



## Darwin Initiative Annual Report



**Important note:** To be completed with reference to the Reporting Guidance Notes for Project Leaders:  
it is expected that this report will be about 10 pages in length, excluding annexes

**Submission Deadline: 30 April**

### Darwin Project Information

Project Reference	<b>DPLUS010</b>
Project Title	<b>“Coral Nursery Project in Little Cayman: Enhancing Resilience and Natural Capacity of Coral Reefs in the UKOTs”</b>
Host Country/ies	Cayman Islands
Contract Holder Institution	Central Caribbean Marine Institute (CCMI)
Partner institutions	Cayman Islands Department of Environment, University of Essex
Darwin Grant Value	£41,631
Start/end dates of project	1 <sup>st</sup> April 2013 – 30 <sup>th</sup> March 2015
Reporting period (eg Apr 2013 – Mar 2014) and number (eg Annual Report 1, 2, 3)	April 2013- March 2014. Annual report Number 1.
Project Leader name	Dr Carrie Manfrino
Project website	<a href="http://www.reefresearch.org">www.reefresearch.org</a>
Report author(s) and date	Dr Carrie Manfrino

### 1. Project Rationale

CCMI's project aims to improve the biological diversity and architectural structure of the UKOTs' reefs by establishing the first coral nursery in the Cayman Islands. This conservation project will directly improve the health of the reef ecosystem by multiplying the current wild coral population, providing high-quality habitats for an abundance of fish and invertebrates and seeking new methods to adapt to climate change impacts. By developing local knowledge and capacity, this project aims to establish coral gardening as a viable conservation practice and will develop an outplanting strategy that considers the effects of Ocean Acidification on the local environment.

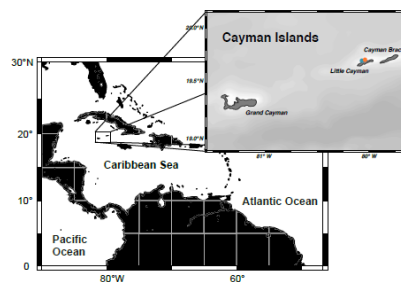
The branching elkhorn and staghorn corals (*Acropora palmata* and *Acropora cervicornis*) were once-dominant large reef-building species in the Caribbean. They are now critically endangered on the IUCN Red List. The demise of this branching coral, which functions as a habitat for fish and invertebrates, has reduced both the structural and biological diversity of Caribbean reefs. Coral nurseries provide an excellent opportunity to enhance these coral species' long-term capacity to recover naturally. The threat of climate change is particularly relevant to these vulnerable species and CCMI seeks to address this within the nursery out planting

methodology, with particular reference to Ocean Acidification. Disentangling why some reefs become degraded while others recover is an opportunity that may resolve significant debates over what conditions will underpin coral reef resilience as climate stress continues. The reef system at Little Cayman provides an extraordinary opportunity to address this challenging debate because it offers a unique example of recovery in the Caribbean region. There are several gaps in knowledge that will need to be addressed to fully understand the key of factors that are responsible for this incredible recovery and the nursery outplanting methodology will be used to test these theories.

This endeavour is the first of its kind to take place within the Cayman Islands, one of the most densely populated UKOTs, which is heavily reliant upon marine tourism. The project therefore seeks to increase coral reef resilience, whilst developing new strategies to support mitigation and adaption to climate change stress.

### Project Overview

This project takes place in the Cayman Islands, where the shallow marine environments of three islands, Little Cayman, Grand Cayman, and Cayman Brac, are protected by a zoned marine park system. The marine protected area system has been in place since 1986 with no-take marine reserves and replenishment zones protecting threatened and harvested species, further supported by environmental zones and wild life interaction zones that regulate tourist interaction with the marine environment. Little Cayman is the



island where the coral nursery is located and a recent positive trajectory in corals at Little Cayman offers a unique opportunity to assess the potential for mitigating local stressors that can underscore coral reef resilience. All three Cayman Islands have the same geographic and oceanographic setting, with deep open ocean water surrounding a double coral reef terrace shelf that extends from sea level to approximately 150 meters in depth. They are flat, low-lying carbonate islands that extend along a tectonic ridge that extends from Cuba to Nicaragua. The islands are positioned 145 km south of Cuba and 320 km northwest of Jamaica (see map, above). Cayman Brac and Little Cayman are small (17 x 2 km) islands located 120 km northeast of Grand Cayman. Little Cayman is 8 km southwest of Cayman Brac (shown in map inset) and has low coastal development pressure with a human population of less than 200.

## 2. Project Partnerships

The CCMI Coral Nursery has been developed and overseen in partnership with the Cayman Islands Department of Environment and specialist partners such as Dr. Diego Lirman of the University of Miami and Dr. David Smith of the University of Essex. This partnership was developed during the pilot phase of the project which preceded this grant (September 2012 – January 2013). The collaboration between these partners has been fully developed during the 2013-2014 reporting period, which is supported through the monthly project updates and concept note development (both of which have been provided as additional evidence attached to this report).

In June 2013, CCMI hosted the second Coral Nursery Workshop with project partners from the Cayman Islands Department of Environment (CIDOE) and advisors from the University of Miami. This important development is further discussed in section 1.1 and 1.3 respectively. The University of Essex and CCMI have also worked closely to develop the climate change and restoration aspect of the project, which will take full effect in year two.

