Darwin Initiative – Final Report

*(To be completed with reference to the Reporting Guidance Notes for Project Leaders (http://darwin.defra.gov.uk/resources/reporting/) - it is expected that this report will be a **maximum** of 20 pages in length, excluding annexes)*

Darwin project information

Project Reference	13032
Project Title	Addressing a threat to Caribbean amphibians: capacity building in Dominica
Host country(ies)	Dominica
UK Contract Holder Institution	Institute of Zoology, Zoological Society of London
UK Partner Institution(s)	Fauna & Flora International
Host Country Partner Institution(s)	(1) Forestry and Wildlife Division & (2) Veterinary Services Division, Ministry of Agriculture, Fisheries and Environment, Commonwealth of Dominica
Darwin Grant Value	204,834
Start/End dates of Project	1st April 2005 – 31st March 2008
Project Leader Name	Dr. Andrew Cunningham
Project Website	www.mountainchicken.org
Report Author(s) and date	Dr. Andrew Cunningham & Becki Lawson (IoZ), Mr. Minchinton Burton (FWD) & Dr. Reginald Thomas (VSD)

1 Project Background

Amphibian chytridiomycosis, a fatal fungal disease, is a major cause of amphibian declines and extinctions. During an FFI Darwin project on bushmeat utilisation on Dominica, epidemic mortality of *Leptodactylus fallax* due to chytridiomycosis was detected. The urgent need for the current project, with the aims of building capacity to mitigate, and protect amphibians in the Lesser Antilles from, the threat of chytridiomycosis, was recognised by Government and NGOs within Dominica. The project has established amphibian conservation capacity within Dominica and initiated amphibian population monitoring and disease surveillance on five other islands. Also, a regional disease management plan has been produced.

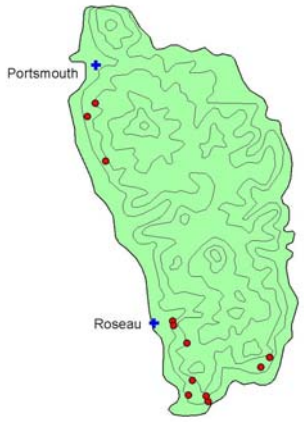

Figure 1. Locations of mountain chicken mortality known to be caused by chytridiomycosis (red dots) and of main towns (blue crosses) on Dominica.

2 Project support to the Convention on Biological Diversity (CBD)

In Dominica, the project has supported the CBD objectives of the conservation of biological diversity and the transfer of relevant technologies. The project has also supported the conservation of biological diversity in other nation states in the Lesser Antilles, in particular in Grenada, St Vincent & the Grenadines and Montserrat, and also in Guadeloupe and Martinique. Through markedly reducing the likelihood of the extinction of *L. fallax* on Dominica, and through awareness raising and changing behaviours that reduce the likelihood of chytridiomycosis being introduced to other Caribbean islands, the project has supported the CBD 2010 target for reducing the rate of biodiversity loss.

The project has also supported the CBD Island Biodiversity thematic programme and the cross-cutting issues of:

- communication, education and public awareness
- identification, monitoring, indicators and assessments
- technology transfer and cooperation

and, to a lesser degree of:

- tourism and biodiversity

Within Dominica, capacity (through both infrastructure and training) was built to meet the CBD objective of the conservation of biological diversity and the transfer of relevant technologies for amphibian conservation. The technology transfer and the capacity built for diagnostics and for population monitoring, however, are transferable to other taxa, thus capacity has been built for biodiversity conservation beyond the specific targets of the project.

The project partners in Dominica are within the same government ministry (Agriculture, Fisheries and the Environment) as Mr. Lloyd Pascal, the Dominican CBD focal point and there was regular and frequent communication between the project partners and Mr. Pascal. Mr. Pascal strongly supported the project and provided some basic equipment to the molecular diagnostic laboratory.

3 Project Partnerships

The initial partnership between the Zoological Society of London (ZSL), the Forestry and Wildlife Division (FWD) and the Veterinary Services Division (VSD) of the Ministry of Agriculture, Fisheries and the Environment, Government of Dominica was sustained, and developed well, over the lifetime of the project. The partnership was initiated at the request of the FWD and the VSD, who made the first approaches to the ZSL, via Fauna and Flora International, for assistance in conserving amphibian biodiversity on Dominica following the emergence of amphibian chytridiomycosis on the island.

At the outset of the project, an MoU was established between the ZSL, the Dominican Ministry of Agriculture, Fisheries and the Environment and the FWD and VSD. Throughout the project, support from the Dominican authorities has been given at a high level, possibly in part because the Head of the VSD at the time the project was conceived had become the Minister of Agriculture, Fisheries and the Environment by the time the project was initiated. By the end of the project, however, a new Minister was in place in this department and a new director was in place in the FWD, but, if anything, support increased during the course of the project. The public awareness-raising aspects of the project might also have helped in this respect, but personal interest and enthusiasm of the FWD and VSD staff was a major contributor to the level of support obtained. Although several set-backs (such as loss of trained personnel or

bureaucratic hold-ups) were experienced during the course of the project, these were overcome largely with the help and support of the Dominican partners.

The partnerships within the UK also developed well during the course of the project. Fauna and Flora International provided staff and expertise for aspects of the fieldwork, namely amphibian population monitoring. Also, links with the London Zoo (within ZSL), Chester Zoo and the Durrell Wildlife Conservation Trust (DWCT) were strengthened: London Zoo and DWCT each hosted Dominican forestry officers to provide animal husbandry training; London Zoo and Chester Zoo each provided staff to visit Dominica for capacity building through training and to assist with the collection of animals to initiate the conservation assurance programme for *L. fallax*. Links were developed between the IoZ and the Dominican partners with DWCT and the Department of Forestry in Montserrat to provide a joined-up approach to mountain chicken conservation. Members of all organisations attended amphibian conservation workshops in Dominica and in Montserrat alike. All UK partners and collaborators worked extremely well together (to the extent that post-project collaboration is continuing) and developed close working relationships with the key staff in Dominica.

In addition, the project work led to the development of new relationships, such as with the Caribbean chapter of the IUCN Amphibian Specialist Group (ASG) and with the University of the West Indies. Both of these organisations became involved via project workshops and both have pledged to continue to work towards the continued success of the project aims and objectives. Also, the ASG has taken on the role of maintaining, and building on, the regional amphibian conservation network established by the DI project.

