Darwin Plus:
Overseas Territories Environment and Climate Fund
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: 30th April 2017

Darwin Plus Project Information

Project reference	DPLUS045
Project title	Mapping Anguilla's 'Blue Belt' Ecosystem Services
Territory(ies)	Anguilla
Contract holder institution	Cefas
Partner institutions	United Kingdom Hydrographic Office (UKHO), Department of Environment Anguilla (DoE), Newcastle University (NU), Environment Systems Limited (ESL)
Grant value	£271,238
Start/end date of project	1st April 2016 to 31st March 2018
Reporting period (e.g., Apr 2016-Mar 2017) and number (e.g., AR 1,2)	Apr 2016 – Mar 2017
Project leader name	Koen Vanstaen
Project website/blog/Twitter	n/a; Updates through social media Twitter and Facebook
Report author(s) and date	Simeon Archer, Koen Vanstaen

1.   Project overview

Anguilla has one of the largest marine areas in the Eastern Caribbean, spanning over 90,000 km^2, with depths ranging from the shallow nearshore to the abyssal depths of over 7,000 m deep. Managing an area of such size and complexity presents significant challenges in biodiversity and sustainability management. Through the Darwin+ funded Anguilla National Ecosystem Assessment (NEA, DPLUS022) workshops, a need was identified to monitor the coastal habitats and resources, as well as changes in sediment regimes caused by the increased incidence and severity of storm events, predicted under climate change scenarios, which can threaten critical ecosystem services.

An initial characterisation exercise was undertaken as part of the NEA for the nearshore environments using satellite data. However, the scale of the area and complexity of the habitats surrounding the island, and the extensive deeper waters, meant that the sparse records were insufficient to develop a robust baseline of evidence for future monitoring. Basic parameters such as water depth, which also underpins nautical charts for safe navigation, had not been collected since 1859 in large parts of the coastal waters and EEZ.

To meet the requirement for high quality data to inform decision making by Anguilla's Government Departments, modern acoustic survey tools, for collecting information on depth and habitat type, would be used to map important areas and give greater detail in the shallow nearshore environment. Using this in combination with new methods of deriving depth and habitat information from satellite data will not only provide a robust baseline map of the Anguilla's marine

ecosystem services, essential for management, but also a method of monitoring any changes in the future.

A stakeholder led identification of priority areas was followed by data collection undertaken by Cefas in conjunction with the UK Hydrographic Office (UKHO), state-of-the-art multibeam echosounder (MBES) equipment and a local vessel (Figure 1). Information on the habitats and biodiversity was collected using high definition cameras providing photographs and video from the seabed environment. Expertise from project partners Newcastle University and Environment Systems will then be used to blend the in-situ acoustic and video data, with the satellite imagery (and derived products), to produce island wide outputs describing the habitats and ecological communities around the island.

Training and capacity building in the first project year focussed on developing understanding and experience of survey approaches and tools. In the coming year the focus will be on the use of the data, including processing of satellite data to create satellite derived maps, analysis of groundtruthing data, methods for the production of habitat maps and the use of map outputs in decision making and monitoring.
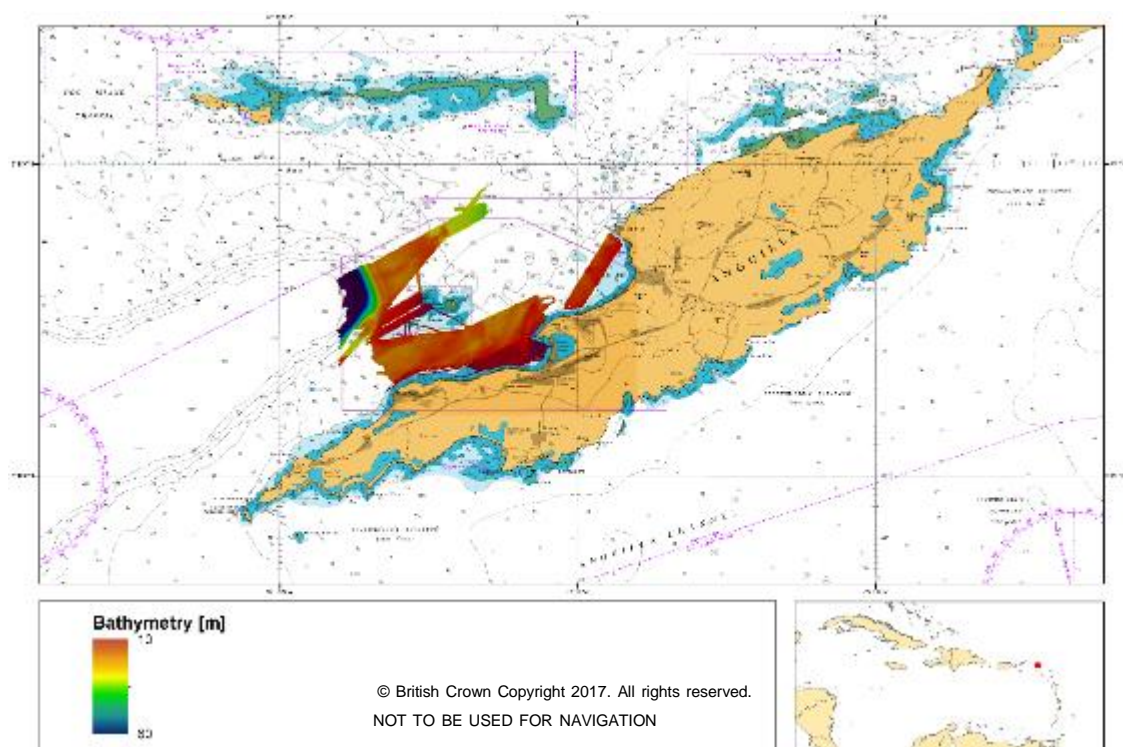

Bathymetry [m]

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NOT TO BE USED FOR NAVIGATION

Figure 1:Overview of Anguilla and the acquired MBES bathymetry.

2.   Project stakeholders/partners

Over the course of the project stakeholder engagement has been key to all decisions taken. Working with our partners at the Anguilla Department of Environment (DoE) we set-up a stakeholder workshop to kick-off the project in June 2016 (Figure 2). The meeting was well attended by representatives from organisations which have a vested interest in the marine activities around Anguilla. Representatives attended from:

- Governor's office
- Department of Environment
- Attorney General's Chambers
- Department of Physical Planning
- Ministry of Infrastructure
- Customs Department
- Anguilla National Trust
- Department of Fisheries and Marine Resources

- Anguilla Air and Sea Port Authority
- Department of Disaster Management
- Anguilla Chamber of Commerce
- Ministry of Health and Social Development
- Department of Lands and Survey
- SOL Petroleum Anguilla

http://theanguillian.com/2016/06/uk-government-funding-marine-project-in-anguilla-cost-price-270-000-about-ec1-million/

Figure 2: Photo taken at the stakeholder kick-off meeting and published in 'The Anguillian' newspaper for their article about the project and meeting. The photo includes the project team, the Governor of Anguilla and Minister of Home Affairs.

The stakeholder meeting was opened by Her Excellency, the Governor of Anguilla, Christina Scott and the Honourable, Cora Richardson-Hodge, Minister of Home Affairs, Immigration, Labour, Cultural Affairs, Youth Affairs, Human Rights, Gender Affairs, Constitutional Affairs, Information and Broadcasting. After the formal launch of the project, the meeting was devoted to engaging with the stakeholders and identifying what their interests are in the marine environment. With the aims of the project in mind, the group gathered around several maps of Anguilla and were asked to mark priority areas for their organisations. Using this information, it was possible to identify where the priorities of the organisations overlapped. Consensus was reached at the meeting that priority areas for hydrographic surveying would be Road Bay and Crocus Bay, while efforts to map habitats should be concentrated around Sandy Island and The Cays.

During survey operations members of the project team from Cefas and UKHO worked closely with partners from the DoE, Department of Lands and Survey and the Department of Fisheries and Marine Resources. This collaboration gave us the local information needed to undertake a successful survey programme, while being able to transfer knowledge on our survey techniques, strategies, and implementation to local organisations. Future training sessions are planned during the second project year to build capacity in using the data and outputs from the project to inform decision making.

The bathymetry data being collected has already been used by the Department of Fisheries and Marine Resources to locate a wreck, which was dived shortly after being found and is being assessed for its suitability as a deep-water dive site (Figure 3).

https://www.facebook.com/1432746530324893/videos/1758743427725200/

Figure 3: Facebook post on the discovery of the Marva W.

The mid-project stakeholder meeting held in March 2016 gave an opportunity for the project team to update the stakeholders on project achievements to date and for the stakeholders to inform the next phase of work. Discussion at the meeting focused on monitoring of the waters around the island, what data are already collected by the stakeholders and how this can fit together to meet the ever-increasing demands to monitor changes and inform management. The multi-disciplinary nature of this project meant that it brought together a diverse range of stakeholders, which traditionally wouldn't meet (often) or discuss these matters. The benefit of this collaborative approach demonstrated by the project led to lively discussions and a real appetite to work more collaboratively between the different departments.