One particular challenge faced by the partnership is attaining government approval for the expansion of the nursery. Due to the novel nature of the project within the country, expansion and the creation of additional nurseries requires the implementation of a new legal framework for coral restoration by the Cayman Islands cabinet. We have faced this challenge by

maintaining frequent and open communication between CCMI and CIDOE, who are in contact with the Cayman Islands cabinet regarding progress on the matter. Both CCMI and CIDOE are confident that a positive outcome will be achieved in due time.

In addition to established partnerships, since the inception of the coral nursery project, CCMI has become a member of the UK Overseas Territories Conservation Forum (UKOTCF). This forum has facilitated communication between CCMI and other restoration practitioners based in the UKOTs and spurred productive discussion about methods, goals, and potential future collaborations. A future goal for CCMI is to host a workshop for those practicing coral restoration in other Caribbean UKOTs. CCMI offers scientifically-informed restoration practices that are currently lacking within much of the Caribbean region, and we aim to improve the science behind restoration and share this knowledge throughout the UKOTs and the wider Caribbean.

The inclusion of both the training and outplanting climate change mitigation and adaptation elements of the project offer a multi-lateral project aim that CCMI is in a unique position to provide. CCMI's climate change and coral reef stress research project contributes to the outplanting methodology that will be fully developed in the 2014-2015 activity of this award. However, we have progressed several key collaborations such as partnerships with Dr Stephen Hetzinger (GEOMAR, Kiel University), Climate Change Policy (Dr Simon Buckle, Imperial College London) and Dr Marguerite Koch (University of South Florida) on a Coral resilience project which will ensure the sustainability of this project. The results from the immediate project will help facilitate recommendations for increased marine protected areas and climate change mitigation strategy in the future. This project is therefore of the highest technical excellence, providing clear and deliverable outcomes.

### **3. Project Progress**

#### **3.1 Progress in carrying out project activities**

##### ***Output 1 - Establish nursery (set-up, maintain, manage and monitor)***

###### ***1.1 Maintain and upgrade nursery structures and assess the nursery year-round, providing biweekly in-situ monitoring of nursery colonies by our conservation coordinator.***

In April 2013, we upgraded the existing pilot nursery by adding two new PVC tree nurseries, each with the capacity to hold 100 fragments of staghorn coral. These tree nurseries received new staghorn colonies resulting from the fragmentation of the existing nursery population in late March and early April, bringing the total number of corals from 58 to 200. In November 2013, an additional fragmentation event occurred, increasing the total number of colonies to 250 and resulting in the creation of 3 additional line nurseries to receive new fragments. Due to the consistent healthy growth of the nursery colonies, biweekly visits were replaced by monthly visits. In each visit, CCMI's Conservation Coordinator checks all colonies for signs of disease, predation, or algal overgrowth, and performs routine cleaning and maintenance of the nursery structures. Photos have been provided of this progress as an attachment to this report, documenting the growth and success of the nursery.

###### ***1.2 Develop management best practices including: refining nursery techniques; managing disease outbreak and natural disaster; and reporting protocol.***

Discussions in the 2013 partner's workshop focused on determining the best methods to return nursery colonies to their natural environment, and the next logical steps required to upscale the nursery project. Project advisors led practical underwater sessions aimed to demonstrate the best techniques for colony attachment while conducting a pilot outplanting effort at two sites in Little Cayman. A total of 66 colonies of staghorn coral were successfully outplanted to Little Cayman reefs as a result of this collaborative workshop.

We have made significant progress in refining nursery techniques through an experiment aimed at maximizing the output of nursery tissue through fragmentation. Our findings suggest that up to 75% of the total linear extension of a nursery-reared colony may be clipped to form several new, 5 cm fragments without any negative impact on survivorship, growth rate, or branching of the parent colony. Fragmenting using this technique will result in the highest possible

productivity for a nursery focused on *Acropora cervicornis*. These results were presented at the 43<sup>rd</sup> Benthic Ecology Meeting in Jacksonville, Florida in March 2014, and are currently in preparation as a scientific manuscript.

To manage disease outbreak, the following two-part protocol has been developed: (1) affected colonies will be moved to a quarantine area at a distance of at least 20 m from both the existing nursery and wild coral colonies, (2) bands of marine epoxy will be placed on affected branches at the disease margin creating a physical barrier to stop the active progression of disease. Alternatively, affected portions of branches may be excised completely from the affected colony and discarded. A proposal to expand the existing nursery is currently awaiting approval by the Cayman Islands cabinet. If approved, this expansion will include a permanent quarantine structure for affected colonies.

In November 2013, a temporary quarantine line was constructed within the nursery to receive colonies displaying tissue loss. One colony became dislodged from its original nursery line and was found loose on the substrate, displaying active tissue loss. The affected colony was moved to the quarantine line and the epoxy band technique was applied. The epoxy band successfully halted the progression of tissue loss, and the remainder of the colony survived and continues to appear healthy.

A natural disaster protocol has also been put in place. In the event of a serious natural threat such as a severe hurricane, a portion of colonies at the nursery will be moved to a deeper site adjacent to the nursery, which would be less impacted by hurricane wave action. Upon cabinet approval of the nursery expansion, sand anchors will be installed at a depth of about 18 m. In the event of inclement weather, entire tree and line nurseries will be removed from their anchors at the nursery site and towed by boat to the deeper contingency site, where they will be reattached to the sand anchors.

The learnings and protocols developed during this project have been established in a concept note. Quarterly reports are also compiled to formally inform all collaborators of project progress. In addition, informal discussions between CCMI and project partners are frequent and focus on problem-solving, increasing efficiency, and new research questions to address in the future.