4 Project Achievements

The main impact of the project has been the assured survival of the mountain chicken frog (*Leptodactylus fallax*). This species is restricted to the islands of Montserrat and Dominica. In Montserrat, the species declined markedly following the loss of approximately two thirds of its habitat with the eruption of the South Soufriere Hills volcano in the mid-1990s. On Montserrat, the species is now restricted to approx. 20 square kilometres and it is still legally hunted. Dominica was regarded as the stronghold for the mountain chicken until chytridiomycosis emerged on the island in 2002 and wiped out at least 80% of the population within 18 months. Now the species is more threatened on Dominica than on Montserrat. The project has helped the survival of the species on both islands. On Dominica, the public awareness campaign has reduced the likelihood of illegal hunting and has boosted government support for mountain chicken conservation. Animals have been brought into captivity and a captive breeding centre has been built on the island. Awareness raising and the development of a regional Management Plan to mitigate the disease spread and impact has reduced the likelihood of chytridiomycosis reaching Montserrat, amongst other islands. Also, early warning disease surveillance activities have been established on Montserrat in collaboration with the project laboratory in Dominica.

These activities also have led to additional support for the termination of the unsustainable harvesting of the mountain chicken for food, and hunting is likely to be made illegal on Montserrat in the near future.

In Dominica, the project has helped to increase national pride in the mountain chicken as a national icon and there are plans by the country's tourism department to erect a statue of the frog at the port of entry for cruise ship passengers and to initiate a mountain chicken festival. The education of tourists and locals of the plight of the mountain chicken and of disease threats to biodiversity will increase once the planned educational centre component of the breeding facility on Dominica is opened. This is awaiting the stocking of the facility with frogs (see 4.3 below).

4.1 Outcomes: achievement of the project purpose and outcomes

The overall purpose of the project was to develop strategies and capacity to minimise the impact and spread of chytridiomycosis within Dominica and other Caribbean islands.

This has been achieved, with the strategies of amphibian population monitoring and disease surveillance, along with in-country rapid diagnostics, in place in Dominica in order to detect if (or when) chytridiomycosis threatens the islands eleutherodactylid amphibians. These strategies are likely too late for the mountain chicken frog, so in-country capacity for captive breeding has been established and this, along with the international fall-back component of the captive breeding programme should help ensure the survival of the Dominican mountain chicken, thus helping to mitigate the impact of chytridiomycosis emergence.

The initiation of amphibian population monitoring and surveillance for the early detection of disease emergence in five other islands will help to mitigate the impacts of disease spread to other islands, but the strategies recommended by the regional management plan to minimise the inter-island spread of disease are most important. These recommendations have been taken very seriously by several islands, including trade organisations, and a new facility for the export of produce is currently under construction in Dominica which will enable many of the biosecurity recommendations to be put into practice.

Additionally, the large amount of public awareness raising within Dominica (which was greater than that originally planned, but which was enthusiastically adopted by the VSD and FWD staff and by the Dominican government information service, amongst others) has led to widespread support for mountain chicken conservation activities, including the hunting ban which was imposed by the government following the emergence of chytridiomycosis.

4.2 Outputs (and activities)

All of the outputs laid out in the logical framework of the original project proposal were achieved, as follows:

The extent and impact of chytridiomycosis on Dominica has been established as far as possible within the limits of a three-year amphibian population monitoring and disease surveillance period. We established that the mountain chicken frog population declined catastrophically, by about 80%, in the 18 months following the emergence of chytridiomycosis. Mountain chicken frogs are no longer either seen or heard during transect surveys, although wild frogs do continue to exist as males can occasionally be heard during the breeding season.

There are three other species of amphibian reported from Dominica: *Eleutherodactylus martinicensis*, *E. johnstonei* and the single-island endemic, *E. amplinympha*. We found it impossible to distinguish between these three species using morphology alone, so we carried out acoustic analyses, comparing calls from different parts of the island (where single species are reported to occur), with those of known *E. johnstonei* and *E. martinicensis* from neighbouring islands. The call of *E. johnstonei* cannot easily be confused with *E. amplinympha* or *E. martinicensis* as the second note of this species' call is narrowband, while the second note of each of *E. amplinympha* and *E. martinicensis* is broadband (Figure 2). Surprisingly, we failed to find evidence of *E. johnstonei* on Dominica, despite lengthy searches and acoustic recording in the places considered the stronghold of this introduced species at two different times of the year: all calls in these areas were of the native *E. martinicensis*.

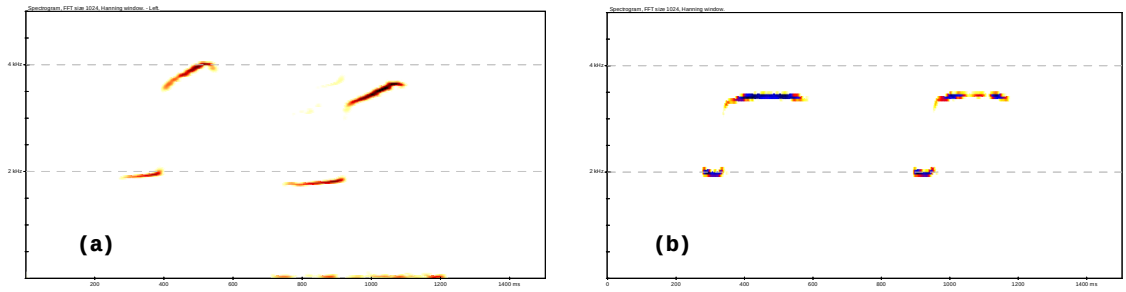

Figure 2. Spectrograms of the advertisement calls of male Eleutherodactylids. (a) Two-note calls of (left side) *E. martinicensis* at a lowland transect and (right side) of *E. amplinympha* at a highland transect in Dominica. (b) Two two-note calls of a male *E. johnstonei* from Montserrat. X axis, time (ms); Y axis, frequency (kHZ).

We found the call of male eleutherodactylid frogs at lowland and highland transects were similar to the published descriptions of the calls of *E. martinicensis* and *E. amplinympha*, respectively. The advertisement calls of *E. amplinympha* and *E. martinicensis* typically consisted of two-notes, though these two-notes were occasionally followed by one to five shorter notes probably functioning as an agonistic signal to conspecific males. The first note of the calls of *E. martinicensis* and *E. amplinympha* are narrowband, whereas the second note is broadband rising from low to high frequency. We found that call frequency appears to be the best metric discriminating between *E. martinicensis* and *E. amplinympha*. Notes produced by *E. martinicensis* are of higher frequency (maximum and minimum frequency, frequency with most energy) than those of *E. amplinympha* (Figure 2). Based on acoustic sampling, *E. amplinympha* probably is the dominant or only species at highland transects and *E. martinicensis* is the only species at lowland transects.