3. Project Progress

3.1 Progress in carrying out project Activities

The first year of this project to map Anguilla's blue belt ecosystem services has been largely successful, with the project team completing fourteen out of the sixteen Activities planned for the first year of the project. Due to efficiencies identified in the mobilisation of the vessel, Activity 3.2 was brought forward from year two and undertaken immediately after the bathymetric survey to save costs in vessel hire and the significant cost in logistics.

The project kick-off meeting (Activity 1.1 and 2.1) held in June 2016 was very well attended (28 attendees) and opened with speeches from The Governor of Anguilla and the Minister of Home Affairs, Immigration, Labour, Cultural Affairs, Youth Affairs, Human Rights, Gender Affairs, Constitutional Affairs, Information and Broadcasting.[1]. Introductory presentations on data collection, habitat map creation and satellite data were given by the partner organisations to give the stakeholders an idea of what the project is aiming to achieve over the coming two years. The second half of the meeting was then used to get input from the stakeholders on their priorities with regards to the marine environment and what they are hoping the project will achieve for them. Using a table top map exercise, we recorded these priorities geographically and identified areas where stakeholder priorities overlapped. The premise of '*collect once, use many times*' is especially important when it comes to marine data, which is often expensive to collect and was used as the premise for identifying areas which benefitted the most organisations.

In the days following the stakeholder meeting the project team worked with the in-country partners at the DoE to source a suitable vessel for the hydrographic and camera surveys later in the year (Activity 2.2). After visiting several boat yards and agencies, a suitable vessel was found

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[1] http://theanguillian.com/2016/06/uk-government-funding-marine-project-in-anguilla-cost-price-270-000-about-ec1-million/

which could be modified to fit the equipment required to complete the survey. Prices and timings of the survey were agreed between the project team and the vessel manager, and a plan for mobilisation was put in place. Equipment for the survey was shipped to Anguilla from the UK in August 2016 (Figure 4) with the mobilisation of the vessel being undertaken in the last week of August.
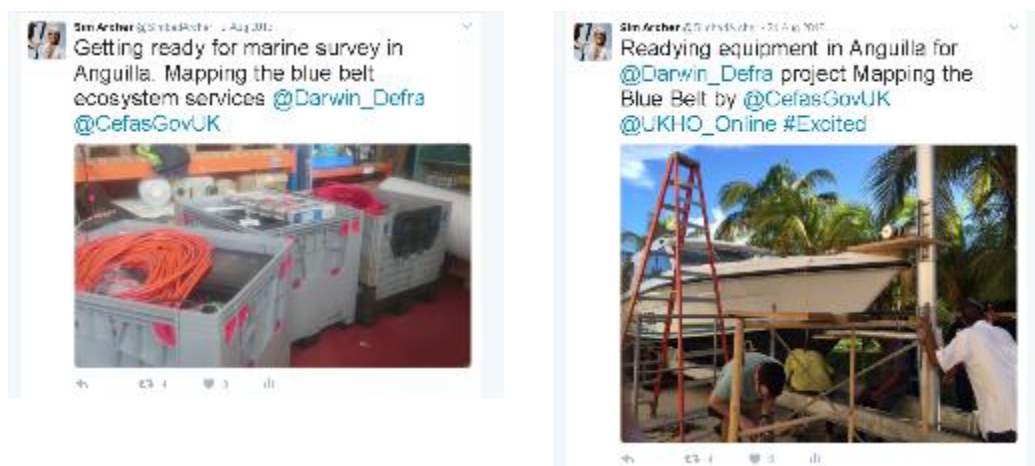

Figure 4: Readying equipment and vessel for the marine surveys in Anguilla.

During the planning stages of the vessel work it was decided to move the ground-truthing survey from year 2 of the project and couple it with the bathymetric survey. This had the advantage of reducing the shipping costs and the costs associated with readying a vessel. In discussion with the project partners it was also decided that the data collected as part of the groundtruthing survey would play a critical role in the development of the satellite derived bathymetry layer (Activity 2.8) which was due to take place towards the end of year one of the project.

With the help of local fabricators, a multi-beam echosounder (MBES) pole was adapted and fitted to the bow of the vessel (Figure 4, right image). From this the MBES system was secured below the waterline. Specialists from the Department of Land and Surveys were trained by the hydrographic surveyors from the UKHO in the precise measuring in of the hydrographic equipment onto the vessel (Activity 1.2). The dimensional control survey gives the precise position of the MBES head and GPS antennas in relation to the centre of the vessel. These offsets are then used by the software to calculate the position of objects on the seafloor to a very high accuracy.

The MBES acoustic survey commenced on 27th August 2016 following a day of vessel and MBES calibrations. The survey initially focused on collecting acoustic MBES data from the area around Road Bay, in particular the main channel running to the south of Sandy Island to the cargo pontoon in Sandy Ground (Activity 2.3). Surveying of the corals around Sandy Island were also undertaken along with a proportion of Crocus Bay and out into the deeper trench like feature to the west of Sandy Island where depths rapidly increase form 15 m to 230 m. The sea conditions during the survey period were at times rough, which meant survey progress was slower than anticipated. The total survey coverage was 14.7 km^2 of high resolution acoustic data (Figure 5).
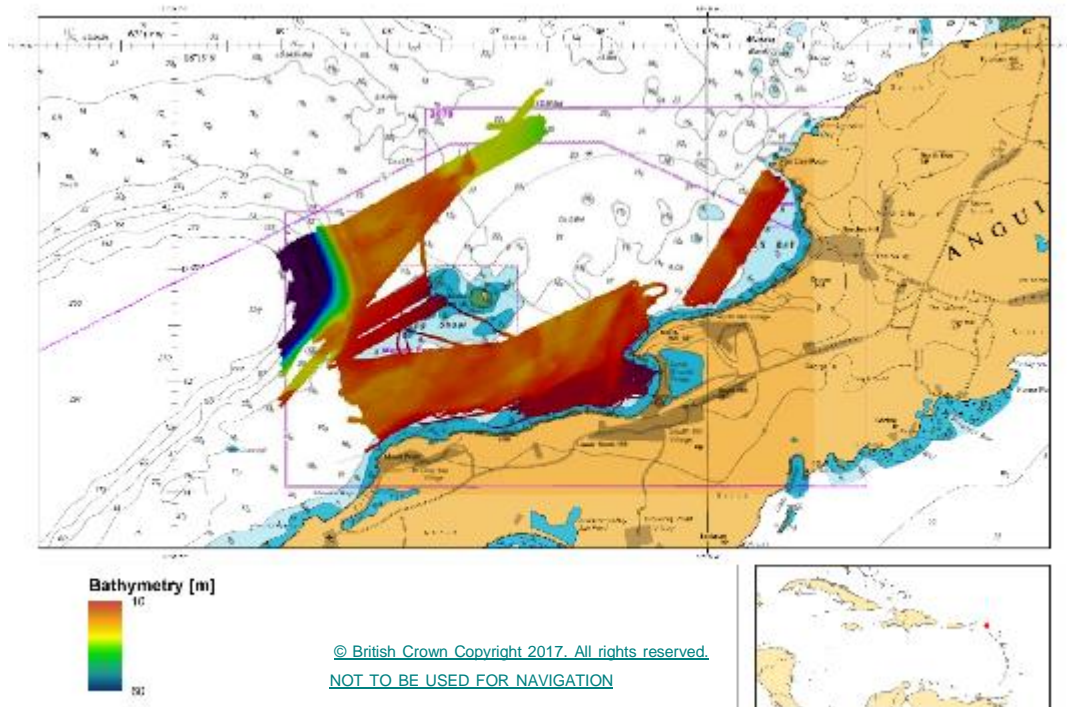
Figure 5: Bathymetry data collected by Cefas and UKHO around Road Bay and Crocus Bay, Anguilla

During the acoustic survey, several wrecks were identified. As well as charted wrecks, several uncharted wrecks were also recorded including the wreck of the *Marva W* which was sunk intentionally in the 1990s, but accidently slipped into deeper water and its final position had never been known since. Coordinates of this wreck and the others found during the survey were passed to the Department of Fisheries and Marine Resources who manage the recreational dive sites and fishery conservation areas, who subsequently dived the *Marva W* the following week to assess the state of the wreck[2].