### *1.3 Quarterly monitoring and reporting of nursery and wild parent colonies to ensure recovery and 6 month reporting as per DEFRA requirements.*

Nursery colonies have been monitored regularly as dictated by output 1.1, and any progress or changes are promptly reported to project partners from CIDOE and the University of Miami. Parent colonies were monitored quarterly for a year beginning immediately after the collection of nursery fragments (September 2012), in order to assess the condition of fragmentation lesions. All parent colonies recovered fully after 4–6 weeks and continued growing normally. Fragmentation lesions were overgrown by new tissue, and in most cases, new branches started growing on the lesion sites. These observations were communicated to all project partners. In September 2013, quarterly monitoring of wild parents ceased as agreed at the initiation of the project. If any additional collections occur over the course of the project, new parent colonies will be monitored quarterly for a period of one year.

A half-year report was submitted to DEFRA in September 2013, and reporting will continue at 6 month intervals per DEFRA requirements, the CCMI quarterly nursery project reports for partners will also continue as per the grant reporting framework.

## **Output 2 - Develop and implement training programme**

*2.1 Hosts coral nursery workshop with project team and relevant local stakeholders to: disseminate project results; develop coral nursery methodology further; develop outplanting strategy.*

In June 2013, CCMI hosted a workshop for project partners to ensure nursery techniques are agreed upon. This workshop was rescheduled from quarter 4 to quarter 1 to accommodate project partner schedules (there was no change to the budget requirements). DEFRA funding is also allotted to a further workshop which will build on the outcomes of this activity, by hosting a training session for other restoration practitioners in Caribbean UKOTs, tentatively planned for

quarter 2 of the 2014-2015 year. Two participants from the University of Miami, six participants from CIDOE, nine participants from CCMI, and one local volunteer were in attendance. Katie Lohr, CCMI's Conservation Scientist, provided a detailed update on the progress of the coral nursery project to date. Dr. Diego Lirman and Stephanie Schopmeyer of the University of Miami provided an overview of outplanting techniques and provided a hands-on demonstration of outplanting methodology in the classroom. After a group discussion and determination of a plan for outplanting, attendees participated in an in-water tissue collection from the nursery and pilot outplanting at a reef adjacent to the nursery. A total of 31 colonies were outplanted to that site, and a total of 35 colonies were outplanted to an additional site on the south side of the island. Additional outplanting pending government approval. Photographic evidence from the workshops has been attached to this report.

### **Output 3 - Develop outplanting strategy, including climate change mitigation and adaptation studies.**

#### *3.1 Develop and test outplanting strategy inline with local ecology.*

The outplanting strategy developed and implemented during CCMI's second coral nursery workshop involves the use of a transect tape to lay out a 9 x 9 meter grid at an appropriate site. At each meter mark, a masonry nail is installed into bare substrate. A coral fragment is then secured to each masonry nail using a combination of cable ties and marine epoxy. A variety of genotypes is outplanted to each plot to ensure a highly genetically diverse outplanted population which will encourage sexual reproduction.

This method proved to be a simple, inexpensive, and successful method of affixing nursery-reared colonies to the substrate. There were, however, marked differences in survivorship between the two outplanting sites. Further work is planned to determine the physical and biological factors which contribute to site-specific outplanting success. Project developments in April 2014 (outside of the scope of the year 1 annual report) undertaken by members of CCMI, CIDOE, and the University of Miami included a nationwide effort to map the locations of extant wild staghorn coral colonies and collect tissue samples to determine genetic diversity of the surviving population. To date, 75 wild colonies have been mapped and sampled in Little Cayman and Grand Cayman, with the intent to sample an additional 25 colonies in Cayman Brac in the coming weeks. Each project partner was instrumental in the success of this effort: the project was planned by CCMI, expertise and instruction in sampling and preservation techniques was provided by the University of Miami, and permitting and logistical support was provided by CIDOE. The results of this project will have important implications for local restoration of staghorn coral by indicating the level of genetic diversity, and thus resilience, of the surviving population, and also by determining the locations of genetically distinct colonies to provide parent tissue to the nursery. This will ensure that CCMI creates the most complete, genetically diverse nursery population possible. The outcome from this work will be a map of genetic distribution which will be completed by the end of Year 2 (March 2015). Although this outcome is supported by matching funds, it is an important project development and ensures the DARWIN element of the project is sustainable.

### **3.2 Progress towards project outputs**

#### **Output 1**

##### *Establish an Acropora nursery and outplanting system*

Output 1 has been successfully achieved. The CCMI coral nursery in Little Cayman sustains 250 healthy, growing colonies of *Acropora cervicornis*. This represents a nearly 5-fold increase in the amount of colonies present within the nursery in only 19 months. All parent colonies from which collections occurred were monitored and shown to have recovered fully. An outplanting strategy has been developed and implemented, resulting in the successful transplantation of 66 colonies of *Acropora cervicornis* to wild reefs. Although site-specific differences in survivorship were observed among the outplants, this has been deemed to be a result of site selection, not outplanting methodology. The role of site selection will be examined more closely in the



completion of output 3. Project reports, including updates on and photographs of parent colonies, nursery colonies, and outplanted colonies, have been compiled by CCMI on a monthly basis and distributed to all project partners.

## **Output 2**

### *Develop and Implement training programme for local region*

Although output 2 is not yet complete, significant progress toward achieving this goal has been made. In June 2013, CCMI hosted a workshop for project partners to ensure nursery techniques are agreed upon. A concept note was created following this workshop outlining agreed practices and a planned timeline of activities. This concept note was distributed to all workshop participants and project partners in August 2013 and is attached to this report.