Capacity within the FWD for both amphibian population monitoring and for *Bd* surveillance was established through a combination of class room work, teaching in the field and practical experience. Twenty-two transects were established and visited every two months throughout the year by FWD staff. The transects were split between lowland areas (13 transects, each 250 m in length) where mountain chickens are/were known to exist and highland areas (9 transects, each 100 m in length) where the endemic tree frog *E. amplinympha* lives. Nine of the lowland transects were already established by a previous FFI Darwin project and, prior to the chytridiomycosis epidemic, mountain chicken frogs were regularly sited along these transects. In year 2 of the current Darwin project, however, only one single mountain chicken frog was sited and none were sighted in year three. Taking all years into account, Figure 3 demonstrates the catastrophic nature of the population decline (*N.B.* there was no monitoring between the Darwin projects, *i.e.* between March 2004 and the end of 2005).

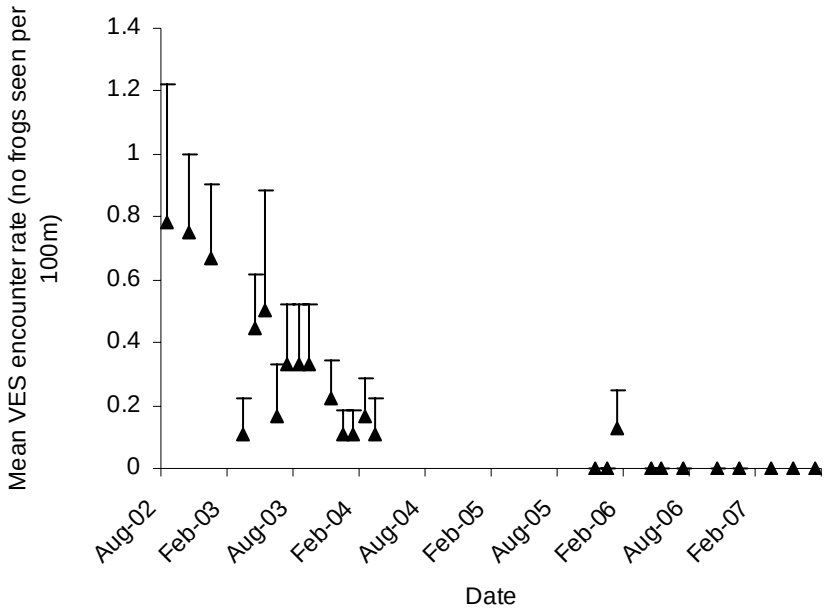

Figure 3. Trends in visual encounter survey (VES) data for the mountain chicken frog on Dominica. Error bars are + 1 standard error.

As can be seen from Figure 4, our transect surveys of *Eleutherodactylus* spp. showed seasonal fluctuations in detectable population sizes, with these being higher in the wet season and lower in the dry season. A similar pattern was detected for both species recorded: *E. martinicensis* and *E. amplinympha*. These are important baseline data for *Eleutherodactylus* spp. population monitoring on Dominica.

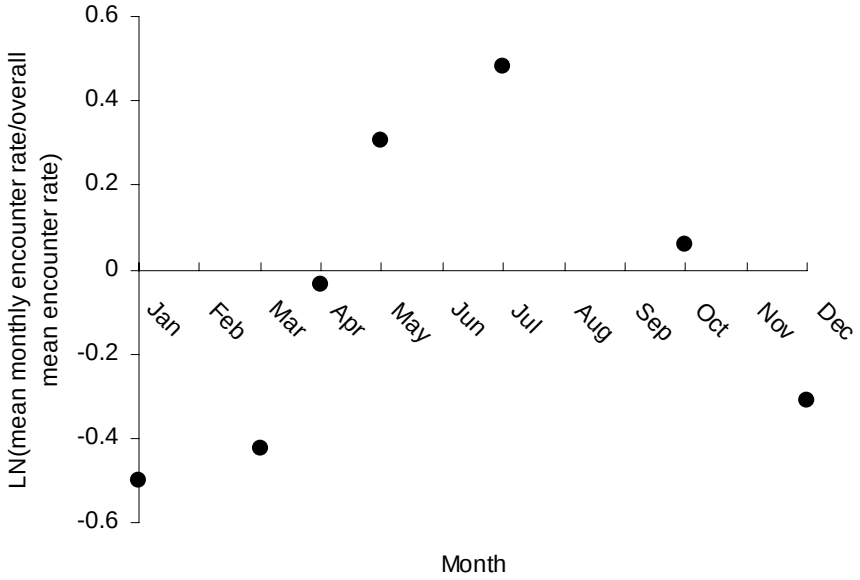

Figure 4. Seasonality in encounter rate of *Eleutherodactylus* species on Dominica.

The extent of infection of amphibians on Dominica with *Batrachochytrium dendrobatidis* (*Bd*), the causative agent of amphibian chytridiomycosis, was established by conducting infection surveillance during population monitoring transects. Eleutherodactylid frogs remained common along all transects throughout the year and 970 were caught and swabbed. *Bd*-positive animals were detected from 12 of the transects, with an overall infection prevalence of 4.8%. Positive frogs were detected in all 13 lowland transects and in five of the nine highland transects,

indicating that the pathogen already is widely spread across the island. Frogs were, however, equally likely to be *Bd*-positive from the highland transects as from the lowland transects, suggesting that there probably are no differences between species susceptibility to infection between the eleutherodactylid species on Dominica. Seasonal differences in infection prevalence were not apparent. Infected eleutherodactylid frogs had no outward evidence of disease, possibly indicating that tree frogs might be acting as reservoir species for *Batrachochytrium dendrobatidis* infection on Dominica.

Environmental sampling along the population monitoring transects was conducted (as an MSc research project) in order to research the possibility of an environmental reservoir of infection. Soil samples and swabbed water pools within bromeliads were collected along each transect in a systematic manner. Testing environmental samples is an expensive process as specialist kits are required to extract DNA before this can be tested for the presence of *Batrachochytrium dendrobatidis* using real-time PCR, so the number of samples tested was limited to five vegetation and five soil samples per upland transect and to six vegetation and six soil samples per lowland transect. Additional funding for this work was provided by the Institute of Zoology, the student and the MSc course. Of 123 bromeliad samples tested, all were negative for the presence of *B. dendrobatidis*, but of 123 soil samples tested, one was positive for the fungus. Unfortunately, although identified as an urgent area for research by the workshop held in March 2006, the hypothesis that *B. dendrobatidis* might be spread within Dominica and to other islands by dirty footwear could not be tested as permission was not granted to carry out this aspect of the proposed study.

The results of the amphibian *Bd* surveillance and the environmental sampling were combined with investigations into the international movements of people and goods for a quantitative risk assessment (which was performed as a second MSc research project) to identify potential routes of spread of *Bd* to other islands in the region. This identified the inadvertent movement of eleutherodactylid frogs in produce exported from Dominica or from other *Bd*-positive countries as the major threat for *Bd* spread to other Lesser Antillean islands.

