshop). Paper on host specificity screening published in Chinese Journal of Biological Control (Fu *et al.,* 2006) (see Annex 3). Paper on biological control policy framework in China (Ding, in press) prepared for publication (see Annex 3). Book published on invasion ecology and management of Mikania with contributions from Darwin personnel (see Annex 3)	in Taiwan in September 2006. Provide Chinese government policy makers with copies of book *Invasive Alien Plants in Asia: Problems and Solutions.* Edited by ST Murphy, CA Ellison and R Murphy (in press). Prepare scientific papers.

Note: Please do NOT expand rows to include activities since their completion and outcomes should be reported under the column on progress and achievements at output and purpose levels.

Annex 2 LOGICAL FRAMEWORK –Updated October 2005

1. Please enter the details of your project onto the matrix using the note at Annex B of the Guidance Note.

Project summary	*Measurable indicators*	*Means of verification*	*Important assumptions*
Goal: To draw on expertise relevant to biodiversity from within the United Kingdom to work with local partners in countries rich in biodiversity but poor in resources to achieve • the conservation of biological diversity, • the sustainable use of its components, and • the fair and equitable sharing of the benefits arising out of the utilisation of genetic resources			
Purpose To develop the capability of exploiting pathogens for the sustainable management of invasive alien weeds in China.	SHORT TERM: *Puccinia spegazzinii* (rust) established in the field in China LONG TERM: *Mikania* weed controlled & conservation areas protected. Conservation authorities adopt classical biological control using fungi as an alternative strategy for the management of alien invasive weeds.	*Mikania* weed no longer an ecological threat. New proposals employing pathogens as classical biological control agents developed; technical reports, scientific papers and publicity generated.	Government of China does not change current policy on introduction and release of exotic biocontrol agents. China maintains its commitment to the CBD. Assumes political situation in China does not prevent project activities.
Outputs 1. Chinese scientists & weed control practitioners trained in weed biocontrol with pathogens 2. Permanent sample plots established & weed impact assessed in China 3. Biocontrol agent imported & released in China 4. Rust impact studies initiated 5. Public awareness campaign implemented 6. Results publicised & new project proposal developed	1. Scientists visit UK & receive training; workshop held 2. Plots established & methodology agreed with collaborators 3. Permit for import & release applied 4. Methodology agreed with collaborators 5. Targeted information produced (leaflets, posters, videos); media contacted 6. Articles/proposals developed	1. Reports from trainees & in-country institutions 2, 4 & 6 Project report/ scientific papers; proposals submitted 3. Document from CAAS 5. Media broadcasts/ popular articles published	Suitable participants available for training courses Import Licence issued Biocontrol agents perform according to expectations Technology transfer allows the scientists to implement the strategy effectively Media uptake
Activities Training	**Activity Milestones (Summary of Project Implementation Timetable)** **Yr 1**: Inception workshop for all collaborators, China (10 days); two Chinese scientists to visit UK (4 weeks). **Yr3**: Workshop held in China on the principles and practices of classical biological control, run by CABI Bioscience (5 days); new project proposals developed (5 days). **Yr 4**: End of project workshop for all collaborators to discuss results & follow on activities (5 days); finalization of new project proposals (5 days).		
Implementation of biocontrol strategy	**Yr 1**: Permanent sample plots set up in nature reserve, China; weed impact assessed; rust imported into China for completion of additional host specificity screening; dossier submitted to China for release of rust. **Yr 3**: Rust released in Guangdong; establishment and spread monitored. **Yr 4**: Rust spread monitored. **Yr 4**: Impact within sample plots assessed; capacity put in place for long-term monitoring of rust impact.		
Promotion of programme	**Yr 3**: Public awareness campaign implemented in Guangdong; policy maker's awareness campaign implemented Beijing. **Yr 4:** Scientific paper prepared and published; assessment report written for Chinese government policy makers.		

Annex 3 Publications

1)

Analysis of ecological-economic loss caused by weed *Mikania micrantha*on Neilingding Island, Shenzhen, China.

Zhong-XiaoQing; Huang-Zhuo; Si-Huan; Zan-QiJie

Journal of Tropical and Subtropical-Botany 2004 12(2): 167-170

English Abstract: In the investigation of vegetation with invasive weed M. micrantha, 81 sample plots, 10x10 m each, were used to study the plant species, breast height diameter, crown diameter, slope and aspect, and the importance value of each species. The corresponding data obtained from original or secondary forest vegetation were used for comparison. Ecological-economic loss was analysed by methods of market valuations, shadow engineering, opportunity cost, and substitute expense. It is estimated that the economic loss amounts to 4.5-10.13 million yuan for the whole island.