In addition to standard data processing methods a new piece of software was being trialled during the survey which can automatically process the MBES acoustic data as it is collected; removing artefacts, errors and applying tidal corrections 'on-the-fly'. Typically, the processing of bathymetric data is a long process carried out over a period of weeks and months. The advantage of using this new piece of software is that it allowed the creation of a set of deliverables, although unverified, which could be used to plan the ground-truthing survey for the purposes of habitat mapping in a very short period. This solution also makes the echosounder technology used a lot more accessible where specialist processing skills are not available in the territory. Along with this bathymetry data set, the system produced a backscatter strength layer. Whereas MBES bathymetry is a measure of the water depth, MBES backscatter is a measure of the strength of the acoustic return signal and the amount of the signal strength lost through absorption and backscatter. The strength of the return signal gives an indication of the roughness, slope and intrinsic nature of the seabed and can help in the identification of different substrates and habitats.

Utilising the deliverables from the MBES acoustic survey and with input from local stakeholders, a groundtruthing survey was designed to characterise the different habitats identified from the acoustic data (Activity 3.1). Four primary substrates were identified from the preliminary analysis of the acoustic datasets. Groundtruthing stations were randomly distributed across the four different substrate types with the number of stations being proportional to the area of each substrate type.

The groundtruthing of the acoustic data began on 12th September 2016 using the same vessel as the MBES acoustic survey (Activity 3.2). Using a custom-built drop-camera frame, high

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[2] https://www.facebook.com/1432746530324893/videos/1758743427725200/

definition stills and video data were collected from stations within the area of the acoustic data coverage. A total of 51 groundtruthing stations were completed in the first 4 days of the survey within the area of acoustic data coverage. On review of preliminary satellite imagery analysis, and with input from the DoE and the Department of Fisheries and Marine Resources, additional groundtruthing stations, outside of the acoustic data, were planned to give good spatial coverage around Anguilla in both the inshore and offshore areas to support the satellite imagery based habitat mapping. High definition video and stills data were collected from a total of 152 groundtruthing stations around the island (Figure 6). This represents a substantial increase in the estimated number of stations to be sampled during the proposal stages of this project. With the survey ahead of schedule the project team also collected data at a few stations on the Anguilla Bank where data had never been collected before and which was of particular interest to the Department of Fisheries and Marine Resources.
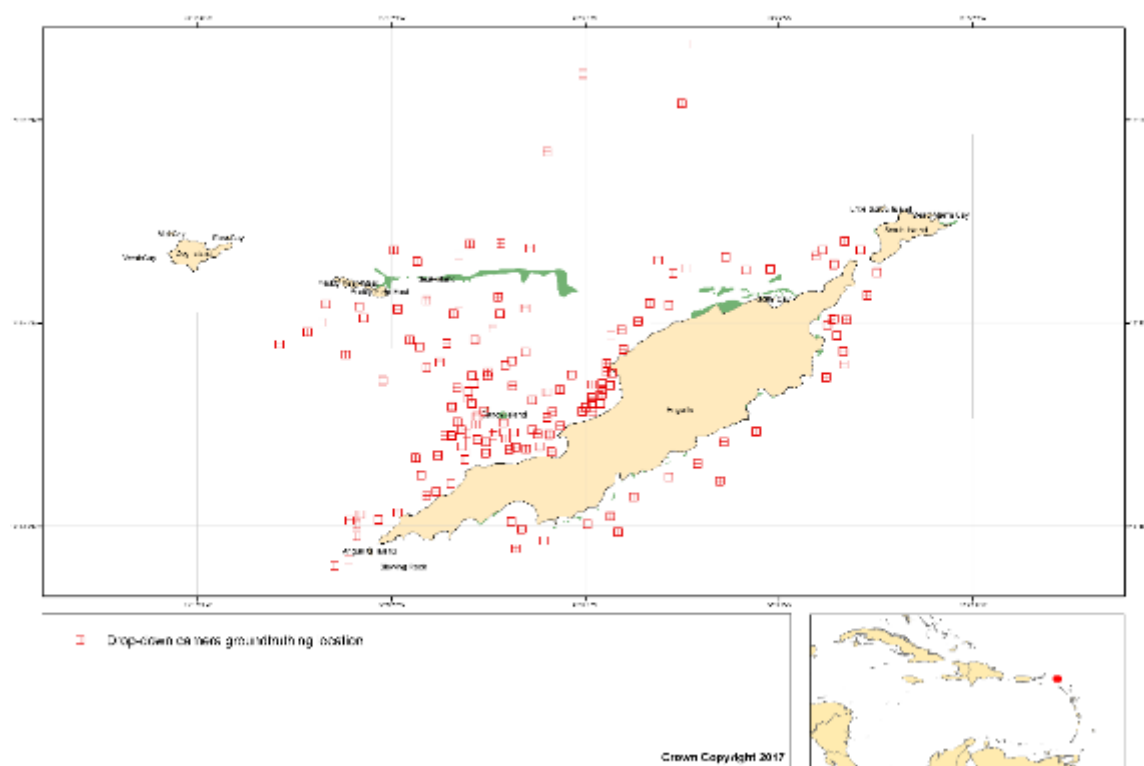
Figure 6: Location of the camera drop-down groundtruthing stations around Anguilla.

The vessel which was chartered for the project was large enough to not only carry the ship's crew and project scientists but also additional representatives. This gave the project team the opportunity to undertake training with members of different organisations on how to plan and implement a ground-truthing survey in aid of habitat mapping and monitoring (Activity 1.3). Representatives from the DoE, Department of Fisheries and Marine Resources and the Anguilla National Trust were able to observe and get involved with the survey operations. Of the 10 days of survey, training was undertaken on 6 of the days (Figure 7). The project team were also joined for one morning by Her Excellency, The Governor of Anguilla and The Honourable Deputy Governor to see first-hand the work undertaken and the underwater species and communities around the island.

Figure 7: Training with the Department of Environment and Anguilla National Trust in Groundtruthing survey planning and undertaking.

After the survey, the equipment and data were returned to the UK. The MBES bathymetric data were handed over the UKHO for processing and quality control (QC) while the MBES backscatter data and video and stills data underwent processing and QC at Cefas (Activity 2.4). The MBES bathymetric data processing involved the review of all the data points collected, with the removal of erroneous points and artefacts. Processing was carried out in Caris Hips and Sips V9.1.5. The data were corrected to local chart datum using locally recorded and modelled tidal data. The corrected and cleaned data set was then validated against the International Hydrographic Organisation (IHO) Standards for Hydrographic Surveys - Order 1a (Special Publication 44, Edition 5) achieving a 99% agreement (Activity 2.5).

Processing of the MBES backscatter data was undertaken by Cefas and was completed in December 2016 (Activity 2.6). The software package QPS FM Geocoder Toolkit (FMGT) was used to produce fully compensated and corrected backscatter mosaic images.

The video and stills photographic data was processed by Cefas, with the video data being cropped to remove water column data and seabed still images undergoing QC. Seabed images were time matched to the positional data collected continuously throughout the groundtruthing survey giving accurate positions (±1 m) of the habitat and species seen on each still image. Further analysis of the video and photographic stills data were started by Newcastle University in November 2016 to be used in the creation of the satellite derived bathymetry maps and habitats maps which are being created in collaboration with Environment Systems.

The creation of the satellite derived bathymetry (SDB) map started in January 2017 with the purchase of a high-resolution Pleiades dataset covering the marine areas around Anguilla (Activity 2.7). Newcastle University and Environment Systems are developing a robust and easily repeatable method of creating a SDB map. The aim is that the method can be used by the local agencies and stakeholders to create full coverage bathymetry and habitat maps easily in the future to monitor changes in sediment distribution and habitat extent, for example following storm events.

Three different methods for creating SDB layers have been trialled (Activity 2.8). The first method described by Stumpf et al. (2003)[3] creates a layer of relative bathymetry which is then compared to real-world bathymetry points derived from MBES and single beam data to create a regression line of actual bathymetries. The second method described by Lyzenga et al (2006)[4] uses multiple regression lines based on the individual bands to derive the absolute depth. These two methods were tested using the Pleiades data with varying success. The third method is a modification of the Stumpf et al (2003) method which does not apply a sun-glint correction to the data before estimating depth. This method, recommended by the IHO, has the advantage of being both