In addition to the research on chytridiomycosis in Dominica, as a follow-up from the results of the workshop held in March 2006, we developed a collaboration with DWCT and the Department of Environment in Montserrat to investigate the threat of chytridiomycosis to mountain chicken frogs on Montserrat. This work, included taking skin swabs from mountain chickens (n = 319) and *B. marinus* (n = 45), and toe clips from *E. johnstonei* (n = 46) and testing these for the presence of *Bd*. (Additionally, mountain chicken blood serum samples (n = 57) were tested for evidence of exposure to ranavirus (ranavirus disease is a major cause of amphibian mortality in some countries, notably the U.K. and the U.S.A.). No evidence of chytrid infection or of exposure to ranavirus was detected in any of the three amphibian species tested. Therefore, it seems likely that Montserrat is currently free from *Bd*, highlighting the importance of a regional plan to mitigate the spread and impact of the disease in the Lesser Antilles.

Diagnostic capacity for chytridiomycosis detection has been established on Dominica. The Dominican partners purpose-built a stand-alone four-room molecular laboratory for the project and this was equipped using DI monies. VSD staff were trained in DNA extraction techniques and in the detection of *Bd* using PCR. Also, VSD staff were trained in amphibian post mortem techniques and in sampling procedures.

The capacity for a mountain chicken captive breeding programme has been established on Dominica: FWD staff were trained, in the UK, in the captive husbandry of mountain chicken frogs and also in techniques for culturing live food. A captive breeding facility has been constructed in Dominica (in the grounds of the Botanic Gardens, Roseau – Figure 5). An international agreement has been signed by the Dominican Forestry, Wildlife & Parks Division, the Zoological Society of London and the North of England Zoological Society and an international studbook has been established, ensuring that all animals and their offspring will remain the property of the Dominican government.

Figure 5. The final phase of the construction of the mountain chicken breeding facility on Dominca.

Founder animals were caught for an international captive breeding programme and these are now housed at the ZSL (under high biosecurity conditions in order to allow the possibility of re-introduction of offspring). The animals will shortly be moved to a new, biosecure educational facility has been developed at London Zoo to enable zoo visitors to see the mountain chicken frog and to learn about the conservation threats to this species and the importance of the DI-funded project (Figure 6).

Figure 6. The new visitor education and mountain chicken breeding exhibit at London Zoo.

A particular issue with regards to the keeping of mountain chickens in captivity in Dominica is that of food. Mountain chickens have voracious appetites. The commonly cultured *Gryllus* spp. crickets used by zoos throughout the world cannot be used in Dominica as escapees are certain to occur and this would lead to the introduction of alien (and potentially highly destructive) invasive species onto the island. It is heartening, therefore, to be able to report that the culture of locally-caught gryllid crickets which was established during the first year of the project, continues to be active. Initially, the hatching-to-maturity period of these crickets was very long and survival to adulthood was low, but over the course of the project the former has been decreasing and the latter increasing, presumably as the crickets become adapted to captivity and as our husbandry improves. We cannot rely on these crickets alone, however, as other live food items are required for variety and as a back-up if there was a sudden loss of the cricket culture. With funding from the ZSL and Chester Zoo, we have, therefore, employed an experienced herpetologist for one year to work on Dominica full-time as a live food technician to develop a variety of sustainable live food cultures to the extent required for the keeping of mountain chicken frogs and to continue the training of Dominican project staff in this area. Only once the security of food supply is reliable, will mountain chicken frogs be brought into captivity in Dominica. This is a high priority for our post-project activities. A manual of live-food culture has been developed for native Dominican invertebrates to help ensure continuity of food production once the volunteer technician returns to the UK.

A regional Management Plan for the Lesser Antilles has been produced in order to minimise the spread and impact of amphibian chytridiomycosis in the Caribbean. This plan was initially drafted at an international workshop in 2006 and was sent for consultation to the relevant authorities in Dominica and other Lesser Antillean islands. The final plan was drafted at a second international workshop in 2008, incorporating comments and suggestions from the attendees and information from project activities and results. This Plan has been disseminated to the relevant authorities in all 10 island states that were involved in the international workshops that culminated in its production.

Delegates attending these international workshops were also given training in amphibian population monitoring and *Bd* surveillance through a combination of class room teaching and field work.

Following the production of the Regional Plan, Frank Clarke (FFI) spent several weeks touring key (based on amphibian biodiversity) island states to discuss the Plan with government and other authorities and, where applicable, with conservation NGOs. Also, through a series of workshops and field work during these visits, identified personnel were given training (or further training if they had attended the workshops in Dominica) in amphibian population monitoring and *Bd* surveillance. Participants from six islands (Dominica, St Vincent & the Grenadines, Grenada, Martinique, Guadeloupe and Montserrat) are able to implement the Management Plan, including the ability to conduct amphibian population monitoring and surveillance for *Bd* infection.

Within Dominica, the government has budgeted for the continuation of amphibian population monitoring and disease surveillance, including the continued running of the molecular diagnostic laboratory. Funding has been secured from two UK NGOs (ZSL and Chester Zoo) to support the in-country mountain chicken captive breeding programme. This includes the stationing of an experienced UK herpetologist in Dominica for one year – from November 2008 - to support and develop live food culture and mountain chicken captive husbandry.

4.3 Project standard measures and publications

See Annex 4 and Annex 5.

4.4 Technical and Scientific achievements and co-operation

Details of the technical and scientific achievements and co-operation are provided in section 4.3, above.

4.5 Capacity building

Capacity for biodiversity conservation has been greatly increased within Dominica through the establishment of permanent field transects, the building and equipping of a molecular diagnostic laboratory, the building of a mountain chicken captive breeding facility, the associated staff training for these activities and the increased public awareness and government support for wildlife conservation. In particular, the population monitoring skills taught to the FWD staff and the diagnostic techniques taught to the VSD staff are transferable to other biodiversity conservation programmes.

4.6 Sustainability and Legacy

The amphibian population monitoring and disease surveillance aspect of the project has now been subsumed into the routine activities of the FWD staff, so this project achievement is likely to endure for the foreseeable future. Similarly, the running of the molecular diagnostic facility will endure as the VSD is now using the technology gained through the project to conduct additional molecular tests for agricultural disease diagnostics and for food-plant improvement projects. The VSD is keen, however, to continue the amphibian chytrid diagnostic work and to expand the repertoire for the detection of other wildlife disease threats. The Dominican staff who worked on the DI project, therefore, all have continuation of employment within the Ministry of Agriculture, Fisheries and Forestry.

The UK and Dominican partners will continue to work together following the end of the DI project. The ZSL and Chester Zoo are funding the placement of an experienced UK herpetologist in Dominica for one year in order to assist with the provision of a secure food supply and, ultimately, the stocking of the captive breeding facility. The development of the international Dominican mountain chicken conservation breeding programme will mean continued contact between the partners and continued in-country support from the ZSL, Chester Zoo, Durrell Wildlife Conservation Trust and other zoos which take on Dominican mountain chickens as the programme grows.