Through our membership in the UKOTCF, CCMI has identified restoration practitioners throughout the UKOTs who would be interested in conducting a training session focused on nursery best practices at CCMI. The goal of this session will be to compare successes and challenges across the Caribbean and identify areas for improvement, provide training on new or unique techniques, present project results, and discuss the possibility for developing cross-territory collaborative restoration projects. In April 2014, CCMI initiated Skype discussions between interested parties to develop a concrete plan to effectively execute this session. This training session, to be facilitated by DEFRA funding, is tentatively scheduled for quarter 2 of the 2014-2015 year. Current discussion participants include Dr. Lianna Jarecki and Dr. Graham Forrester of the Guana Island Wildlife Sanctuary in the British Virgin Islands (BVI), Dr. Shannon Gore of The Nature Conservancy in BVI, Mr. Don Stark and Mr. David Stone of the Turks and Caicos Reef Fund, Ms. Marsha Pardee of the Reef Ball Foundation in Turks and Caicos, and Ms. Ann Pienkowski, Ms. Catherine Wensink, Mr. Bruce Dinwiddy, and Mr. Mark Pienkowski of the UKOTCF.

## **Output 3**

Develop outplanting strategy, including investigation of climate change (bleaching and ocean acidification) on *Acropora*, in various habitats

Through discussion with project collaborators and experts in the field, CCMI has developed a plan to conduct outplanting at sites with diverse ocean chemistry to determine differences in outplanting success. With assistance from Dr. David Smith (Essex) graduate student Emma Camp, conducted a series of metabolic studies on a variety of coral species that were abundant inside the reefs where we established good trends for varying pH levels.

Results are currently being analyzed and should be available for integrating into our coral restoration planned for Q3 and 4 2014/15. Fundamentally, we are measuring whether corals that are acclimatized to high ranges of pH will be more capable of calcification in mid-shelf reef zones. This information will assist us in determining which corals (individuals) might be more robust for selection for coral nursery growth.

In February 2014, data collection using the Acoustic Doppler Current Profiler (ADCP) and SeaFET instruments have been deployed at a variety of sites throughout Little Cayman. These instruments will allow us to understand site-specific differences in water flow and pH. Once we have analyzed this oceanographic data, we can select outplanting sites with differing hydrographic conditions, combining this data with the climate change work described above. Outplanting is tentatively planned between October 2014 and May 2015 to avoid compounding outplanting stress with temperature stress in order to get clear signals in the data.

### **3.3 Progress towards the project Purpose/Outcome**

#### **Overall project outcomes:**

*1) Enhance the Cayman Island's capability to protect marine biodiversity and specific coral species' long-term capacity to recover naturally by establishing a productive coral nursery. The nursery will provide more independently growing colonies as a result of outplanting*

*nursery-reared corals, which will encourage a genetically diverse and sexually viable breeding population.*

This outcome has already been successfully achieved at a preliminary level. The Little Cayman coral nursery maintains 250 healthy, growing colonies of *Acropora cervicornis*, and 66 colonies have already been outplanted back to degraded local reefs, immediately improving the structural diversity of the habitat and increasing the abundance of an endangered coral species. By the end of the funding period, we expect to profoundly multiply this outcome. Upon approval by the Cayman Islands cabinet, we will be able to add new structures to our existing nursery, doubling our capacity. This will allow us to collect new wild tissue to increase the genetic diversity of the nursery and the number of colonies within the nursery. Increasing the number of colonies in the nursery will improve CCMI's capacity for outplanting, thus enhancing the capacity of *Acropora cervicornis* to proliferate and reproduce sexually in the wild, improving the resilience of the species.

*2) Increase project partners' and local stakeholders' knowledge and ability to develop reef restoration techniques.*

CCMI has already made achievements toward this outcome by hosting two workshops with project partners from the University of Miami and CIDOE: one on nursery setup and maintenance in September 2012 and one on outplanting in June 2013. The next step to increase the scope of this outcome is to host a workshop for stakeholders throughout the UKOTs in 2014. Through membership in the UKOTCF, CCMI has identified relevant stakeholders involved in restoration throughout the UKOTs and is in the process of planning and scheduling a workshop aimed at comparing successes and challenges across the Caribbean, identifying areas for improvement, providing training on new or unique techniques, presenting project results, and discussing the possibility for developing cross-territory collaborative restoration projects.

*3) Develop climate change mitigation and adaptation techniques to provide a stronger response to threats on the marine environment from increasing climate change impacts such as ocean acidification and coral bleaching.*

CCMI has already made significant progress toward achieving this outcome by initiating hydrographic and oceanographic data collection across Little Cayman Island and by developing the climate change methodology that will link directly to the outplanting strategy. This work is the first step toward achieving this outcome. Once we have identified sites where physical and chemical factors vary significantly, we will outplant colonies to these habitats and monitor their response. This element of the project will build on CCMI's work in partnership with the University of Essex to consider the effects of the metabolic rates in corals and the rates of calcification in highly variable environments. The results from this work will allow us to optimize outplanting sites in order to minimize the impact of climate change on outplants and help the species to survive into the future despite mounting environmental threats.

### **3.4 Goal/ Impact: achievement of positive impact on biodiversity and poverty alleviation**

The CCMI Coral Nursery has therefore been developed to:

Ensure increased protection and conservation for *Acropora cervicornis*, which will directly sustain marine biodiversity in Little Cayman/Cayman Brac;

Provide a training facility for nurseries of this kind on Grand Cayman and Little Cayman (overseen by the DOE), to build resilience capacity within the region;

And present an outplanting methodology that includes climate change mitigation and adaptation strategy for this species.