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[3] Stumpf, Richard P., Kristine Holdried, and Mark Sinclair. (2003). "Determination of Water Depth with High-Resolution Satellite Imagery Over Variable Bottom Types." Limnology and Oceanography 48.1 Part 2: Light in Shallow Waters: 547-556.
[4] Lyzenga, David R., Norman P. Malinas, and Fred J. Tanis. (2006). "Multispectral Bathymetry Using a Simple Physically Based Algorithm." IEEE Transactions on Geoscience and Remote Sensing 44.8: 2251-2259

faster and more accurate than the other two methods. The method can also be completed using standard geographic information systems (GIS) which are commonly used by agencies and organisations, including many in Anguilla. Further refinements are required to enhance the accuracy and understand the error involved, however the current data shows that the method is accurate enough for the purposes of ongoing monitoring (Figure 8).
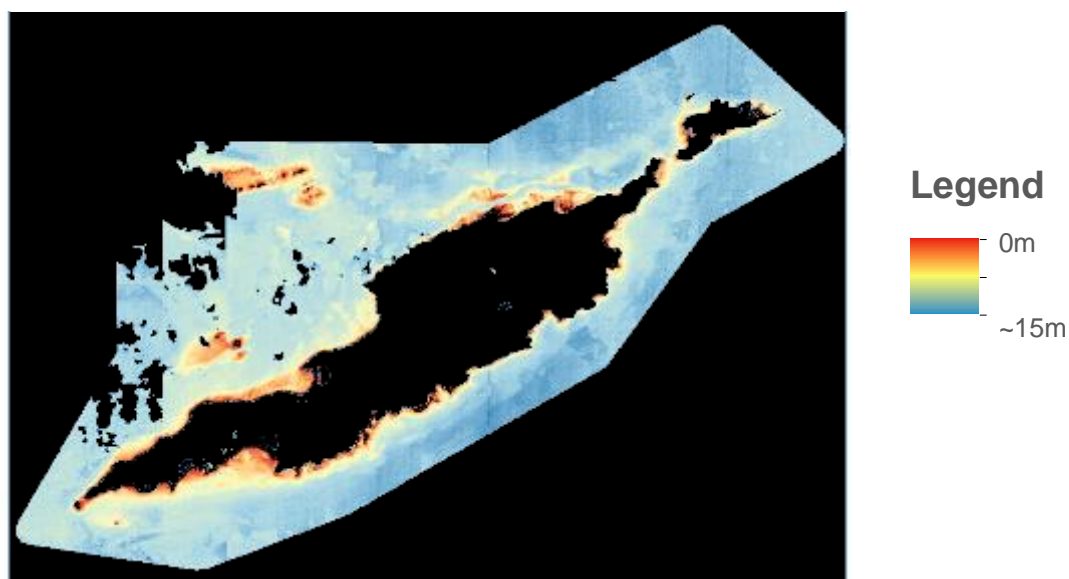

Figure 8: Initial results of the Satellite Derived Bathymetry model derived from the Pleaides Satellite data.

The final analysis of the video and stills data is due to take place in the first quarter of the second year of the project with expert marine ecologists at the University of Newcastle recording species, habitat type and habitat health. These data will then be used in conjunction with the data from the MBES survey and the SDB data to create habitat and substrate maps for most the marine area around Anguilla (Activity 3.4).

3.2 Progress towards project Outputs

1.1. At least 5 days of training opportunities provided during the lifetime of the project on hydrographic and environmental survey techniques, either classroom based or through practical experience.

During the first year of the project the equivalent of 3 days' worth of training in survey planning and implementation has been carried out with representatives of local agencies. This has mostly taken the form of practical training during survey operations. A breakdown of the training given and the agencies involved is given in Table 1.

Table 1: Training given to stakeholder agencies and organisations within the first year of the project.

Training	Agencies	Days	Training Method
Dimensional Control Survey	Department for Lands and Surveys	1	Practical – Shore based
Habitat Mapping Groundtruthing Survey	Department of Environment Department of Fisheries and Marine Resources Anguilla National Trust	2	Practical – on the survey vessel

In the second year of the project further training will be undertaken on the use of the data and outputs, including the processing and creation of satellite derived bathymetry layers to compliment the MBES bathymetry data collected during this project and aid in the monitoring of the marine environment in the future. Training will also be given in interpretation of the groundtruthing data and how these results can be combined with the bathymetry maps to create

habitat maps to quantify the extent of the marine resources. Registers of participants and course completion feedback forms will act as a gauge for the level of engagement and the usefulness in the course for the stakeholders. The feedback forms will also allow us to identify any gaps in the training which can be filled through this project or through later collaborations.

1.2. At least one person attending from each local stakeholder organisation.

During the mid-year stakeholder meeting where the idea of the classroom based training sessions was introduced, there was good enthusiasm from all stakeholders for attending the training sessions. It was impractical to have representative from each agency out on the vessel due to time pressures in completing the survey and concerns over safety with individuals not having previous training in sea survival and vessel safety.

1.3. One DoE staff member participates in researcher exchange, gaining hands-on experience of marine survey

An exchange programme with a member of the Department of Environment is due to take place towards the end of the project, with them participating in an offshore marine protected area survey on board the *RV Cefas Endeavour*. The knowledge gained through this exchange will add to the capability of the Department of Environment, allowing them to plan and implement marine environmental surveys in Anguilla and the surrounding region.

2.1. Deliver at least 10 days (incl. any weather downtime) of high resolution multibeam echosounder surveys in water depths exceeding 15m.

The MBES survey was undertaken in September 2016 with 14 days devoted to the collection of hydrographic data. One day did have to be cancelled due to adverse weather but good data collection was completed on the remining days. A survey report is currently being finalised by the UKHO detailing the mobilisation, daily progress, demobilisation and data processing. The report will be made available to Darwin once finalised and will act as the evidence for the completion of this task.

2.2. Multibeam bathymetry data meets recognised international standards (IHO Order 1a)

The MBES bathymetry data has been validated against IHO standards to be accepted by the UKHO Bathymetry Data Centre. The data achieved a 99% agreement to Standard 1a and a 95% agreement to Special Order bathymetry data meaning the data is very high quality. A full report of the agreement between the data and international standards will be published in the processing report by UKHO and released before the completion of the project.

2.3. Process available satellite imagery to derive a satellite derived bathymetry data layer with 2m resolution for Anguillan coastal waters.

Processing of the satellite bathymetry data is currently being undertaken by Environment Systems and Newcastle University. The purchase of high-resolution Pleiades satellite data (2 m pixel) was made in January 2017 and was followed by the trial of three different methods for deriving bathymetry from the multi-colour images. The trials revealed a method with a high level of accuracy and a relatively simple process to follow. Further work on increasing the accuracy and understanding the errors is required before the final SDB layer is produced and the method is handed over to the other project partners.

3.1. Undertake 5 day video characterisation survey of habitats identified in deeper waters.

After the MBES bathymetric survey 10 days of boat time was devoted to the collection of video and still images groundtruthing data. Only half a day was lost during the ten days due to adverse weather conditions. Daily progress reports were sent to the project partners detailing the number of stations completed each day and any issues with equipment or weather (see Annex 3).

3.2. At least 75% of coastal habitats (<20m) mapped using satellite imagery and habitat map produced from MBES survey area.

The creation of the habitat map of the area is due to happen in Q1 and Q2 of the second year of the project. In collaboration with all the project partners, the data collected during the surveys and created from satellite data will be used to create a habitat layer covering over 75% of the coastal areas around Anguilla.

3.3. Coastal and deeper water habitat data made available to DoE/Anguilla National GIS by end of project and through free online portal.

On completion of the habitat map, all data layers created as part of the project and the methods used to create them will be shared wtih the DoE and the Anguilla National Geographic Information System (GIS) to be used for the purposes of monitoring the coastal habitats around Anguilla. The data will also be made available through online portals including the Cefas Data Hub. The video data has already begun being uploaded to the project YouTube channel where anyone can access the data for interpretation[5].

3.3   Progress towards the project Outcome

With the completion of the majority of Activities within each Output, the project is on target to complete the project outcome of "developing the marine survey capability and data layers to enhance the ability to protect biodiversity and manage the marine environment and its resources sustainably".

All the data required for the completion of the project have been successfully collected during the two vessel-based surveys and the satellite data required for the creation of the SDB layers has been procured. The processing of the MBES bathymetry and backscatter layers has also been complete with the verification of the bathymetry data due to be issued in the first part of year two of the project. The creation and verification of the SDB layer is predicted to be complete in Q1 of the second year of the project. The data will then be brought together using modern techniques for semi-automated habitat mapping to create a map for the coastal areas around Anguilla, producing the first full coverage and high resolution biodiversity baseline map for the island.

The baseline map and the techniques developed through this project will then be disseminated to the project partners at the DoE and other stakeholder organisations on the island through a final stakeholder meeting and training sessions in Q3/Q4 of the final year of the project. This will give the island's agencies the skills and confidence required to develop their own monitoring plan for Anguilla's marine ecosystem services based on a robust baseline assessment.

3.4   Project support to environmental and/or climate outcomes in the UKOTs

The data collected during the first year of the project has given an insight into the extent and quality of the marine environments around Anguilla. This includes sensitive habitats such as seagrass meadows and coral reefs. This information has already been used as part of a campaign by the DoE to highlight the importance of Anguilla's ecosystems. The campaign has included talks, literature and the production of an educational video (Figure 9).

https://youtu.be/hOr6ysXsJSQ

Figure 9: Educational campaign video developed by the Department of Environment, Anguilla, using some data collected by the Darwin+ project.