5 Lessons learned, dissemination and communication

One of the main lessons learned was to identify key in-country trainees and to develop a better system (e.g. legally-binding contract) to ensure that, once trained, they remain in-post at least for the duration of the project. If possible, back-up trainees would be identified in the future to ensure that the departure of one person does not have a disproportionate impact on the running of the project.

Continued close contact/communication with in-country project staff is essential in order to ensure the uninterrupted running of the project. Ideally, there would be a continuous presence of UK staff on the ground, but failing this, frequent visits by UK staff are required, both for training and for moral support and to maintain momentum. Good personal relationships between in-country personnel and UK staff are incredibly important for the success of a project.

Information relating to the project was disseminated internationally via a web site and locally via the distribution of leaflets, including distribution to every school child in Dominica. In addition, a series of presentations was given at each school in Dominica by forestry and/or veterinary staff. The veterinary and forestry staff also discussed the project with locals routinely while carrying out their normal jobs. Numerous newspaper, radio and television articles were broadcast about the project by both UK and Dominican staff throughout the course of the project. Media outputs also occurred on other islands in the region, including several on Montserrat and St Vincent.

The Regional Management Plan has been distributed to the relevant government departments of all states in the Lesser Antilles, to the CBD focal points and also to trade organisations within the Lesser Antilles region.

Dissemination will continue through direct communication with/between government departments; via the IUCN Amphibian Specialist Group and via scientific and popular press publications.

5.1 Darwin identity

The Darwin Initiative was widely and repeatedly publicised during the course of the project, including in newspaper articles and in radio and television broadcasts. The DI logo and acknowledgement of funding was prominent in all project literature, including educational leaflets, and in signage for the captive breeding facility. Equipment in the molecular laboratory is marked with the DI logo.

The DI support was recognised as a distinct project with a clear identity.

The DI is widely recognised and understood within Dominica, from the public through to government ministers and by all workshop attendees from other islands. The Dominican Minister of Agriculture publicly thanked the DI for funding the project in speeches on the occasions of opening the molecular laboratory and each of the international workshops. These speeches were broadcast on national television.

6 Monitoring and evaluation

There were no major changes in the project design, but the schedule for the establishment of the captive breeding programme had to be altered. This was primarily due to a number of bureaucratic difficulties involved with trying to coordinate the acquisition of land and the approval of architects drawings, budget and contractor across three government departments. These difficulties were eventually overcome and the facility built, but the delays had a knock-on effect in delaying other areas of capacity building for the captive breeding programme. However, the most important aspect of the in-country part of this programme is the provisioning of adequate live food, and this also has delayed the progress of captive breeding within Dominica. We are continuing to address this during the immediate post-DI phase (see 4.7 above) as this aspect of the project is extremely important for the continued buy-in of the Dominican public and authorities for the conservation of the mountain chicken.

Monitoring and evaluation of the forestry staff was undertaken during a series of visits by UK staff during the course of the project. These visits included in-field evaluation of the work and class room activities to test the abilities of the project staff. The molecular laboratory staff were similarly tested by UK staff visits and quality control was monitored through the analysis of a subset of duplicate samples in the UK.

6.1 Actions taken in response to annual report reviews

Issues were raised only in the review of the second annual report and, following discussion amongst the partners and collaborators, these issues were addressed during the final year of the project. The reviewer was principally concerned about the ability of the project to meet its aims of strengthening regional capacity. This was partially addressed by the higher attendance of regional governmental and NGO staff at the second workshop on the regional management of chytridiomycosis, than had been the case for the first workshop. In addition, Dr Frank Clarke visited several key island states following the second workshop in order to conduct local training workshops on amphibian monitoring and chytrid surveillance (see 4.3 above). The combination of the regional workshop and the follow-up visits has greatly increased awareness and capacity in the region.

7 Finance and administration

7.1 Project expenditure

CATEGORY	BUDGETED EXPENDITURE (in original proposal)	ACTUAL EXPENDITURE	BALANCE
Rent, rates, heating, overheads etc			
Office costs (e.g. postage, telephone, stationery)			
Travel and subsistence			
Printing			
Conferences, seminars, etc			
Capital items/equipment			
Others			
Salaries			
B. Lawson (ZSL wildlife veterinarian)			
Dr F. Clarke (FFI)			
VSD-veterinarian 1*			
VSD veterinarian 2*			
VSD Lab technician*			
TOTAL			

* Due to local circumstances and regulations, we were unable to pay towards the salaries of VSD staff, therefore we employed a laboratory technician full-time rather than several staff part-time, as had originally been planned. One senior veterinarian spent part of his time on the project, but his salary continued to be paid entirely by the Dominican government.

7.2 Additional funds or in-kind contributions secured

Over the lifetime of the project, additional funds of £73,975 were secured: £53,975 to fund the project in Dominica and £20,000 to fund the project in the UK (for the housing and husbandry of mountain chicken frogs in the ZSL). Also, sponsorship was obtained from private companies in Dominica to fly mountain chicken frogs from Dominica to Antigua (the first leg of their journey to the UK) and to fund signage for the captive breeding facility in Roseau, Dominica. One senior veterinarian (Dr. Reginald Thomas) spent part of his time on the project, but his salary continued to be paid entirely by the Dominican government. The amount of time spent by forestry officers and government veterinarians promoting the project and giving presentations about the project in schools has not been costed, but would have cost a substantial amount had it not been carried out as an in-kind contribution.

7.3 Value of DI funding

Without DI funding, the capacity for amphibian population monitoring, disease surveillance or for the molecular diagnosis of *B. dendrobatidis* infection in Dominica would not have been developed. Perhaps more importantly, without this DI funding, there would not be the high degree of awareness of the threat of chytridiomycosis to amphibians and the potential mitigation measures that should be taken within the Lesser Antilles.

Additionally, the DI funding has enabled the extent of *Batrachochytrium dendrobatidis* infection in Dominica (geographically and taxonomically) to be determined along with the severe degree of the mountain chicken population decline on Dominica and the collection of baseline data for future population monitoring of *Eleutherodactylus* spp. on the island.

Annex 1 Report of progress and achievements against final project logframe for the life of the project

Project summary	Measurable Indicators	Progress and Achievements April 2007 - March 2008	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 constrained 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		The extinction of the mountain chicken frog (*Leptodactylus fallax*) has been prevented through a captive assurance programme and reduced likelihood of disease spread to Montserrat. The survival of amphibian biodiversity in the Caribbean has been strengthened through greater awareness of the need for its conservation and through reduction in the risk of disease spread.	(do not fill not applicable)
Purpose To develop strategies and capacity to minimise the impact and spread of chytridiomycosis within Dominica and other Caribbean islands.	Government of Dominica endorses and participates with in-country capacity building. Representatives of at least 6 Caribbean States endorse and agree to implement the Management Plan to minimise the spread and impact of chytridiomycosis.	Dominica and other countries in the Lesser Antilles have remained signatories to the CBD and are taking their responsibilities for amphibian biodiversity conservation more seriously. There is a gradual increase in political willingness to act on the recommendations from this project and there is currently good political stability in the region.	It is hoped that we can continue our engagement with the relevant government authorities now that the project has come to an end. Funding is in place for this to occur in Dominica for at least one year post-project.
Output 1. Current extent and impact of chytridiomycosis on Dominica established and future impacts and routes of spread predicted.	International and scientific community endorses the research results.	Scientific papers reporting these results are currently in preparation.	