CCMI's coral nursery project has contributed to achieving this goal by creating a repository for 250 colonies of the endangered staghorn coral, *Acropora cervicornis*. This contributes directly

to increasing the abundance of this endangered species within the Cayman Islands by propagating tissue within the nursery and outplanting new colonies back to degraded local reefs. Outplanting new, healthy colonies will improve the capacity of this species for resilience following disturbances by increasing the abundance and genetic diversity of the population. Once complete, the outplanting methodology we develop will help to optimize the effectiveness of outplanting and long-term survivorship of outplanted *A. cervicornis* colonies throughout the wider Caribbean region.

Whilst this project does not directly impact poverty alleviation, the increased awareness of the threatened coral species and intended outcome to provide higher protection for *Acropora cervicornis* will benefit local biodiversity greatly. To date, over 250 local students have been briefed on the nursery at the station in Little [Cayman](#).

**Comment [C1]:** This might be a stretch, but we could also mention that reef restoration leads to increased habitat for commercially important fish and invert species, supporting the sustainability of local fisheries (and associated incomes).

#### **4. Project support to the Conventions (CBD, CMS and/or CITES)**

The nursery project and above criteria are aligned to policy outlined by the UK government regarding Climate Change in the UKOTs (2008) and Environment and the UKOTs (2012). Small island states have been identified as particularly vulnerable to climate change and the least adaptable (IPCC 4<sup>th</sup> Assessment, 2007). This is reflected by the Cayman Islands Climate Change proposed policy (September 2011), which states the need to:

*"Enhance the resilience and natural adaptive capacity of terrestrial, marine and coastal biodiversity and ecosystems".*

The nursery project has also facilitated increased cooperation with other UKOT conservation groups through participation in the UKOT Conservation Forum. Information sharing across UKOTs will ensure that the best possible conservation practices are used with regard to coral restoration projects and increase cross-territory cooperation and partnership.

This project is unique within the Cayman Islands and has resulted in a policy change being presented to the cabinet, to allow restoration activity to be legalised. Currently, taking corals from the wild is illegal and this has been reconfirmed with the recent passing of the National Conservation Law. The policy seeks to allow endangered coral species to be propagated for conservation purposes. This proposed policy change links directly to the 2012 White paper ensuring the UK Overseas Territories have a better strategic approach to managing their rich environmental assets and the OT Environmental Charter to improve national biodiversity strategies. The climate change management aspect of the project supports the proposed Cayman Islands Climate Change policy (2011) and the OT Environmental Charter 's environmental action plan focus, as the protection of threatened species (or those that respond favourably to climate change) will be identified through the outplanting strategy.

#### **5. Project support to poverty alleviation**

This is not directly applicable to this project.

#### **6. Monitoring, evaluation and lessons**

This project is monitored and evaluated through monthly internal reports which are distributed internally and to project partners. These reports include information on health, growth, and survivorship among parent colonies, nursery colonies, and outplanted colonies, which are supplemented by individual and time-series photos. Positive indicators within internal reports include survivorship, visual signs of health, and positive growth rate values. These reports have recorded the successful growth of the nursery to its current size of 250 healthy colonies.

Through our June 2013 workshop, CCMI and project partners were able to agree on proposed techniques and future project activities. A concept note from this workshop was created and distributed internally and to all project partners and workshop participants. Through this workshop and ongoing discussions with project partners, we learned about what materials tend to work best for attachment within the nursery and for outplanting and have upgraded equipment accordingly (i.e. upgrading cable tie attachments to less obstructive monofilament attachments).



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

N/A

## 8. Other comments on progress not covered elsewhere

The project has benefited from a new element, which includes the genetic testing and distribution mapping of the wild staghorn colonies across all three Cayman Islands. Although this aspect of the project is being funded by additional funding revenues, the outcomes from this activity will be hugely beneficial for the project and the sustainability of the project success.

## 9. Sustainability

2014/15 activities of this project look specifically at the outplanting activity for the coral nursery. Essentially, the exit strategy will involve the nursery being successfully outplanted. To achieve this however, testing of best outplanting conditions will be conducted. The recent 2014 work to establish the genetics of the wild staghorn population has led to increased interest and involvement from the local community, as locals were involved in 'scouting' healthy staghorn colonies for testing. Talks are in place about extending a nursery to Grand Cayman if and when the Cayman Islands Department of Environment feel the project has reached a suitable level of expertise to support an expansion.

The sustainability of the project is also being supported by two important developments – firstly the CIDOE have proposed a policy change to allow coral restoration practice to become legalised in the Cayman Islands (this project operates under a special licence, a copy of which is attached to this report) and secondly, the genetic testing and distribution mapping (as described above) across all three islands will be continued as part of CCMI's monitoring protocol for the future. Both of these developments contribute to more restoration work and better understanding of the natural coral populations, which in turn will support important decision-making at policy level.

## 10. Darwin Identity

The Darwin Initiative already has a fairly high profile in the Cayman Islands through the successful project work undertaken by the Cayman Islands Department of Environment. CCMI runs a full PR campaign throughout the year, including formal communications such as our annual report, website, newsletters (quarterly) and project reporting. We also provide exposure of the Darwin Initiative through our corporate sponsorship support and fundraising support, which is prominent in Grand Cayman and we introduce of 2,500 tourists and 250 students per year to the nursery in Little Cayman. We have attended several international conferences such as the 43<sup>rd</sup> Benthic Ecology Meeting in Jacksonville Florida and the American Geophysical Union meeting 2013.