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[5] https://www.youtube.com/channel/UCZRSjw2xiJIdHdgcCOt7Tkg

The products and techniques which will be delivered at the end of the project will give the DoE and island stakeholders the tools to be able to effectively monitor and manage the environment around Anguilla. The methods being developed to map depths and habitats from satellite data will be packaged into easy to use formats which can be run through standard GIS programmes already being used by agencies in Anguilla. By combining these new techniques with the ongoing monitoring programmes being run by other departments such as the National Trust, Department of Fisheries and Marine Resources and the Maritime Administration, an effective marine resources management plan can be developed in aid of conservation, disaster management and climate change adaptation.

3.5 Monitoring of assumptions

The majority of the assumptions have held true throughout the first year of the project. Weather conditions, which would play a major role in the success of the surveys, were moderate to good throughout both the hydrographic and groundtruthing survey with only 2 days lost. Weather conditions were also good during the overpass of the Pleaides satellite giving good coverage of the inshore areas with a very low proportion of cloud cover. The processing of the satellite data to create the island wide bathymetry model has displayed very promising results (Figure 8) with good correlation occurring between the modelled depths and the actual depths form the bathymetric survey.

Assumptions made with regards to stakeholder engagement have also held true with a great enthusiasm for the project and for continuing the work after the end of the funding period between the various agencies. Interest from local agencies and the press has kept the profile of the project high during the first year (Figure 2).

4. Monitoring and evaluation

Cefas' project management approaches are accredited to ISO9001. As part of this commitment, meetings between project manager and project sponsor occur once a month. This ensures that all elements of the project are under control and discussions take place at an early stage when issues arise.

To date the project has been a success, exceeding the number of survey days originally planned for both the hydrographic and groundtruthing survey. The original scope for the five days of groundtruthing was to just cover the area of hydrographic data coverage. With the additional 100% survey time, data was collected around the whole island increasing the overall impact and robustness of outputs from the project. This increase was achieved by negotiating an excellent daily rate for the survey vessel and accommodation for the survey team.

Bathymetric data was collected and processed to international standards (International Hydrographic Organisation – Standards for Hydrographic Surveys – Special Publication S44 Edition 5) and validated by UKHO bathymetry analyst. The data collected achieved a 99% agreement with IHO Order 1a and 95% agreement with IHO Special Order data quality.

Stakeholder engagement with the project has been extremely good with a very high attendance at the kick-off meeting and continued good attendance at the mid-project stakeholder meeting (Table 2).

Table 2: Attendance of opening and mid-project stakeholder meetings

Meeting	Date	Attendance
Opening Kick-off meeting	June 2016	28
Mid-project Stakeholder meeting	March 2017	20

5. Lessons learnt

What worked well?

During the planning stage of the survey we had anticipated that survey times would be restricted by long shipping times, vessel mobilisation problems and vessel operators potentially not working weekends. We had been told about the limited resources on the island including having no fabrication facilities and limited access to raw materials. These fears were instantly allayed when

the equipment arrived in Anguilla and with the help of our partners at the DoE was rapidly processed by customs and delivered to the boat yard ready for mobilisation. The vessel charter company we worked with were extremely proactive and showed great initiative even though this work was something completely new to them. Mobilisation of hydrographic equipment can be very complicated and needs to be very precise. The work was completed to an extremely high standard and perfect for our survey requirements.

<u>What didn't work well</u>

Several pieces of equipment including the tide gauge suffered under the extreme heat and high salinity conditions. This meant that tidal data had to be estimated based on the results of a permanent tide gauge on the neighbouring island of St Martin. Several parts of the multibeam echosounder equipment were also found to be broken on arrival after shipping back to the UK. In the future provisions will have to be made to source equipment or housings which are able to withstand the tropical conditions and handling during shipping, especially when working in remote locations where spares/other data sources may not be available.

Cefas has incurred costs over and above the project grant due to the extreme currency fluctuations between the British Pound and US Dollar. The surveys were planned at the beginning of June and commitments made. Following the EU Referendum in Britain, currency changes led to cost increases of almost 20%, which the project budget had not accounted for.

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

Not applicable

7. Other comments on progress not covered elsewhere

No further comments to add. Any difficulties have been discussed and no new major risks face the remainder of the project.

8. Sustainability and legacy

The project has had good publicity across the island and is having a positive impact on the stakeholders involved. The kick-off meeting was opened by Her Excellency the Governor of Anguilla and the Acting Chief Minister and Minister of Home Affairs. This was reported on by the local newspapers and through Twitter and Facebook accounts of project partners, as well as local stakeholders. Interest has remained high during the first year of the project with a very good turnout for the mid-project stakeholder meeting.

During the mid-project stakeholder meeting the idea of developing an island wide marine monitoring plan was put to the group. The idea would be to use the products provided by the project partners and focus training sessions on how to develop these products themselves to create a dynamic and robust plan for monitoring the marine habitats and resources. The group was asked to discuss what data they collect on the marine environment and how often. From the discussion a real desire for working together more closely arose and the need for an island wide plan for the marine environment, which will be underpinned by the project outcomes.

The training provided so far has already given members from the DoE, Department of Fisheries and Marine Resources and the Anguilla National Trust the skills required to undertake a marine biodiversity groundtruthing surveys and the training provided to the Department of Lands and Surveys means that they know have the capability to undertake dimensional control surveys on survey vessels, but also on various other ships.

As mentioned in section 3.2, video data has already been uploaded to YouTube to allow stakeholders to use the data for purposes beyond the project aims.

The awareness raised on the importance of high quality data has already had further impacts. This Darwin+ project focussed on spatially limited priority areas to collect navigational chart quality hydrographic data. Building on the contacts and knowledge gained as part of this project, funding became available late in 2016 for the UKHO to undertake a marine Light Detection and

Ranging (LIDAR) survey across the marine areas of the island. This survey was undertaken in February 2017 using aircraft mounted equipment, collecting bathymetry data to a depth of 15 m. The high resolution multibeam echosounder data collected as part of this project will be part of the validation of the LIDAR data, and the LIDAR data can also act as a useful validation tool against the satellite derived bathymetry maps created as part of this project. Due to the prohibitively high cost of performing a LIDAR survey, it is unlikely that repeat surveys will be undertaken as part of future monitoring. Validation of the satellite based methods developed as part of this project, will therefore provide the necessary evidence and confidence as part of the development of an affordable and effective monitoring programme.

Environment Systems and Newcastle University are also involved in ongoing marine and terrestrial surveys and assessments which will contribute to the products of this project, but also mainstream the use of project outputs in management in Anguilla.

9. Darwin identity

The identity of the Darwin Initiative has been at the forefront of all the activities carried out as part of this project. Progress during survey activities and stakeholder engagement has been captured on Twitter and Facebook by both Cefas and stakeholders. Social media engagement has always made clear links to the Darwin Initiative by including @Darwin_Defra (Figure 10). Posters provided for the stakeholder events along with promotional literature have all included prominent branding of the Darwin Initiative (Figure 11).
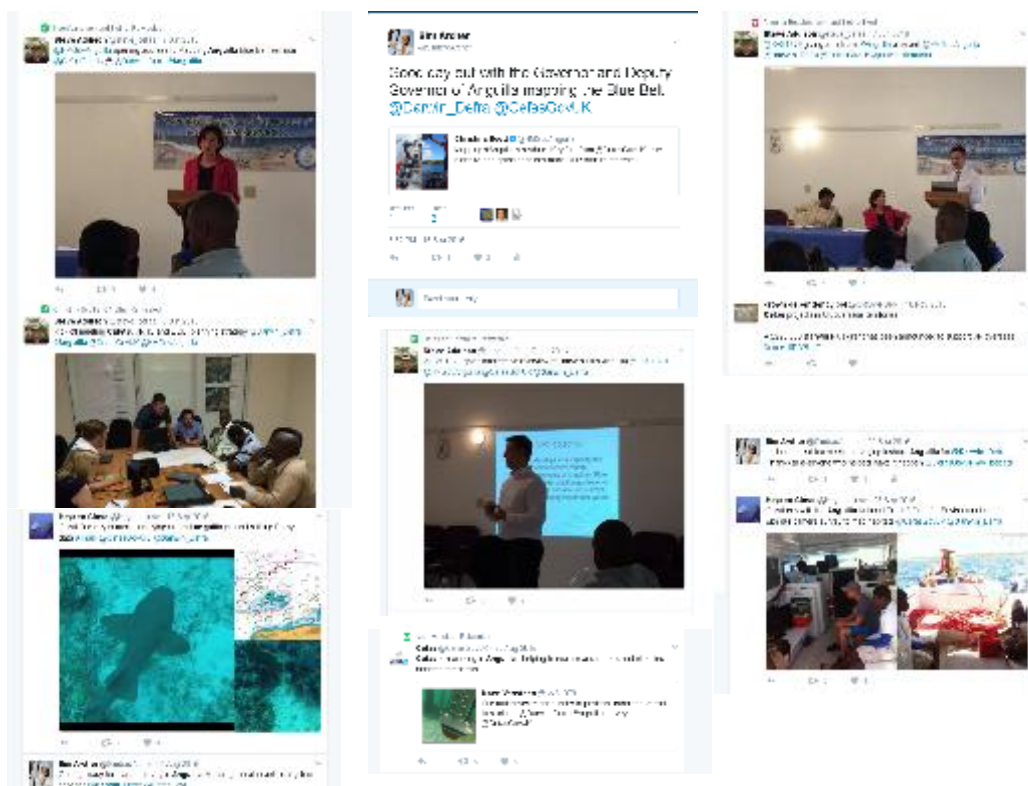