Activity 1.1 transects identified and monthly amphibian monitoring and disease surveillance begun		transects identified and bi-monthly amphibian monitoring and disease surveillance begun
Activity 1.2. possible modes and routes of spread to other islands identified and mitigating measures identified		possible modes and routes of spread to other islands identified and mitigating measures identified
Output 2. Diagnostic capacity for chytridiomycosis detection established on Dominica.	Equipped diagnostic laboratory and trained staff on Dominica. Diagnostic results produced and these verified by international scientific community	Diagnostic laboratory built and equipped. Dominican staff trained in molecular diagnostic methods. Diagnostic results produced. These are being incorporated into scientific papers currently being written – publication in peer-reviewed international journals will provide verification by the international scientific community.
Activity 2.1. PCR diagnostic laboratory on Dominica established, equipped and functioning.		PCR diagnostic laboratory on Dominica established, equipped and functioning.
Activity 2.2. One member of VSD staff trained in PCR diagnostic techniques in the UK; 3 members of VSD staff trained in diagnostic techniques in Dominica		One member of VSD staff trained in PCR diagnostic techniques in the UK; 2 members of VSD staff trained in diagnostic techniques in Dominica.
Activity 2.3. Three members of VSD staff given further training in PCR diagnostic techniques on Dominica		One member of VSD staff given further training in PCR diagnostic techniques on Dominica (staffing issues in the VSD reduced the available number of staff for molecular training to one).
Output 3. Capacity for mountain chicken captive breeding programme established on Dominica.	Presence of captive breeding facility and trained staff on Dominica.	Captive breeding facility built and Dominican staff trained in live food production and in mountain chicken captive husbandry.
Activity 3.1. Captive-breeding facility built and stocked with at least 50 mountain		The captive breeding facility has been built in Dominica, but until security of food supply can be established, this facility will not be stocked.

chicken frogs		
Activity 3.2. captive-breeding attempts for mountain chickens begun		Whilst mountain chickens have yet to be brought into captivity in Dominica, breeding attempts have already taken place in the captive assurance colony in the UK.
Output 4. Management Plan to minimise the spread and impact of the disease in the Caribbean produced and disseminated.	Plan developed and produced collaboratively by participating Caribbean states (10 participants); media events; educational material; popular and scientific publications.	Plan developed and produced by representatives from 10 Caribbean states. Workshops on Dominica, St Vincent, Martinique and Grenada held to promote the Plan and media events held.
Activity 4.1. Training workshop held with at least 10 participants from 6-8 Caribbean islands		Training workshop held with 23 participants from Dominica and one each from three additional islands.
Activity 4.2. Draft management plan to counter threat of chytridiomycosis to Caribbean amphibian fauna produced		A Draft Management Plan was produced and circulated for comments. It was revised during the second international workshop to develop the final Management Plan.
Activity 4.3. Training workshop held on addressing the threat of chytridiomycosis to the Caribbean with at least 10 participants from 6-8 Caribbean islands		Training workshop held with 18 participants from Dominica and one each from 10 additional islands. (The increase in attendance from other islands compared to the first workshop is a testament to the effectiveness of project's awareness raising activities in putting amphibian conservation on the political agenda in the region.)
Activity 4.4. Final management plan to counter threat of chytridiomycosis to Caribbean amphibian fauna published and disseminated to governments of participating, and other, Caribbean islands		Final Management Plan published and disseminated.
Output 5. Participants from six countries able to implement Management Plan.	10 staff from 6-8 countries trained in mitigation of disease spread and impact; email network created.	Staff from Dominica, Montserrat, Grenada, St Vincent, Guadeloupe and Martinique have been trained in amphibian population monitoring, disease surveillance and mitigation measures. In addition, staff from Barbados, St Lucia, Antigua, St Kitts, US Virgin Islands and Trinidad have been trained in mitigation measures. An email network for all participants from these

		countries has been created and this is facilitated by Professor Patricia Burrowes, University of Puerto Rico, through the Caribbean chapter of the IUCN Amphibian Specialist Group, of which Prof. Burrowes is the co-ordinator.
Activity 5.1. Ten representatives of other Caribbean islands able to put into place amphibian population monitoring and chytridiomycosis surveillance programmes on their own islands.		Eight representatives from five other Caribbean islands have been trained to the extent of being able to put into place amphibian population monitoring and chytridiomycosis surveillance programmes on their own islands. Training was given initially on Dominica with follow-up training on each of their own islands.
Output 6. Fundraising strategy developed	Strategy agreed	Strategy discussed with Director of FWD, Chief Veterinary Officer, the Minister of Agriculture, Fisheries and Forestry and with Dominican businesses and philanthropists. This has a promising outlook, but it will take more time before sizeable funding, other than from the Dominican government, is forthcoming.
Activity 6.1. Fundraising strategy developed; funding obtained for sustainability of diagnostic laboratory, captive-breeding programme and for amphibian monitoring and surveillance on Dominica.		Funding has been obtained for the sustainability of the diagnostic laboratory, the captive breeding programme and for amphibian monitoring and disease surveillance on Dominica. The Government of Dominica has agreed to cover the costs of continuing amphibian population monitoring and disease surveillance in Dominica. The ZSL and Chester Zoo have committed funding for the captive breeding programme and, for at least one year post-Darwin funding, for continued engagement with the project in Dominica. In addition, the Grenada, St Vincent, Montserrat and Martinique governments will cover the costs of their respective amphibian population monitoring and will pay a small fee for molecular diagnostics to be undertaken in the Dominican laboratory. It is likely that these costs will be met by an NGO in Guadeloupe. A grant proposal has been submitted to the Darwin Initiative to further develop this work to a larger area and to encompass control and mitigation of invasive species in addition to invasive diseases.