**Comment [C2]:** Also used the logo in my BEM presentation, is that relevant enough to include here?

## 11. Project Expenditure

**Table 1 project expenditure during the reporting period (1 April 2013 – 31 March 2014)**

Project spend since last annual report	2013/14 Grant (£)	2013/14 Total actual Darwin Costs (£)	Variance %	Comments (please explain significant variances)
Staff costs (see below)				
Consultancy costs				
Overhead Costs				
Travel and subsistence				
Operating Costs				
Capital items (see below)				

Others (see below)				Annual report audit
<b>TOTAL</b>	<b>15,696</b>	<b>15,696</b>	<b>0</b>	<b>Expenditure has matched the proposed budget</b>

**12. OPTIONAL: Outstanding achievements of your project during the reporting period (300-400 words maximum). This section may be used for publicity purposes**

I agree for the Darwin Secretariat to publish the content of this section (please leave this line in to indicate your agreement to use any material you provide here)

This year, we established the Cayman Islands first coral nursery with nearly 100 % coral survival, we outplanted sixty-six nursery-reared fragments of *Acropora cervicornis* to the reef in Little Cayman for the first time in history. The Department of Environment scientists have been involved in establishing new policy and guidelines for expanding restoration as a result of our work. We consider this to be a great achievement, as these colonies are now directly contributing to the improvement of local reefs by providing new structure and habitat for fish and invertebrates, and as they grow will serve as healthy breeding colonies which will potentially result in the recruitment of new juvenile colonies.

We also succeeded in strengthening partnerships with the Cayman Islands Department of Environment and the University of Miami through a productive workshop in June 2013 and created new partnerships with other UKOT restoration practitioners via the UKOTCF.

In addition, we were able to disseminate our project results to the wider scientific community through an oral presentation at the 43<sup>rd</sup> Benthic Ecology Meeting in Jacksonville, Florida in March 2014.

As a result of our membership in the UKOTCF, we have developed a cross-territory initiative to support coral nursery and restoration ecology work through training at CCMI.

## Annex 1: Report of progress and achievements against Logical Framework for Financial Year 2013-2014

Project summary	Measurable Indicators	Progress and Achievements April 2013 - March 2014	Actions required/planned for next period
<p><b>Goal/Impact</b></p> <p>CCMI's project aims to improve the biological diversity and architectural structure of the UKOTs' reefs by establishing the first coral nursery in the Cayman Islands. This conservation project will directly improve the health of the reef ecosystem by multiplying the current wild coral population, providing high-quality habitats for an abundance of fish and invertebrates and seeking new methods to adapt to climate change impacts. By developing local knowledge and capacity, this project aims to establish coral gardening as a viable conservation practice and will develop an outplanting strategy that considers the effects of Ocean Acidification on the local environment.</p>		<p>This project has had a positive impact on biodiversity during the 2013-2014 reporting period by multiplying the abundance of an endangered coral species and returning individuals to the wild, where they have an immediate impact on habitat structure and will have a long-term impact on the success of sexual reproduction and recruitment for this declining species. The project has also amplified this positive impact by sharing successful restoration strategies with local stakeholders through workshops and the scientific community through a conference presentation.</p>	
<p><b>Purpose/Outcome</b></p> <p>The CCMI Coral Nursery has therefore been developed to: Ensure increased protection and conservation for <i>Acropora cervicornis</i>, which will directly sustain marine biodiversity in Little Cayman/Cayman Brac; Provide a training facility for nurseries of this kind on Grand Cayman and Little Cayman (overseen by the DOE), to build resilience capacity within the region; and Present an outplanting methodology that includes climate change mitigation and adaptation strategy for this species.</p>	<p>1) Enhance the Cayman Island's capability to protect marine biodiversity and specific coral species' long-term capacity to recover naturally by establishing a productive coral nursery. The nursery will provide more independently growing colonies as a result of outplanting nursery-reared corals, which will encourage a genetically diverse and sexually viable breeding population.</p> <p>2) Increase project partners' and local stakeholders' knowledge and ability to develop reef restoration techniques.</p>	<p>CCMI has made progress toward the project outcomes with the following activities in Year 1:</p> <ol style="list-style-type: none"> <li>1) Successfully propagated tissue within the nursery to increase the number of healthy colonies from 58 to 250 in 19 months.</li> <li>2) Tested the quarantine and epoxy band method for disease management within the nursery with a successful outcome.</li> <li>3) Successfully outplanted 66 colonies to two reefs in Little Cayman using the grid-and-nail method.</li> <li>4) Hosted two regional methodological workshops for project partners at the University of Miami and CIDOE.</li> <li>5) Initiated discussions with restoration</li> </ol>	<ol style="list-style-type: none"> <li>1) Add new structures to nursery, fragment existing population, and add tissue from new parent colonies to increase the size and genetic diversity.</li> <li>2) Outplant on a larger scale to increase the size and genetic diversity of the outplanted population.</li> <li>3) Building a cross-territory initiative to improve restoration training for practitioners throughout the UKOTs.</li> <li>4) Use ADCP and SeaFET data to determine hydrographically and chemically variable sites for outplanting.</li> <li>5) Outplant to hydrographically and chemically variable sites in order to determine the best sites to outplant in order to avoid stress resulting from</li> </ol>