Figure 10: Social media engagement promoting the project and the Darwin Initiative.
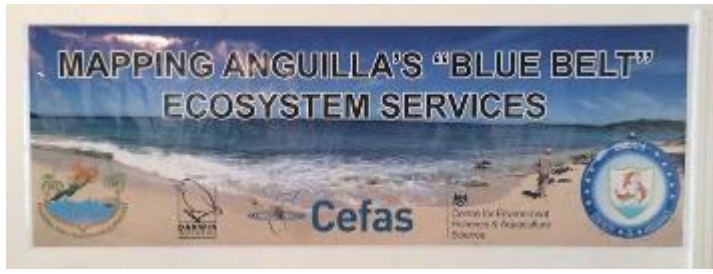
Figure 11: Posters and promotional literature for the project

10. Project Expenditure

Table 1: Project expenditure <u>during the reporting period</u> (1 April 2016 – 31 March 2017)

Project spend (indicative in this financial year	2016/17 D+ Grant (£)	2016/17 Total actual D+ Costs (£)	Variance %	Comments (please explain significant variances)
Staff costs			6%	
Consultancy costs				
Overhead Costs			8%	
Travel and subsistence			-3%	
Operating Costs			-6%	
Capital items				
Others (Please specify)			-26%	The overspend in this category can mostly be attributed to the decrease in the value of GBP against the USD in July 2016. The items in this category were essential to the outcome of the project and spending could not be reduced in this category.
TOTAL	**197,448.00**	**196,298.17**		

Highlight any agreed changes to the budget and **<u>fully</u>** explain any variation in expenditure where this is +/- 10% of the budget. Have these changes been discussed with and approved by Darwin?

Annex 1:   Report of progress and achievements against Logical Framework for Financial Year 2016-2017 – if appropriate

Project summary	Measurable Indicators	Progress and Achievements April 2016 - March 2017	Actions required/planned for next period
Impact To provide the Anguillan Government the necessary skills and tools for effective management of marine biodiversity, fisheries resources and monitor coastal change.		Training provided to various government agencies during survey operations and vessel mobilisation has started to increase the islands capability for the effective management of the marine environment and resources. Although not finalised the tools which are being developed as part of this project were showcased at the mid-project stakeholder meeting. With the knowledge that these tools will be available in the near future, discussions on collaboration and monitoring programmes were enthusiastically started by the stakeholders.	
Outcome To develop marine survey capability and data layers to enhance the ability to protect biodiversity and manage the marine environment and its resources sustainably.	0.1 Publish a territory wide database of coastal habitats. Increase habitat knowledge in waters exceeding 20m compared to baseline 0.2 Anguilla Government staff are confident and have the skills to implement and maintain good marine surveys	With the completion of the majority of Activities within each Output, the project is on target to complete the project outcome. All data required for the creation of the data layers has been collected and verified. The development of the methods to create the final deliverables is ongoing but on course for completion within the agreed timeframes for the project. Training in the methods of creating the data layers and how to use them has been planned to occur towards the end of the project when the final data layers are ready to be handed over to the stakeholders.	The key actions for the coming year are: Finalisation and verification of the MBES and SDB data layers Analysis of the Groundtruthing data to capture species information, biodiversity and habitat type Creation of a comprehensive marine habitat map. Training of stakeholders in data analysis, method development and marine habitat monitoring.

Output 1. Provide training for local stakeholders in state-of-the-art marine survey techniques and processes	1.1 At least 5 days of training opportunities provided during the lifetime of the project on hydrographic and environmental survey techniques, either classroom based or through practical experience.	During the first half of the year for the project the equivalent of 3 days of training has been undertaken with participants from the DoE, Anguilla National Trust, Department of Fisheries and Department of Land and Surveys. This training has predominantly been practical training based on either the survey vessel during the groundtruthing survey or during the mobilisation of the hydrographic equipment onto the vessel at the boatyard.
	1.2 At least one person attending from each local stakeholder organisation.	Training planned for the second project year will see representations from stakeholder organisations learning about 1) collection and processing of satellite data to create SDB maps, 2) marine groundtruthing survey methods and 3) methods of habitat analysis and the production of habitat maps.
	1.3 One DoE staff member participates in researcher exchange, gaining hands-on experience of marine survey techniques onboard Cefas' ocean going research vessel Cefas Endeavour.	A researcher exchange programme is scheduled towards the end of year two of the project with a member of the DoE travelling to the UK to work alongside project partners and where possible partake in a survey onboard Cefas' ocean going research vessel *Cefas Endeavour*.
Activity 1.1, Project kick off meeting, mid-project and final project stakeholder meetings		A project kick-off meeting was held on 7th June 2016 in Anguilla and was hosted by the Department of Environment. The meeting was opened by HE The Governor of Anguilla and the Acting Chief Minister and Minister of Home Affairs. A mid-project meeting was held on 14th March 2014 and was well attended by the stakeholders.

The final stakeholder meeting will be held towards the end of 2017. |
Activity 1.2, 2 day acoustic survey techniques and analysis training course		Initial training was conducted during data acquisition of MBES data with training conducted by UKHO and Cefas in methods and processes involved in measuring in a tide-gauge and conducting a dimensional control survey of the vessel with the Department of Land and Surveys. Additional training on analysis will be conducted later in the year before the final stakeholder meeting with local data.
Activity 1.3, 2 day video survey techniques and analysis training course		Representatives from DoE, Fisheries and NPT participated in the collection of the groundtruthing survey in September 2016 learning about survey design and data acquisition. Further training planned for late 2017 in analysis will be conducted before the final Stakeholder engagement meeting.
Activity 1.4, 1 day data interpretation and mapping training course		During the mid-project stakeholder meeting 2 hours was put aside to go through the method of data interpretation to be used to create the final habitat and bathymetry maps for Anguilla. Further training is planned for late 2017.

Activity 1.5, Researcher exchange		A member of the Anguilla DoE will visit project partners in the UK, and hopefully partake on a survey onboard Cefas' ocean going research vessel Cefas Endeavour towards the end of year two of the project.
Output 2. High resolution bathymetry data for majority of coastal waters and selected deeper water sites	2.1 Deliver at least 10 days (incl. any weather downtime) of high resolution multibeam echosounder surveys in water depths exceeding 15m.	In total 14 days of hydrographic survey was completed covering a total area of 14.7 km2. The data has now been processed and is undergoing validation against IHO standards. Preliminary results suggest that the data is very high quality achieving a 95% agreement with Special Order data.
	2.2. Multibeam bathymetry data meets recognised international standards (IHO Order 1a)	The processing of the Pleiades satellite is currently being undertaken by Newcastle University and Environment Systems. Several methods have been trialled to derive bathymetry from the data. One of the methods produces good results and is relatively easy to carry out. Once the method has been developed further it can be taught to stakeholders on Anguilla to aid in future monitoring and mapping projects.
	2.3 Process available satellite imagery to derive a satellite derived bathymetry data layer with 2m resolution for Anguillan coastal waters.	
Activity 2.1. Stakeholder meeting to identify priority survey area(s) (align with activity 1.1 kick off meeting)		During the project kick-off meeting in June 2016 the second half of the meeting was put aside for local stakeholders to identify areas of high priority for high resolution Bathymetry. The approaches to Road Bay and the Coral Reefs to the South of the Cays was identified as an area of high traffic and importance to tourism. Similarly, Crocus Bay was identified as an area of importance with the area being more regularly frequented by large cruise ships.
Activity 2.2 Vessel and equipment mobilisation		With the help of local stakeholders, a suitable vessel to undertake the MBES survey was chosen and local partners to help with the mobilisation were identified. Equipment for the survey arrived in Anguilla at the beginning of September 2016 and was mobilised onto the vessel with the assistance of the Department of Lands and Survey.
Activity 2.3 Hydrographic survey of deeper water habitats and bathymetry		A total of 11 days of hydrographic survey was undertaken collecting bathymetry data between Sandy ground and The Cays and within Crocus Bay.
Activity 2.4 Data processing		Data processing of the MBES bathymetry data was undertaken by UKHO and completed in March 2017. Data will be made available to the other partner organisations in April 2017
Activity 2.5 UKHO validation against IHO standards		The bathymetry data was processed in accordance with the International Hydrographic Organisation (IHO) Standards for Hydrographic Surveys - Order 1a (Special Publication 44, Edition 5). The data achieved a 99% agreement with Order 1a and a 95% agreement with Special Order data.