Annex 2 Project's final logframe, including criteria and indicators

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 strategies and capacity to minimise the impact and spread of chytridiomycosis within Dominica and other Caribbean islands.	Government of Dominica endorses and participates with in-country capacity building. Representatives of at least 6 Caribbean States endorse and agree to implement the Management Plan to minimise the spread and impact of chytridiomycosis.	Signed Memorandum of Understanding	Countries retain commitment to CBD. Sufficient political stability to implement strategy.
Outputs Current extent and impact of chytridiomycosis on Dominica established and future impacts and routes of spread predicted.	International and scientific community endorses the research results.	Annual reports; four peer-reviewed scientific papers published and submitted to Darwin Initiative.	
Diagnostic capacity for chytridiomycosis detection established on Dominica.	Equipped diagnostic laboratory and trained staff on Dominica. Diagnostic results produced and these verified by international scientific community.	Annual reports; media releases file; results published in peer-reviewed scientific papers.	
Capacity for mountain chicken captive breeding programme established on Dominica.	Presence of captive breeding facitility and trained staff on Dominica.	Annual reports; media releases file.	Dominican mountain chickens are not extirpated by chytridiomycosis before facility is stocked.
Management Plan to minimise the spread and impact of the disease in the Caribbean produced and disseminated.	Plan developed and produced collaboratively by participating Caribbean states (10 participants); media events; educational material; popular and scientific publications.	Management Plan documentation published and submitted to Darwin Initiative; Media releases file; project web site report; copies of all publications sent to Darwin Initiative.	Participating Caribbean Governments maintain collaboration.
Participants from six countries able to implement Management Plan.	10 staff from 6-8 countries trained in mitigation of disease spread and impact; email network created.	Correspondence; Participants attendance & assessment record; Training reports.	
Fundraising strategy developed	Strategy agreed	Strategy on file at ZSL, FFI & Dominican Government.	

Activities	Activity Milestones (Summary of Project Implementation Timetable)
Conservation and Research programme	Year 1: PCR diagnostic laboratory on Dominica established, equipped and functioning; building of captive-breeding facility underway; transects identified and monthly amphibian monitoring and surveillance begun; possible modes and routes of spread to other islands identified and mitigating measures identified. Year 2: Captive-breeding facility built and stocked with at least 50 mountain chicken frogs; international captive breeding programme established; measures put into place to minimise the risk of chytridiomycosis spreading to other Caribbean islands. Year 3: Extent of spread of chytridiomycosis on Dominica established; impact of disease on amphibian fauna established; captive-breeding attempts for mountain chickens begun; further mitigation against the spread of chytridiomycosis identified and enacted in light of project results.
Training programme	Year 1: One member of VSD staff trained in PCR diagnostic techniques in the UK; 3 members of VSD staff trained in diagnostic techniques in Dominica; 3 members of FWD staff trained in mountain chicken captive husbandry and breeding techniques; 9 members of FWD staff trained in amphibian population monitoring and disease surveillance; Training workshop held with at least 10 participants from 6-8 Caribbean islands. Year 2: Three members of VSD staff given further training in PCR diagnostic techniques on Dominica; 3 members of FWD staff completed further training in mountain chicken captive husbandry and breeding techniques. Year 3: Training workshop held on addressing the threat of chytridiomycosis to the Caribbean with at least 10 participants from 6-8 Caribbean islands.
Management plan development	Year 1: Draft management plan to counter threat of chytridiomycosis to Caribbean amphibian fauna produced. Year 3: Final management plan to counter threat of chytridiomycosis to Caribbean amphibian fauna published and disseminated to governments of participating, and other, Caribbean islands.
Communication and project dissemination	Year 1: Public awareness educational material produced and disseminated within Dominica; communication and surveillance network between Caribbean islands developed; project website launched; dissemination through popular and scientific media. Year 2: Continuation of project website and communication network; dissemination through popular and scientific media and through public awareness educational material. Year 3: Continuation of project website and communication network; dissemination through popular and scientific media; revised public awareness educational material produced and disseminated within Dominica and the Caribbean; ten representatives of other Caribbean islands able to put into place amphibian population monitoring and chytridiomycosis surveillance programmes on their own islands.
Project sustainability	Year 3: Fundraising strategy developed; funding obtained for sustainability of diagnostic laboratory, captive-breeding programme and for amphibian monitoring and surveillance on Dominica.

Annex 3 Project contribution to Articles under the CBD

Project Contribution to Articles under the Convention on Biological Diversity

Article No./Title	Project %	Article Description
6. General Measures for Conservation & Sustainable Use		Develop national strategies that integrate conservation and sustainable use.
7. Identification and Monitoring	50	Identify and monitor components of biological diversity, particularly those requiring urgent conservation; identify processes and activities that have adverse effects; maintain and organise relevant data.
8. In-situ Conservation		Establish systems of protected areas with guidelines for selection and management; regulate biological resources, promote protection of habitats; manage areas adjacent to protected areas; restore degraded ecosystems and recovery of threatened species; control risks associated with organisms modified by biotechnology; control spread of alien species; ensure compatibility between sustainable use of resources and their conservation; protect traditional lifestyles and knowledge on biological resources.
9. Ex-situ Conservation	20	Adopt ex-situ measures to conserve and research components of biological diversity, preferably in country of origin; facilitate recovery of threatened species; regulate and manage collection of biological resources.
10. Sustainable Use of Components of Biological Diversity		Integrate conservation and sustainable use in national decisions; protect sustainable customary uses; support local populations to implement remedial actions; encourage co-operation between governments and the private sector.
11. Incentive Measures		Establish economically and socially sound incentives to conserve and promote sustainable use of biological diversity.
12. Research and Training	10	Establish programmes for scientific and technical education in identification, conservation and sustainable use of biodiversity components; promote research contributing to the conservation and sustainable use of biological diversity, particularly in developing countries (in accordance with SBSTTA recommendations).
13. Public Education and Awareness	15	Promote understanding of the importance of measures to conserve biological diversity and propagate these measures through the media; cooperate with other states and organisations in developing awareness programmes.
14. Impact Assessment and Minimizing Adverse Impacts		Introduce EIAs of appropriate projects and allow public participation; take into account environmental consequences of policies; exchange information on impacts beyond State boundaries and work to reduce hazards; promote emergency responses to hazards; examine mechanisms for re-dress of international damage.
15. Access to Genetic Resources		Whilst governments control access to their genetic resources they should also facilitate access of environmentally sound uses on mutually agreed terms; scientific research based on a country's genetic resources should ensure sharing in a fair and equitable way of results and benefits.