	3) Develop climate change mitigation and adaptation techniques to provide a stronger response to threats on the marine environment from increasing climate change impacts such as ocean acidification and coral bleaching.	practitioners throughout the UKOTs as a first step toward a cross-territory workshop.  6) Deployed ADCP and SeaFET instruments in order to collect hydrographic and chemical data to determine sites for outplanting in order to determine the role of these site-specific factors in outplant survivorship. This work will be continued through Year 2.	climate change.
<b>Output 1.</b> Establish an <i>Acropora</i> nursery and outplanting system	Nursery is healthy and parent colony is recovering. Any risks have been mitigated.	This output has been fully achieved, and the indicator has been used successfully. The nursery remains healthy, with 95% survivorship and no active signs of disease. All parent colonies have recovered fully.	
Activity 1.1 Collection from parent colonies to populate nursery structures.		During the next reporting period, we will aim to expand the scope of this output by collecting tissue from new, genetically diverse parent colonies to increase the size and genetic diversity of the nursery population. Monitoring of nursery fragments and parent colonies will progress as during the first reporting period.	
Activity 1.2 Monitoring of nursery colonies and parent colonies to ensure continuing health, growth, and recovery and maintenance of nursery structures.		A successful monitoring and reporting protocol has been put in place, indicators including monthly photographic updates and structural techniques being expanded to facilitate coral growth have been developed. A disease protocol has been successfully implemented and the nursery is growing well.	
<b>Output 2.</b> Develop and Implement training programme for local region	A project workshop was hosted in Quarter 2 rather than Quarter 4 which has ensured techniques and expansion of the project are agreed upon. We continue regular contact within the region especially with the CIDOE. We have started discussions with the dive community in coordination with CIDOE.	This output has been achieved, and the indicator has been used successfully. The second coral nursery workshop at CCMI resulted in instruction for local stakeholders at CIDOE and the development of a long-term plan for the nursery between all partners.	
Activity 2.1. Developing and hosting the second coral nursery workshop at CCMI for local project partners at CIDOE and the University of Miami.		During the next reporting period, we will aim to expand the scope of this output by hosting a workshop for restoration practitioners in other UKOTs. Funding permitting.	
Activity 2.2. Develop local training methodology, based on project results and workshop developments.		This is ongoing but the concept note produced in June 2013 is the first initial output to support further training developments.	

Activity 2.3 Facilitate training, based on DOE requirements.	This will be developed in Year 2 of the project	
Activity 2.4 Disseminate results—training notes made available through CCMI's website and project reports.	This is ongoing but all documents produced as per the project partnerships have been made available via CCMI's website and annual/project reports.	
<b>Output 3.</b> Develop outplanting strategy, including investigation of climate change (bleaching and ocean acidification) on <i>Acropora</i> , in various habitats	A successful outplanting strategy will include over half the original nursery fragments being outplanted and remaining healthy. The outplanting will also include climate change mitigation and adaptation strategy.	Significant progress has been made toward achieving this outcome, and we continue to believe that this indicator will be appropriate in determining whether or not the outcome has been achieved. The first step of designing an outplanting strategy for climate change adaptation has been initiated, and the hydrographic and chemical data necessary to leverage this project is currently being collected and analyzed.
Activity 3.1 Develop and test outplanting strategy in line with local ecology.	The June workshop began the outplanting activity. Results will be fed back to the partners for further development, planned for year 2 activity.	
Activity 3.2 Select small number of outplants to be used to test climate change (ocean acidification) variations in habitats relevant to this species, <i>Acropora cervicornis</i> .	The climate work is due to begin in Quarter 1 of Year 2.	
Activity 3.3 Refine outplanting techniques and strategy, then complete on larger scale, including climate change mitigation and adaptation recommendations.	The outplanting work will be fully developed in Year 2	
Activity 3.4 Disseminate results and publish a scientific paper	This final outcome is planned for the beginning of 2015	

## Annex 2 Project's full current logframe

Output ( <i>what will be achieved e.g. capacity building, action plan produced, alien species controlled</i> )	Indicators of success ( <i>how we will know if its been achieved e.g. number of people trained/ trees planted</i> )	Status before project/baseline data ( <i>what is the situation before the project starts?</i> )	Source of information ( <i>where will you obtain the information to demonstrate if the indicator has been achieved?</i> )	Current Status
<ul style="list-style-type: none"> <li>1. Establish an <i>Acropora</i> nursery and outplanting system</li> </ul>	Nursery is healthy and parent colony is recovering. Any risks have been mitigated.	The pilot project results will provide the baseline data, including photography.	Photographic reporting will be provided on a monthly basis	This output has been completed. The nursery is healthy and parent colonies have recovered. Photographic reporting to project partners has occurred monthly throughout the entirety of the project.
<ul style="list-style-type: none"> <li>2. Develop and Implement training programme for local region</li> </ul>	A project workshop will be hosted to ensure techniques are agreed upon. This will translate into nursery training within the region for 10 local participants, using local best practice developed by the CCMI team.	Good training tools are available, therefore the project team will establish best practice and any regional differences applicable.	A workshop concept note will be established, followed by training best practice notes which will be available on CCMI's website.	A workshop to ensure techniques are agreed upon was hosted by CCMI in June 2013. A concept note was compiled and distributed following this workshop. Training for 10 local participants using the CCMI team's best practices is tentatively scheduled for quarter 2 2014-2015.
<ul style="list-style-type: none"> <li>3. Develop outplanting strategy, including investigation of climate change (bleaching and ocean acidification) on <i>Acropora</i>, in various habitats</li> </ul>	A successful outplanting strategy will include over half the original nursery fragments being outplanted and remaining healthy. The outplanting will also include climate change mitigation and adaptation strategy.	An outplanting strategy has been informally scoped out but will need further development. CCMI's climate change project has identified habitats that are more vulnerable to climate change impacts (pH in particular) and will be included in the strategic approach.	The outplanted colonies will be monitored bi-weekly and a quarterly report will be issued to stakeholders. Results will be made available on CCMI's website.	CCMI is currently collecting baseline oceanographic data which will be used to develop an outplanting strategy which includes climate change mitigation and adaptation. This output will be developed further in year 2 of the project.