Activity 2.6 Processing of multibeam backscatter data for habitat mapping		Processing of the MBES backscatter data was conducted by Cefas and was made available to the Partner organisations in December 2016.
Activity 2.7 Acquisition of high resolution satellite imagery		Environment Systems acquired high resolution Pleiades satellite imagery in January 2017.
Activity 2.8 Data processing of satellite imagery to derive bathymetry		Environment Systems and Newcastle University have undertaken significant steps into deriving bathymetry data from satellite images. The SDB layer they have created was presented at the mid-project stakeholder meeting in March 2017. The method they have developed is both robust and easily replicated on standard software packages.
Activity 2.9 Calibration of satellite derived bathymetry against multibeam echosounder data		After the final validation of the MBES bathymetric data, calibration of the two datasets will take place and be undertaken by Environment Systems and Newcastle University
Activity 2.10 Review of satellite derived bathymetry by UKHO assessment team		The review of the SDB data will hopefully occur in Q1 and Q2 of the second year of the project.
Output 3. Provide detailed coastal habitat layer database to local stakeholders	3.1 Undertake 5 day video characterisation survey of habitats identified in deeper waters.	The groundtruthing survey was undertaken in September 2016 with the survey time doubled from 5 to 10 days of data collection. In total 152 stations were assessed for biodiversity, species and substrate type.
	3.2 At least 75% of coastal habitats (<20m) mapped using satellite imagery and habitat map produced from MBES survey area.	The groundtruthing data will be processed and compiled with the SDB and MBES bathymetry data to create the marine habitat map in the first half of year 2 of the project.
	3.3 Coastal and deeper water habitat data made available to DoE/Anguilla National GIS by end of project and through free online portal.	
Activity 3.1 Review multibeam echosounder data and design video characterisation survey		To decrease mobilisations costs the GT survey was undertaken immediately after the MBES survey. Bathymetry and backscatter data were interpreted with GT stations positioned to characterise the different substrates and habitats identified from the data.
Activity 3.2 Undertake 5 day video characterisation survey		A total of 10 days of GT survey were undertaken with the additional days used to collect data from the un-surveyed Anguilla Bank and from the south of Anguilla.
Activity 3.3 Analyse and quantify physical characteristics and biological communities from video and photographs. Qualitatively describe reef health.		This will be undertaken during Q1 of the second year of the project by NCL.

Activity 3.4 Undertake object based image analysis of satellite and multibeam echosounder data and combine with in-situ observations to develop habitat characterisation data layers.	This will be undertaken during Q2 of the second year of the project by NCL.
Activity 3.5 Share habitat layers with local stakeholders	Local stakeholders will be introduced to the new data layers and methods at the final stakeholder meeting and given directions in how to access and interrogate the data.
Activity 3.6 Make data freely available to data archive centres and through online portals. Data available to UK and local Government to inform Blue Belt assessments, where necessary.	Groundtruthing data sets have been made available via the Projects YouTube Channel. All subsequent data produced will be made available to local governments and UK governments via the Cefas Data Hub.

Annex 2: Project's full current logframe as presented in the application form (unless changes have been agreed) - – if appropriate

N.B. if your application's logframe is presented in a different format in your application, please transpose into the below template. Please feel free to contact Darwin-Projects@ltsi.co.uk if you have any questions regarding this.

Project summary	Measurable Indicators	Means of verification	Important Assumptions
Impact: To provide the Anguillan Government the necessary skills and tools for effective management of marine biodiversity, fisheries resources and monitor coastal change. (Max 30 words)			
Outcome: To develop marine survey capability and data layers to enhance the ability to protect biodiversity and manage the marine environment and its resources sustainably. (Max 30 words)	0.3 Publish a territory wide database of coastal habitats. Increase habitat knowledge in waters exceeding 20m compared to baseline 0.4 Anguilla Government staff are confident and have the skills to implement and maintain good marine surveys.	0.1 Area coverage (km^2) increased compared to 2004 baseline. 0.2 Two-way knowledge exchange has been undertaken between local managers and UK domain specialists. Anguilla staff attended UK based knowledge exchange. Course certificates issued.	0.1 Good quality satellite imagery is available for the area of interest. Weather allows new multibeam echosounder data collection 0.2 Training and knowledge exchange will give staff skills and confidence needed.
Outputs: **1**. Provide training for local stakeholders in state-of-the-art marine survey techniques and processes	1.1 At least 5 days of training opportunities provided during the lifetime of the project on hydrographic and environmental survey techniques, either classroom based or through practical experience. 1.2 At least one person attending from each local stakeholder organisation. 1.3 One DoE staff member participates in researcher exchange, gaining hands-on experience of marine survey techniques onboard Cefas' ocean going research vessel *Cefas Endeavour.*	1.1 Training course registers 1.2 Training course register 1.3 Participation in knowledge exchange.	Local staff are able to participate in knowledge exchange events. DoE are able to participate in researcher exchange and are able to obtain necessary seagoing and medical qualifications.

Project summary	Measurable Indicators	Means of verification	Important Assumptions
2. High resolution bathymetry data for majority of coastal waters and selected deeper water sites	2.1 Deliver at least 10 days (incl. any weather downtime) of high resolution multibeam echosounder surveys in water depths exceeding 15m. 2.2. Multibeam bathymetry data meets recognised international standards (IHO Order 1a) 2.3 Process available satellite imagery to derive a satellite derived bathymetry data layer with 2m resolution for Anguillan coastal waters.	2.1 Daily progress reports produced during survey. 2.2 Data verified and accepted by UKHO Bathymetry Data Centre 2.3 More than 75% of coastal waters (<20m) covered by high resolution SDB data.	Weather conditions suitable for survey activities to be undertaken during time in country. Quality of satellite imagery allows bathymetry down to 20m to be extracted. Bathymetry extraction routines can be applied successfully to the satellite imagery.
3. Provide detailed coastal habitat layer database to local stakeholders	3.1 Undertake 5 day video characterisation survey of habitats identified in deeper waters. 3.2 At least 75% of coastal habitats (<20m) mapped using satellite imagery and habitat map produced from MBES survey area. 3.3 Coastal and deeper water habitat data made available to DoE/Anguilla National GIS by end of project and through free online portal.	3.1 Number of survey days delivered, evidence from daily progress reports. 3.2 Area covered by habitat data layers 2.6 Confirmation of delivery of data to Anguillan Government. Mechanism in place to make data freely available to end-users and interested parties.	Weather conditions suitable for survey activities to be undertaken during time in country. Correlation between satellite/echosounder data and ecological communities can be established.
4.			

Activities (each activity is numbered according to the output that it will contribute towards, for example 1.1, 1.2 and 1.3 are contributing to Output 1)

1.1 Project kick off meeting, mid-project and final project stakeholder meetings

1.2 2 day acoustic survey techniques and analysis training course

1.3 2 day video survey techniques and analysis training course

1.4 1 day data interpretation and mapping training course

1.5 Researcher exchange

2.1 Stakeholder meeting to identify priority survey area(s) (align with activity 1.1 kick off meeting)

Project summary	Measurable Indicators	Means of verification	Important Assumptions
2.2 Vessel and equipment mobilisation			
2.3 Hydrographic survey of deeper water habitats and bathymetry			
2.4 Data processing			
2.5 UKHO validation against IHO standards			
2.6 Processing of multibeam backscatter data for habitat mapping			
2.7 Acquisition of high resolution satellite imagery			
2.8 Data processing of satellite imagery to derive bathymetry			
2.9 Calibration of satellite derived bathymetry against multibeam echosounder data			
2.10 Review of satellite derived bathymetry by UKHO assessment team			
3.1 Review multibeam echosounder data and design video characterisation survey			
3.2 Undertake 5 day video characterisation survey			
3.3 Analyse and quantify physical characteristics and biological communities from video and photographs. Qualitatively describe reef health.			
3.4 Undertake object based image analysis of satellite and multibeam echosounder data and combine with in-situ observations to develop habitat characterisation data layers.			
3.5 Share habitat layers with local stakeholders			
3.6 Make data freely available to data archive centres and through online portals. Data available to UK and local Government to inform Blue Belt assessments, where necessary.			

Annex 3 Onwards – supplementary material (optional but encouraged as evidence of project achievement)

Groundtruthing Survey Daily Progress Reports

Darwin Plus - Anguilla DPR 12/09/2016

Day's Activities: Vessel was brought alongside pontoon and MBES pole was removed. Camera equipment was setup on the vessel and wet tested in the harbour. The majority of the equipment is working well however we are having a small issue with the overlay system for the Bowtech camera. The nav string from the POS MV isn't currently compatible with the overlay. Hayden has contacted the office to enquire into the spec for the nav string.

HSE issues: No HSE issues. 2 x toolbox talks carried out (MBES Pole removal and deployment of camera frame).