Article No./Title	Project %	Article Description
16. Access to and Transfer of Technology	5	Countries shall ensure access to technologies relevant to conservation and sustainable use of biodiversity under fair and most favourable terms to the source countries (subject to patents and intellectual property rights) and ensure the private sector facilitates such assess and joint development of technologies.
17. Exchange of Information		Countries shall facilitate information exchange and repatriation including technical scientific and socio-economic research, information on training and surveying programmes and local knowledge
19. Bio-safety Protocol		Countries shall take legislative, administrative or policy measures to provide for the effective participation in biotechnological research activities and to ensure all practicable measures to promote and advance priority access on a fair and equitable basis, especially where they provide the genetic resources for such research.
Other Contribution		Smaller contributions (eg of 5%) or less should be summed and included here.
Total %	100%	Check % = total 100

Annex 4 Standard Measures

Code	Description	Totals (plus additional detail as required)
Training Measures		
1a	Number of people to submit PhD thesis	0
1b	Number of PhD qualifications obtained	0
2	Number of Masters qualifications obtained	2
3	Number of other qualifications obtained	0
4a	Number of undergraduate students receiving training	0
4b	Number of training weeks provided to undergraduate students	0
4c	Number of postgraduate students receiving training (not 1-3 above)	0
4d	Number of training weeks for postgraduate students	0
5	Number of people receiving other forms of long-term (>1yr) training not leading to formal qualification(ie not categories 1-4 above)	0
6a	Number of people receiving other forms of short-term education/training (ie not categories 1-5 above)	66
6b	Number of training weeks not leading to formal qualification	46
7	Number of types of training materials produced for use by host country(s)	3 Training Manual on amphibian population survey techniques and disease screening for chytrid surveillance in Dominica. Mountain chicken husbandry guidelines. Manual on livefood culture.
Research Measures		
8	Number of weeks spent by UK project staff on project work in host country(s)	49
9	Number of species/habitat management plans (or action plans) produced for Governments, public authorities or other implementing agencies in the host country (s)	1 Chytridiomycosis management plan for the Lesser Antilles region: minimising the risk of spread, and mitigating the effects, of amphibian chytridiomycosis.
10	Number of formal documents produced to assist work related to species identification, classification and recording.	1 Species identification of Dominica's Eleutherodactylus frogs (Anura:

Code	Description	Totals (plus additional detail as required)
		Leptodactylidae): vocalisations and morphology.
11a	Number of papers published or accepted for publication in peer reviewed journals	1 (with three more in the pipeline)
11b	Number of papers published or accepted for publication elsewhere	0
12a	Number of computer-based databases established (containing species/generic information) and handed over to host country	3 Amphibian population monitoring database Amphibian disease screening database Amphibian post mortem database
12b	Number of computer-based databases enhanced (containing species/genetic information) and handed over to host country	0
13a	Number of species reference collections established and handed over to host country(s)	0
13b	Number of species reference collections enhanced and handed over to host country(s)	0
Dissemination Measures		
14a	Number of conferences/seminars/workshops organised to present/disseminate findings from Darwin project work	8 (including one each in St Vincent, Martinique and Grenada).
14b	Number of conferences/seminars/ workshops attended at which findings from Darwin project work will be presented/ disseminated.	9
15a	Number of national press releases or publicity articles in host country(s)	9, plus press articles in Montserrat, St Vincent and Barbados.
15b	Number of local press releases or publicity articles in host country(s)	0
15c	Number of national press releases or publicity articles in UK	5
15d	Number of local press releases or publicity articles in UK	1
16a	Number of issues of newsletters produced in the host country(s)	0
16b	Estimated circulation of each newsletter in the host country(s)	N/A
16c	Estimated circulation of each newsletter in the UK	N/A
17a	Number of dissemination networks established	1
17b	Number of dissemination networks enhanced or extended	2
18a	Number of national TV programmes/features in	10 in Dominica, plus television coverage in St Vincent of the

Code	Description	Totals (plus additional detail as required)
	host country(s)	workshop held in that country.
18b	Number of national TV programme/features in the UK	0
18c	Number of local TV programme/features in host country	0
18d	Number of local TV programme features in the UK	0
19a	Number of national radio interviews/features in host country(s)	8, plus radio programmes in Montserrat, Barbados and St Vincent.
19b	Number of national radio interviews/features in the UK	0
19c	Number of local radio interviews/features in host country (s)	0
19d	Number of local radio interviews/features in the UK	0
Physical Measures		
20	Estimated value (£s) of physical assets handed over to host country(s)	£68,000
21	Number of permanent educational/training/research facilities or organisation established	2 Molecular diagnostic laboratory Mountain chicken breeding and public education facility
22	Number of permanent field plots established	24
23	Value of additional resources raised for project	£73,975
Other Measures used by the project and not currently including in DI standard measures		

Annex 5 Publications

Type * (eg journals, manual, CDs)	Detail (title, author, year)	Publishers (name, city)	Available from (eg contact address, website)	Cost £
Training manual*	Training manual on amphibian population survey techniques and disease screening for chytrid surveillance in Dominica. B. Lawson & F. Clarke 2005	Zoological Society of London, London	Dr. Andrew Cunningham, Institute of Zoology, Regent's Park, London NW1 4RY	N/A
Leaflet – Saving Dominica's Amphibians	2005, reprinted 2007	Zoological Society of London	www.mountainchicken.org	N/A
Poster – Save the Mountain Chicken!	2005, reprinted 2007	Zoological Society of London	www.mountainchicken.org	N/A
Husbandry Guidelines*	Mountain chicken husbandry guidelines. R. Gibson & K. Buley 2006	Zoological Society of London, London	Dr. Andrew Cunningham, Institute of Zoology, Regent's Park, London NW1 4RY	N/A
Published journal article*	Garcia, G., Cunningham, A. A., Horton, D. L., Garner, T. W. J., Hyatt, A., Hengstberger, S., Lopez, J., Ogrodowczyk, A., Fenton, C. & Fa, J. E. (2007) Mountain chickens *Leptodactylus fallax* and sympatric amphibians appear to be disease free on Montserrat. *Oryx* **41,** 398-401. 2007	Cambridge University Press, Cambridge	Dr. Gerardo Garcia, Durrell Wildlife Conservation Trust, Les Augres Manor, Trinity, Jersey JE3 5BP, U.K. or Dr. Andrew Cunningham, Institute of Zoology, Regent's Park, London NW1 4RY	N/A

Workshop proceedings*	Chytridiomycosis management plan for the lesser antilles region: minimising the risk of spread, and mitigating the effects, of amphibian chytridiomyosis. A. A. Cunningham & B. Lawson 2006	Zoological Society of London, London	Dr. Andrew Cunningham, Institute of Zoology, Regent's Park, London NW1 4RY	N/A
MSc Thesis*	Caribbean chytrid: the threat posed by chytridiomycosis to the mountain chicken (*Leptodactylus fallax*) and other amphibians endemic to the Lesser Antilles D. Horton 2005	University of London, London	Tony Sainsbury, MSc Course Director, Institute of Zoology, Regent's Park, London NW1 4RY	N/A
MSc Thesis*	Chytridiomycosis in the Caribbean: Informing risk assessments and mitigating actions E. Pini 2006	University of London, London	Tony Sainsbury, MSc Course Director, Institute of Zoology, Regent's Park, London NW1 4RY	N/A

Annex 6 Darwin Contacts

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