### Annex 3 Standard Measures

Please expand and complete Table 1: new projects should complete the Y1 column and also indicate the number planned during the project lifetime. Continuing project should cut and past the information from previous years and add in data for the most recent reporting period. Quantify project standard measures over the last year using the coding and format from the Darwin Initiative Standard Measures (see website for details: <http://darwin.defra.gov.uk/resources/>) and give a brief description. Please list and report on relevant Code Nos. only. The level of detail required is specified in the Standard Measures Guidance notes under 'definitions' column. Please devise and add any measures that are not captured in the current list. Please note that these measures may not be a substitute for output level objectively verifiable indicators in the project logframe.

**Table 1 Project Standard Output Measures**

Code No.	Description	Year 1 Total	Year 2 Total	Year 3 Total	Year 4 Total	Total to date	Number planned for reporting period	Total planned during the project
6A	Outplanting Training during 2 <sup>nd</sup> Coral Nursery Workshop for CIOE and other CCMI Staff	12						
14A	2 <sup>nd</sup> Coral Nursery Workshop hosted by CCMI	1						
14B	43 <sup>rd</sup> Benthic Ecology Meeting presentation by Katie Lohr	1						
22	Outplant sites at ICON Reef and Coral City	2						
New - Project specific measures								

In Table 2, provide full details of all publications and material produced over the last year that can be publicly accessed, e.g. title, name of publisher, contact details, cost. Mark (\*) all publications and other material that you have included with this report.

**Table 2 Publications**

Type (eg journals, manual, CDs)	Detail (title, author, year)	Publishers (name, city)	Available from (eg contact address, website)	Cost £

#### **Annex 4 Onwards – supplementary material (optional but encouraged as evidence of project achievement)**

This may include outputs of the project, but need not necessarily include all project documentation. For example, the abstract of a conference would be adequate, as would be a summary of a thesis rather than the full document. If we feel that reviewing the full document would be useful, we will contact you again to ask for it to be submitted.

It is important, however, that you include enough evidence of project achievement to allow reassurance that the project is continuing to work towards its objectives. Evidence can be provided in many formats (photos, copies of presentations/press releases/press cuttings, publications, minutes of meetings, reports, questionnaires, reports etc) and you should ensure you include some of these materials to support the annual report text.

Abstract from the 43<sup>rd</sup> Benthic Ecology Meeting, Jacksonville, FL, USA, 19-22 March 2014.

##### **Optimizing the productivity of a coral nursery focused on *Acropora cervicornis* Lohr, K.E.<sup>1</sup>; Bejarano, S.<sup>1</sup>; Lirman, D.<sup>2</sup>; Manfrino, C.<sup>3,4</sup>**

<sup>1</sup> Central Caribbean Marine Institute, Little Cayman Research Centre, North Coast Road, Little Cayman, KY3-2501, Cayman Islands; <sup>2</sup> Rosenstiel School of Marine and Atmospheric Science, University of Miami, 4600 Rickenbacker Cswy, Miami, FL 33149, USA; <sup>3</sup> Central Caribbean Marine Institute, P.O. Box 1461, Princeton, NJ 08540, USA; <sup>4</sup> Department of Geology and Meteorology, Kean University, 1000 Morris Ave, Union NJ 07083, USA. [katielohr@reefresearch.org](mailto:katielohr@reefresearch.org)

The rapid decline of the staghorn coral *Acropora cervicornis* throughout the Caribbean prompted the development of coral gardening as a management intervention to restore wild stocks. Given that coral gardening relies on propagating tissue collected from wild donor colonies, it is imperative to optimize productivity within a nursery to reduce dependence on wild tissue. This study determined the maximum amount of tissue that may be clipped from a donor colony during propagation without causing mortality or decreased productivity. We applied three experimental treatments to 12 nursery-reared staghorn corals, in which 25%, 50%, or 75% of the colony's total biomass was removed to create a number of smaller fragments. Four additional colonies served as unfragmented controls. Treatment had no effect on colony productivity, defined as the ratio of new tissue growth to initial colony size, over 87 days. Similarly, treatment had no effect on the rate at which colonies developed new branches. Results indicate that 75% of the biomass of staghorn colonies may be removed without affecting their growth. We anticipate that our observations will have practical applications for propagation of staghorn coral in nurseries throughout the wider Caribbean while minimizing the impact of this management measure on remnant wild populations.

<http://www.compasscayman.com/whatshot/2013/01/08/Establishing-the-Cayman-Islands%E2%80%99-first-coral-nursery/>

## Checklist for submission

	Check
<b>Is the report less than 10MB?</b> If so, please email to <a href="mailto:Darwin-Projects@ltsi.co.uk">Darwin-Projects@ltsi.co.uk</a> putting the project number in the Subject line.	yes
<b>Is your report more than 10MB?</b> If so, please discuss with <a href="mailto:Darwin-Projects@ltsi.co.uk">Darwin-Projects@ltsi.co.uk</a> about the best way to deliver the report, putting the project number in the Subject line.	
<b>Have you included means of verification?</b> You need not submit every project document, but the main outputs and a selection of the others would strengthen the report.	yes
<b>Do you have hard copies of material you want to submit with the report?</b> If so, please make this clear in the covering email and ensure all material is marked with the project number.	n/a
Have you involved your partners in preparation of the report and named the main contributors	yes
Have you completed the Project Expenditure table fully?	yes
Do not include claim forms or other communications with this report.	