2)

Biology and Host Specificity of *Puccinia spegazzinii*, a Potential Biocontrol Agent for *Mikania micrantha*

FU Wei-dong, YANG Ming-li, DING Jian-quing

Chinese Journal of Biological Control 2006 22(1): 67-72

(Institute of Envitonment and Sustainable Development in Agriculture, CAAS, Beijing 100081, China)

English Abstract: Biology and specificity of *Puccinia spegazzinii*, a potential biocontrol agent of invasive weed, *Mikania micrantha*, were investigated under quarantine greehouse in China. As an obligate parasite with short-cycled autoecious, it completed life cycle on Mikania micrantha, by teliospores and basidiospores. It infected leaves, petioles and other vegetative organs of the host plant infected parts became chlorosis after inoculation for 4-5 d. Twelve to fifteen days later, yellow telia appeared from back of infected leaves. The infected leaves died and/or defoliated. Teliospore was yellow to brown color without dormancy. 72 species of plant, belonging to 29 families, 62 genera, were tested for infection. They were divided into 12 groups in the testing program. *M. micrantha* was used as CK plant in each group. Three replicates were settled. Inoculation method of the pathogen was in line with the sequence and regulation of the Centre for Agriculture and Bioscience International. Result showed that chlorosis spot appeared on *Asparagus cochinchinensis, Eupatorium adenophorum, Elephantopus scaber* and *Helianthus annuus.* However, no mycelium and hostorium were found. It is recognized that the fungus infected *Mikania micrantha* and *M. cordata* in China.

Key words: *Puccinia spegazzini; Mikania micrantha*; biology; host specificity

3)

Invasion Ecology and Management of Alien Weed *Mikania micrantha* H.B.K. (2004)

Wang Bo-sun, Wang Yong-jun, Liao Wen-bo, Zan Qi-jie, Li Ming-guang, Peng Shao-lin, Han Shi-chou, Zhang Wei-yin, Chen Rui-ping.

Science Press, China, 239pp

4)

Chapter 10. Policy Frameworks for the Implementation of a Classical Biological Control Strategy: the Chinese Experience

Ding Jianqing

Invasion Ecology and Biocontrol Lab, Wuhan Botanical Garden, Chinese Academy of Sciences, Wuhan, 430074 China

In: *Invasive Alien Plants in Asia: Problems and Solutions.*
Edited by ST Murphy, CA Ellison and R Murphy (in press).

Annex 4

Darwin Initiative Workshop on Biological Control

Towards sustainable management of invasive alien weeds in southern China: Implementing a biological control strategy for Mikania micrantha

25th -- 28th, April 2006,

Guangdong Entomological Institute

Guangzhou, China

Programme

Day 1: 25th, April

Chairperson: Prof. Han Richou

3:00 Opening Ceremony: {Meeting room at Guangdong Entomological Institute (GEI)}

3:10 Welcoming speech: Professor Guo Mingfang, Director of GEI,

3:20 Speech by Dr. Sean Murphy (CABI)

3:30 Group photo

3:40: Coffee break

4:00 Dr. Sean Murphy (CABI): Invasive species: global issues and the role of CABI and GISP

4:30 Dr. Carol Ellison (CABI): Sustainable management of *Mikania micrantha*: the global experience

5:00 Porf. Tang Wenhua (Institute of Environment and Sustainable Development in Agriculture, CAAS, Beijing 100081, China): The Biology of the rust *Puccinia spegazzinii* and its host specificity testing

Day 2: 26th, April

Chairperson: Dr. Carol A. Ellison

9:00 Han Shichou: (GEI) *Mikania micrantha* and their biocontrol in Guangdong.

9:30 Prof. Li Mingguang (Zhongshan University): Plant community restructuring to control *Mikania micrantha*

10: 00 Coffee break

10:20 Prof. Ye Wanhui (Southern China Botanical Garden): *Mikania micrantha*: Invasion biology and control.

10:40-12:00 Training course and Group discussion

14:30: Field trip to Zhuhai.

Day 3: 27th, April

Field trip to Zhuhai

9:00- Field trip, by boat to Jiuzhou Island

15:00 Back to Guangzhou

Participants of the Workshop:

Dr. Carol Ellison: (CABI)

Dr. Sean Murphy (CABI)

Dr. Zhang Feng (CAAS-CABI Project Office)

Prof. Tang Wenhua (Institute of Environment and Sustainable Development in Agriculture, CAAS)

Dr. Zhangguoliang (Institute of Environment and Sustainable Development in Agriculture, CAAS)

Prof. Guo Mingfang Director of Guangdong Entomological Institute,

Prof. Han Richou Vice Director of Guangdong Entomological Institute,

Prof. Li Liying, Prof. Han Shichou, Prof. Peng Tongxu, Prof. Liu Wenhui, Guangdong Entomological Institute,

Prof. Li Mingguan, Zhongshan University,

Prof. Ye Wanhui, Dr. Shen hao South China Botanical Garden, the Chinese Academy of Science,

Prof. Huang Shoushan, Asociate Prof. Zhang Maoxin, South China Agricultural University

Dr. Zan Qijie, Neilingding-Futian Nature Reserve Bureau of Guangdong.

The postgraduate students from Guangdong Entomological Institute, Zhongshan University, South China Botanical Garden, South China Agricultural University

Presenters at the Workshop