Tomorrow: Start surveying the areas covered by MBES data. Random points selected for initial day. Once I have a better understanding of the BS data from the GT data will plan remaining stations using a more targeted approach.

Tomorrows weather: No storm warning. Winds = NW 3-4, Sunny, Max 29°C

Darwin Plus: Angulla DPR 13/09/2016

Today's Activities: Good day surveying. 18 video stations completed in the nearshore areas around Sandy Bay (See attached Screenshot). Video data from the Bowtech was good. We have managed to fix(ish) the overlay system. We were unable to identify the nav-string coming out of the Saab GPS unit which works with the video overlay so left it plugged in and ran with 2 navigational systems.

GoPro stills and video data is looking good with high levels of detail n both. There is a bit of an issue with the level of blue in the images but nothing which can't be fixed later.

HSE: 1 x toolbox talk (Camera Deployment)

Tomorrow: Continue with camera stations covering the MBES data. Now we are up to speed with how the system works we should be able to achieve around 20 stations a day if weather is favourable.

Weather outlook: Wind 2-3 NW, Cloudy

Darwin Plus: Anguilla DPR 14/09/2016

Days Actions: Had another good day today. Managed to cover 20 stations within Area 1 (See attached). Video data for both the Bowtech and GoPro are very good. Attached is a screen shot from the GoPro footage. Still images are generally also very good.

HSE: Nothing to report

Tomorrow: Will be joined by Stuart Wynne and a fisheries officers for the day to discuss survey areas and for them to get a look at what we do. Hopefully get some stations done around Prickly Pare island

Weather: Weather looking good for next 24 hours (and 5 day outlook also looks good).

Darwin Plus: Anguilla DPR 15/09/2016

Day's Activities: Today we had two representatives from the Fisheries department come out with us while we worked on stations to the north of Anguilla around Prickly Pear and Anguilla Bank. We managed 13 stations due to the extended transit times between stations (See attached). They were really happy with what we got data wise and have asked whether they would be able to get a copy of today's video data before we leave. Is that okay Koen?

The GoPro video failed for two of the camera tows due to battery issues. Have quarantined this battery. Rest of the data is very good.

HSE: Nothing to report.

Tomorrows activities: We will hopefully complete the remaining stations within Area 1 tomorrow morning before collecting the Governor from Sandy Ground at 1300. We are looking to take her into Crocus Bay to ground-truth Area 2 for the afternoon.

Weather: 5 day forecast looks good, 3-4 NW tomorrow. Tropical depression Twelve is currently moving across the Atlantic and is on course for Anguilla for about Thursday next week (Very long range forecast).

Darwin Plus: Anguilla 16/09/16 DPR

Days Activities: 15 Camera Stations completed. The Governor and the Deputy Governor came out on the vessel with us this afternoon to have a look at the work we are carrying out and to discuss the methods/results which we will use during the next part of the project. You have probably already seen the Tweets. We have two stations left for groundtruthing Area_1 and 4 stations remaining for Area_2. Small issue with Bowtech camera cutting out. Problem appear to have been solved by replacing camera on frame. Will test old camera tomorrow and hopefully identify fault.

HSE issues: No HSE issues, Vessel induction given to Christina and Perin.

Tomorrow and Future: As we have nearly finished the remaining GT stations for the Bathy Data we are looking at moving further afield and GT the remainder of the Island. Attached is a map of proposed stations for the areas outside of the acoustic data. This is based on randomly selected stations which have then been altered to fall within the polygons of differing underwater features identified by EnvServ with their 1995 reef map. Any suggestions on additional stations would be welcome.

Weather: Weather for next 5 days looks good. Still keeping an eye on Storm Karl, although I believe it is going to go north of our location.

Darwin Plus: Anguilla 17/09/2016 DPR

Today Activities: Day began with a thunderstorm which delayed us for an hour. After that had passed we found that our replacing of the camera yesterday had not fixed the intermittent fault with the Bowtech. Hayden identified one of the lower cables as having a fault and replaced it off the camera frame. After getting out on the water we were able to complete 12 camera stations before an approaching storm forced us off the water.

Video and stills data looks good. On one station the GoPro video did not record (Bowtech video and GoPro stills were recorded).

Total to date: 80 Stations.

HSE issues: Hayden received a small cut to his index finger while handling some cables. Plaster applied to cut.

Tomorrow: Continue with stations to the north east of the island working our way towards Shoal Bay and the marine park.

Weather: Some more rain is forecast for tomorrow but without the lightning and more scattered.

Darwin Plus: Anguilla 18/09/2016 DPR

Today's Activities: Completed the stations from Crocus Bay up to Windward Point on the very NE of the Island. A lot of fish traps around the reefs so not as many reef stations as I would have liked but we still managed to get quite a few. No issues with the cameras or the data.

HSE: No issues

Tomorrow: Working our way from Meads Bay down to Anguillita Island in the SW.

Weather: Outlook looks good with no serious weather likely to hit us during survey time.

Darwin Plus: Anguilla 19/09/2016 DPR

Today's Activities: completed a block of stations to the west of Meads Bay down to Anguillita Island. We also took a number of CTD dips along the route. We are having some problems trying to get a sechi depth anywhere. We have been putting some significant weight on it but have been unable to get it to a depth where it disappears from view before streaming off down wind acting

as a drogue. We will try a bit more weight tomorrow when we reach the deeper areas (can still see it at 30 m).

HSE issues: No Issues

Tomorrow: Tomorrow we are being joined by two members form DoE and we will be working on some stations between Sandy island and Dog island. We are looking to move to start surveying the south of the island on Thursday and plan to do around 20 to 25 stations.

Weather: Patchy rain and sun at the moment and for tomorrow (Quite nice to have a bit of shade).

Darwin Plus: Anguilla 20/09/2016 DPR

Today's Activities: Surveyed the area to the north of Sandy Island to the south of the Prickly Pear Cays. We completed 14 video stations in addition to two drops with the 3D camera. Video data looks good. We are still having some issued with the tide gauge and have spoken to both GSE and Valeport about the problem. We are currently trying a fix from Valeport about resetting the internal batteries. Will report in the morning if problem persists.

HSE issues: None

Tomorrow: Today the DoE was unable to make it due to all hands being required for a beach survey. So we are expecting them tomorrow morning to help us finish the stations towards Dog Island. At the end of the day we are intending on moving the vessel round to Cove Bay to begin surveying the south of the island.

Darwin Anguilla 21/09/2016 DPR

Today Activities: Today we had Clint on board from the DoE to see how we perform our GT surveys. Due to time constraints on his side he needed to be back on land after a few hours. We completed 6 stations near the Prickly Pear Cays before heading back to drop him in. After seeing discussions from Clare regarding the need for data on the South of the Island I have made the decision to start the South Side this afternoon. I have added a number of extra points over at Savanah Bay which should hopefully be enough for Katie and Clare.

HSE issues: None

Tomorrow: We might have either/both/non of DoE and National Parks Trust tomorrow but both have said they will confirm in the morning. I am hoping to head to the far South East of the island tomorrow and star working my way back for the day.

Weather: Good weather tomorrow S 2-3. Weather also looking good for Friday.

Other issues: Tide gauge. After speaking to Valeport yesterday we thought we had a fix and the system seemed to be running when we turned it on this morning. It looked very much like a power issue which was solved by draining the internal capacitors to cause a total reset. It turned on fine this morning and the power management issue seemed to be solved. However, since then we have been unable to connect it to a computer or get through the inbuilt display file system without it all crashing. It did display a message to say it was logging so we plugged it in and left it running during the day. However, when we returned we were still having the same problem. We brought the head unit back to the house and have been trying to coax it into life unsuccessfully. We have just got back from trying to get it working again back on the jetty with no luck. I will give Valeport another ring in the morning but whatever happens we will not have 30 days of continuous logging. Even before it started going wrong for us, Alison and Andrew were having problems with it not logging or stopping logging at random times.

Darwin Plus Anguilla 22/09/2016 DPR

Today's Activities: We were working from the south of the island today. In the morning we went up to Savanah Bay. Swell was around 1 m and fairly high energy on the seabed so visibility is much reduced compared to the north of the island (still great compared to UK). After dropping off Clint from DoE and the guys from NPT we worked from Corito to Savanah Bay in very variable weather conditions. Lots of squally showers and a water spout which was quite exciting. During the squalls the visibility was down to a few meters so transits between stations were very slow. Increased wind and swell through the afternoon meant things had to be taken a bit slower. Managed 12 stations today with good coverage around Savanah bay.

HSE issues: adverse weather conditions meant reassess of procedures in rougher conditions.

Tomorrows activities: Morning out on survey with Stuart and Carlos from fisheries finishing stations between Litlle Harbour and Corito. Afternoon – bring boat onshore to begin demobilisation.

Weather: looking good for tomorrow. SE 3-4

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Checklist for submission

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